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RESEARCH ARTICLE OPEN ACCESS

The impact of blockchain technology application on the supply chain and financial performance of manufacturing companies listed in the Zimbabwe stock market.

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ABSTRACT
Blockchain technology has the potential to transform the way businesses are done and improve daily lives. Blockchain's decentralized and distributed nature ensures that all transactions and data remain private, secure, and easily accessible to anyone who requires them. The study seeks to find the impact of the blockchain application on the supply chain and financial performance of manufacturing companies listed in the Zimbabwe stock market.
The study used a quota sampling method to select four respondents from each of the 37 listed manufacturing companies listed in the Zimbabwe stock market. The questionnaire was the only means through which all the data were collected. The respondents are the general managers, the engineers, and the operations managers. The data collected were analyzed using SPSS software.
We found that consensus and immutability have a positive and significant impact on supply chain management performance, while security has a negative and significant impact on supply chain management performance. We also discovered that immutability and consensus have a positive and significant impact on financial performance.
Keyword: Blockchain application, consensus, immutability, security, supply chain performance

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I. Introduction

According to Rabah (2018), blockchain technology has the potential to transform the way businesses are done and improve daily lives. Blockchain's decentralized and distributed nature ensures that all transactions and data remain private, secure, and easily accessible to anyone who requires them (Gaurav et al., 2020). Blockchain is a distributed, open, and peer-to-peer ledger that stores and record data and its transactions are supported by a cryptographic value. Data cannot be changed after it's been entered, so it's secure for a company to operate with that information (Politou et al., 2018). Unlike the current web2 Internet, blockchain technology keeps identical blocks of information across its network (Zarrin et al., 2019). Blockchains are immutable, which means that no single entity can take command of them or cause them to fail. Due to the distributed nature of its data storage, the blockchain reduces the security concerns associated with centralized data storage (Abdullah, Hakansson&Moradian, 2017).

In today's Internet, there exist security issues that are well-known to individuals and organizations. People rely on login and password credentials to get access to internet services. Encryption is used to enhance the security of the Blockchain (Halaburda, 2018). Web 3 backbone has been established with blockchain technology, which allows data and information to be broadly dispersed (Seven et al., 2020). Aside from Bitcoin, businesses and techies are discovering a wide range of applications for the blockchain. Non-programmers and enterprises are learning blockchain applications. Blockchain has altered the way people and individuals work and live because of the way it's impacted business models across sectors (Seppälä, 2016). Every industry, business and individual including those who used the supply chain in their operation also benefits from disruptions caused by new technologies (Sheel& Nath, 2019). A contemporary supply chain relies heavily on both efficiency and reactivity to its customers. An advantage over rivals in today's supply chain may be

gained via the application of cutting-edge technological advances (Bhandari, 2014).

There has been a paradigm shift from traditional production to intelligent and environmentally friendly manufacturing. (Shah et al., 2020). Traditional manufacturing organizations are seeking to use contemporary information technology solutions to boost firm performance and increase cooperation and coordination amongst supply chain partners (Gandhi, Shaikh &Sheorey, 2017). As one of the most recent internet-based applications, blockchain has the potential to be employed in the supply chain (Fernández-Caramés et al., 2019). According to Vovchenko et al. (2017), blockchain is important since no firm functions in isolation. When many institutions work together, they can accomplish more than if they worked alone. It is possible to drastically reduce costs by putting in place business procedures that make use of the group's collective expertise and create new processes that were previously inaccessible. Thus, many organizations have the chance to gain an advantage over their competitors as a result (Hughes et al., 2019).

There is a long-term possibility that blockchain technology may change corporate methods of operation (Qiu, Zhang & Gao, 2019). The distributed ledger technology that underpins the blockchain is indispensable. Distributed ledger technology (blockchain) will significantly enhance global supply chains, financial transactions, asset ledgers, and decentralized social networking (Dutta et al., 2020). Existing business models may be upended by disruptive innovations like blockchain, which make it possible to develop products at a lower cost than previously thought (Schneider, Leyer & Tate, 2020). Several studies on blockchain technology have been conducted, with a focus on the impact of blockchain adoption on partnership performance; a systematic review of blockchain; the impact of blockchain in the food industry; the impact of blockchain in the automobile industry; and the agricultural and pharmaceutical industries. All the studies that have been done so far did not focus on the main parts of blockchain technology, which are transparency, security, immutability, consensus, and smart contracts (Arun, Cuomo, and Gaur, 2019) and how they affect the supply chain and financial performance. Also, of the studies reviewed so far, none of them explored the impact of blockchain technology on the manufacturing companies listed in the Zimbabwe stock market. To contribute to existing literature, the study will focus on the unexplored or underexplored, that is, the impact of blockchain technology application on the supply chain and financial performance of manufacturing companies listed on the Zimbabwe stock market.

II. Literature review

The concept blockchain application

The decentralized ledger technology known as blockchain is the basis of the digital currency known as Bitcoin, which was developed for use in financial applications after the 2008 financial crisis. Because of its distinguishing qualities in comparison to those of other business information technologies, Blockchain technology has the potential to be implemented in a variety of settings, including the healthcare industry, the energy sector, and supply chains, to solve a variety of problems (Dutta et al., 2020). The blockchain is a decentralized digital ledger that stores information and transactions as encrypted, time-stamped chains (Bonyuet, 2020). A blockchain is made up of a series of linked data structures known as blocks. Each block in the chain includes a timestamp, a cryptographic hash of the block that came before it, and several transaction records. Based on this one-of-a-kind data structure, whenever a new transaction is generated inside the system, a block is constructed along with a connection to the blocks that came before it and added to the distributed ledger. According to Bambara et al. (2018), there are three (3) types of blockchain technology. They are private blockchains, consortium blockchains, and public blockchains.

Private blockchain

With private blockchain, only one organization has access to the write permissions. A user's reading permissions can be made public or private to an arbitrary degree. Database administration and auditing inside a single organization may not necessitate public accessibility, but in other circumstances, public accessibility is desirable. Some of the issues that might be solved by private blockchains are compliance agents for rules such as HIPAA, anti-money laundering (AML), or know-your-customer (KYC).

Consortium blockchains

It's a decentralised database where a network of nodes makes decisions about reaching a consensus. The public can have access to the blockchain if the root hashes of the blocks are made public, or the blockchain can be kept private except to the participants, or a hybrid model can be used in which the public can make limited queries and receive cryptographic proofs of certain parts of the blockchain state via an application programming interface. There is a chance that the decentralised

nature of the internet shows up in these distributed ledgers, which are also called blockchains.

Public Blockchains

When they first envisioned a public blockchain, this is exactly what they had in mind. A blockchain that is accessible to all users and where all valid transactions are recorded; a blockchain where all users contribute to reaching a consensus.Instead of relying on a centralized server, the public blockchain relies on cryptographic verification backed by rewards for the network's miners. A miner is somebody who gathers and publishes the transactions. All users on the public blockchain follow an algorithm that validates transactions by brute force since no user is implicitly trusted to verify transactions.

The Five Disruptive Elements of Blockchain Technology

According to Arun, Cuomo, & Gaur (2019), blockchain technology consists of five elements. These elements are transparency, immutability, security, consensus, and smart contracts.

Transparency

Using blockchain technology, it is possible to keep track of the product's route from its inception through its delivery to customers using Ehsan et al. (2022). As a result, all parties participating in the supply chain have access to this data. The supply chain might benefit from increased confidence if the information is made available to all participants (Francisco & Swanson, 2018). The distributed ledger in the company network may be copied or shared across the distributed ledger in a blockchain to enable end-to-end visibility of your business activities (Miehl et al., 2019). A transaction's whole history may be viewed by anybody with access to a blockchain-based business network, regardless of whether the network is private or public. In the past, this kind of openness has not been present in multi-party commercial networks. Through the new peer-to-peer connection and trade that is enabled by the new transparency, many middlemen or third parties in your business network are disrupted (Chen &Bellavitis, 2020). A supply chain network based on blockchain technology gives better visibility and transparency, which leads to greater efficiency and higher value (Tayal et al., 2021).

HI: Transparency as an element of blockchain applications has a significant impact on supply chain and financial performance.

Immutability

No one can remove a transaction after it has been entered into a blockchain. Everyone on the network may see another updated record that was added to the transaction as soon as someone tries to change it (Li et al., 2019). A transaction on a blockchain is recorded into a data block, which is signed and timestamped for each transaction. In a nested structure, each block is linked to the ones that came before and after it. These building blocks cannot be changed or rearranged since they are connected in an unbreakable chain (Rajasekaran, Azees& Al-Turjman, 2022). Counterfeiting and other forms of fraud may no longer be an issue for companies because of the irreversible history of transactions (Soundarya, Pandey &Dhanalakshmi, 2018). This technology prevents fraud and manipulation in a system or process because the participants in the blockchain network can see and identify the immutable digital record and history of the transfer of an asset or item (Moin et al., 2019). Cryptography algorithms are used to achieve such high levels of security. Transparency in the supply chain may also help to prevent scandals like the discovery of hazardous chemicals in children's toys (Badzar, 2016). The blockchain's recording and auditing capabilities, as well as the transaction's near-real-time monitoring, make this possible (Penkin, 2019).

H2: Immutability as an element of blockchain applications has a significant impact on supply chain and financial performance.

Security

According to Acharjamayum, Patgiri& Devi (2018), transactions on the blockchain are very secure and nearly impossible to attack. A blockchain's transaction records are encrypted with digital signatures and accompanied by a history of changes to each one (Jogenfors, 2019). Private keys assigned to a transaction or an update to a current transaction are assigned to participants in the network. As a result, security flaws are easy to spot and easy to avoid. A hacker would have to search through every ledger to see if the same data or record appears in more than one ledger, which would be very consuming (Verma & Garg, 2017). A distributed ledger, transaction integrity, high availability, and auditability all work together to improve safety, privacy, and regulatory compliance (Ali et al., 2018). Businesses of all sizes and in all sectors are concerned about the security of their most important data and transactions. Complexity in today's corporate environment and new security concerns arise because of this digital transition, which is the driving force behind greater complexity (Demirkan&Delen, 2013). In most cases, businesses'

and customers' information is kept in a single database. Centralized systems are inherently weak points that may be exploited (Dhar et al., 2021). Blockchain allows its participants to keep their anonymity and privacy while still being identifiable, which is critical for enterprises looking to build trust (Zhang, Xue& Liu, 2019).

H3: Security as an element of blockchain applications has a significant impact on supply chain and financial performance.

Consensus

Using a consensus mechanism, the participants in a blockchain network can independently verify each other's business transactions (Puthal et al., 2018). A public blockchain, for example, serves as the cornerstone of cryptocurrencies since it requires miners to verify currency transactions. It takes a tremendous amount of computational power and energy to carry out the proof of work (also known as mining overhead) procedure. On the other hand, a permissioned blockchain comprises trusted members of the network and employs consensus methods that confirm transactions anonymously without mining overhead and with a fraction of the computing power and energy expenditure that are utilized in a public blockchain (Dorri et al., 2019). In a democratic corporate network, equitable participation is driven by consensus. It's possible that the democratic and open way that blockchain technology makes transactions possible could eventually replace the systemic unfairness that plagues both government and business (Khoirunisa, 2021).

H4: Security as an element of blockchain applications has a significant impact on supply chain and financial performance.

Smart Contracts

A smart contract is a sort of electronic contract in blockchain technology that is implemented following the negotiated terms and conditions between the chain members, according to Philipp, Prause, and Gerlitz (2019). Supply chain contracts are self-verified and executed by technology, which has a favourable impact on business operations (Mukherjee et al., 2021). Self-executing electronic contracts that describe the conditions of an agreement between business partners are known as smart contracts (Unsworth, 2019). Using smart contracts in blockchain technology can help automate business processes (Wang et al., 2019). Transactions and agreements can be carried out without the intervention of a central authority, legal system, or arbitrator in such contracts (Savelyev, 2017). Because blockchain transactions are reliable, transparent, and immutable, smart contracts may be used to automate business processes. Smart contracts enable business process innovation by providing automation, speed, and compliance without heavy costs or risks (Asharaf& Adarsh, 2017). Business contracts may be completed in minutes rather than days using blockchain technology and for a fraction of the present cost without the involvement of any legal organization, according to preliminary estimates (Haarmann, 2019).

H5: Smart contracts as an element of blockchain applications have a significant impact on supply chains and financial performance.

III. Methodology

Research Design

The research design refers to the overall framework of research methodologies and processes that a researcher chooses to make use of in their study (Hyett, Kenny & Dickson-Swift, 2014). The design not only lets the researchers focus on research methods that are relevant to the subject, but it also sets the stage for their successful investigations by giving them a base to build on. The study used two research designs. The research designs used are descriptive and correlation research designs. A researcher employing a descriptive research strategy is only concerned with describing the circumstance or case being studied (Bazeley, 2013). The correlational research design is used to establish a link between two variables that are closely related (Bleske-Rechek, Morrison &Heidtke, 2015).

Research Instrument

According to Kimberlin and Winterstein (2008), a research instrument is a tool that is used to acquire, measure, and evaluate data from participants surrounding the study topic. The research instrument used for the study was a questionnaire. We used questionnaires to gather important data from participants (McGuirk & O'Neill, 2016). The questionnaires were designed based on the objectives of the study, and the questionnaires used have been applied before. The questionnaire consists of four sections. The first section collected personal information from the respondents who took part in the study. The second section solicited information on the use of blockchain technology by the manufacturing companies listed on the Zimbabwe stock market. The third section collected information on the supply chain performance of the manufacturing companies, and the fourth section collected information on their financial performance.

The Population of the Study

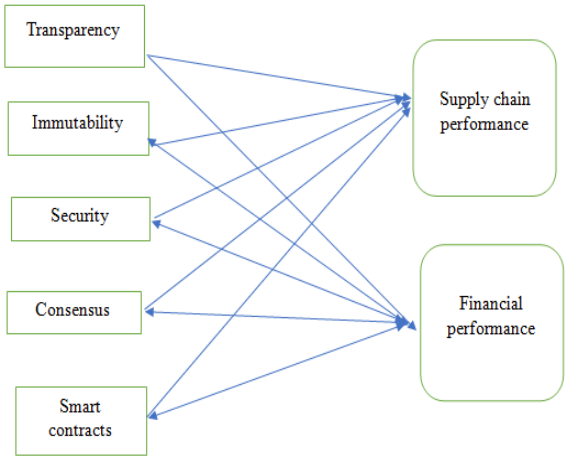
The total group, in conclusion, is referred to as a population (Nardi, 2018). The population of the study is the manufacturing companies listed on the Zimbabwe stock market. The study chose the manufacturing companies listed on the Zimbabwe stock market because they are involved in the production of goods. They produce consumer goods, industrial goods, and basic materials. They also used supply chains in their production process since the study wanted to find out the impact of blockchain technology on supply chain performance. Therefore, adding financial institutions to part of the study will not contribute to the objectives of the study. In all, there are thirty-seven (37) manufacturing companies listed on the Zimbabwe stock market as of the 1st of April, 2022.

The Sample Size

The study used the quota sampling method to determine the sample size. The participants considered for the study were the general managers, the engineers, and the operations managers. In all, four participants were chosen for the study in each organization. There are 37 manufacturing companies listed on the Zimbabwe stock market, and selecting 4 participants from each company gave a sample size of 148. Therefore, the sample size used for the study was 148.

Conceptual Framework

To achieve an all-encompassing understanding of a phenomenon, the conceptual framework acts as a device for analysing the existing conditions (variables or ideas) and the relationships among them (Varpio et al., 2020). A conceptual framework is the way ideas are organised to accomplish their goal, and explanation is the most common approach adopted. It is an organized and self-explanatorily written approach for the readers. A conceptual framework refers to a researcher's view of the study topic.



Source: Composed by the researchers

Model specification

To find the impact of blockchain application on supply chain and financial performance, we used two models. The model is specified below.

Model 1

$$SUPCAIN = \beta 0 + \beta 1TRANS + \beta 2IMMUT + \beta 3SECUR + \beta 4CONSES + \beta 5SMARCON + \mathcal{E}$$

Model 2

$$FINPER = \beta 0 + \beta 1TRANS + \beta 2IMMUT + \beta 3SECUR + \beta 4CONSES + \beta 5SMARCON + \mathcal{E}$$

Where supply chain performance was denoted by "SUPCAIN", financial performance was denoted by "FINPER" transparency was denoted by "TRANS", immutability was "IMMUT", security was denoted by "SECUR", consensus was denoted by "consensus", smart contract was denoted by "SMARCON" and error term was denoted by "Ɛ "

Data Analysis

To analyze the data, SPSS software was used. The results of the study were presented in the form of a table, complete with their respective frequencies and percentages. To make each outcome more actionable and helpful for decision-making, interpretations were provided for each. The results include descriptive statistics, correlation analysis, and regression analysis.

IV. Results And Discussions

Table 1 shows the demographic characteristics of the respondents. Among the genders, 104 are males, representing 71.2%, and 42 are females, representing 28.8%. According to the age distribution of the respondents, 15.8% are between the ages of 18 and 20, 31.5% are between the ages of 21 and 30, 40.4% are between the ages of 31 and 40, 8.2% are between the ages of 41 and 50, and 4.1% are between the ages of 51 and 60. In

terms of the respondents' levels of education, 18 have an SHS certificate, which is 12.3%, 55 have a diploma, which is 37.7%, 57 have a first degree which is 39.0%, 11 have master's degree which is 7.5%, and 5 have a professional certificate, which is 3.4%.

36 respondents (24.7%) are managers; 67 respondents (45.9%) are engineers; 34 respondents (23.3%) are operations managers; and 9 respondents (6.2%) chose other. Information on the years that the respondents had worked in the organization was collected. 15.3% of respondents said they had been with the company for less than ten years. 57 respondents, representing 39.0%, said that they had worked in the organization for 11–15 years. 47 of the respondents, representing 32.2%, said they have worked in the organization for 16–20 years, and 27 of the respondents, representing 18.5%, said that they have worked in the organization for over 21 years and above.

Table 2 shows the results for multicollinearity tests performed through the use of variance inflation factor (VIF). According to Senaviratna& Cooray (2019), if the VIF for each of the independent variables is greater than 5, then there is multicollinearity. However, if the VIF for each of the independent variables is less than 5, it means that there is no multicellularity. It is evident from the results that there is no multicollinearity since the values for transparency, immutability, security, consensus, and smart contracts are all less than 5 (1.099, 1.206, 1.200, 1.026, and 1.026). Also, the mean for the VIF is 1.123, which is less than 5, and also shows that there is no multicollinearity.

Table 3 shows the results for reliability tests. The reliability tests show how consistent the research instruments used are. The results of Cronbach's Alpha coefficient of 70% are accepted as evidence that the research instruments are internally consistent. The results show that most of the coefficients for the Cronbach's Alpha are greater than 70%, with only consensus being less than 70% but not below 60%. Therefore, the results show that the instruments are internally consistent.

Table 4 shows the validity test results. The KMO and Bartlett's test were used to determine the validity of the data. The results obtained for Kaiser-Meyer-Olkin, which measure the sampling adequacy, were 79%. According to Atalay, Anafarta&Sarvan (2013), if the KMO is 70% and above, then it is accepted. Also, the results of Bartlett's test were statistically significant. The results obtained for the KMO and Bartlett's show that the instruments are valid.

Table 5 shows the relationship between the two dependent variables (supply chain and financial performance) and the five independent variables (transparency, immutability, security, consensus, and smart contract). The results from the table show that the supply chain has a positive relationship with transparency, immutability, and consensus. The results show that there is a negative relationship between supply chain performance, security, and smart contracts. The results show that the relationship of only two variables (immutability and consensus) is statistically significant at a 1% level.
The results show that the financial performance of the manufacturing companies has a positive relationship with transparency, immutability, security, consensus, and smart contracts. Also, the relationship between financial performance, immutability, and consensus is statistically significant at 1%, while the relationship between financial performance and smart contracts is statistically significant at 5%.

Table 6 shows the effect of the blockchain application on supply chain performance. The results show that transparency, immutability, and consensus have a positive effect on supply chain performance, while security and smart contracts have a negative effect on supply chain performance. If the transparency, which is an element of the blockchain application, is improved by 1%, it would result in an increase in the supply chain performance of 0.67%. Also, if immutability and consensus, which are all elements of blockchain applications, were increased by 1%, it would lead to an increase in the supply chain performance of the manufacturing companies by 0.375% and 0.294%, respectively. Also, if all other variables stayed the same and security and smart contracts, which are part of blockchain applications, were increased by 1%, the performance of the supply chains of manufacturing companies would drop by 0.214% and 0.009%.

A study by Akhavan and Namvar (2021) found that transparency and security have a positive influence on supply chain performance. One of the study findings by Akhavan and Namvar (2021) is in line with the results obtained from the study, which is that security has a positive influence on supply chain performance. Akhavan and Namvar (2021) found that security has a positive effect on supply chain performance, which is different from what the study found, which was that security has a negative effect on supply chain performance.A study by Yousefi and Tosarkani (2022) found that blockchain applications (transparency and smart contracts) have an influence on the supply chain performance of the mining sector. One of the results obtained by Yousefi and Tosarkani (2022) supports the finding of the study that transparency has a positive influence on supply chain performance, while the results of the smart contract were seen to have a

positive influence on supply chain performance, which contradicts the study findings.

A study by Kshetri (2018) found that blockchain applications have a positive impact on supply chain management performance, such as cost and quality control, speed and reliability, dependability, risk reduction, sustainability, and flexibility. The findings by Kshetri (2018) are compatible with the results obtained by the study. Stevenson and Aitken (2019) found that blockchain technology has the potential to transform practice in numerous areas, including product safety and security, quality management, the reduction of illegal counterfeiting, sustainable supply chain management, inventory management and replenishment, the elimination of intermediaries, and the impact on new product design. The results are in line with what the study found, which is that transparency, immutability, and consensus all make the supply chain work better.Sheel& Nath (2019) discovered that blockchain technology increases supply chain flexibility, alignment, and agility, which leads to competitive advantage, which leads to higher company performance and supports the results of the study. The study found that immutability, security, and consensus have a statistically significant influence on supply chain performance. Longo et al. (2019) found that the application of blockchain leads to greater supply chain performance and that is precisely what the study found out. Wamba, Queiroz, and Trinchera (2020) contend that uses of blockchain technology have the potential to enhance supply chain performance, and this is backed by the study findings. According to the findings of Mahyuni et al. (2020), implementing blockchain technology inside the supply chain has the potential to improve the chain's performance in terms of transparency, traceability, sustainability, trust, and cost-efficiency. The findings are the same as what the study revealed.

The results show that immutability, security, and consensus have a statistically significant influence on supply chain performance, since their probability values are less than 5%. Therefore, immutability, security, and consensus are seen to have an influence on supply chain performance and their alternative hypotheses are accepted. Also, the results show that transparency and smart contracts are not statistically significant since their probability values are greater than 5%. The null hypotheses for transparency and smart contracts failed to be rejected since they do not have a statistically significant influence on supply chain performance.

Table7 shows the effect of the blockchain application on the financial performance of the manufacturing companies. The results show that immutability, consensus, and smart contracts have a positive effect on financial performance, while transparency and security have a negative effect on financial performance. If immutability, consensus, and smart contracts were each increased by 1% while all other variables stayed the same, the financial performance would go up by 0.534%, 0.398%, and 0.131%.According to the findings of Stranieri et al. (2021), blockchain technology has a positive impact on profit, and the findings are exactly the same as the results of the study.

Also, if transparency and security are increased by 1%, it would result in a fall in financial performance of 0.119% and 0.062% if all other variables are held fixed. The results show that immutability and consensus are statistically significant since their probability values are less than 5%. The alternative hypotheses for immutability and consensus are accepted. Immutability and consensus have a statistically significant influence on financial performance.The results show that transparency, security, and smart contracts are not statistically significant since their probability values are greater than 5%. The hull hypotheses for transparency, security, and smart contracts failed to be rejected. Therefore, transparency, security, and smart contracts do not have a statistically significant influence on financial performance.

The R-square shows the variation in the supply chain performance explained by the blockchain application. The results show that the blockchain application elements only explain 17% of the variation in the supply chain performance.The R-square shows the variation in the financial performance explained by the blockchain application. The results show that the blockchain application elements only explain 32% of the variation in the financial performance.

V. Conclusions and implications to managers

The purpose of the study was to determine the impact of the application of blockchain on the supply chain and financial performance of the manufacturing companies listed in the Zimbabwe stock market. We collected data from 37 manufacturing companies listed on the Zimbabwe stock market through the use of a questionnaire. The answer to the questionnaire was only limited to the general managers, operations managers, and the engineers of the companies. In each company, we selected only four respondents to be part of the study. We found that the supply chain has a positive relationship with transparency, immutability, and consensus, while there is a negative relationship

between supply chain performance, security, and smart contracts. We discovered that financial performance has a positive relationship with transparency, immutability, security, consensus, and smart contracts.

We concluded that transparency, immutability, and consensus have a positive effect on supply chain performance, while security and smart contracts have a negative effect on supply chain performance. The study found that immutability, security, and consensus have a statistically significant influence on supply chain performance, while transparency and smart contracts are not statistically significant. The study revealed that immutability, consensus, and smart contracts have a positive effect on financial performance, while transparency and security have a negative effect on financial performance. We concluded from the study that immutability and consensus have a statistically significant influence on financial performance, while transparency, security, and smart contracts do not have a statistically significant influence on financial performance.

The use of blockchain applications significantly impacts both the supply chain and financial performance of manufacturing companies in Zimbabwe. The benefits include that blockchain enables transaction coordination among parties, decreasing extra costs and delays and resulting in a more efficient supply chain. The application of blockchain technology enables their organization to cut transaction costs through automation; aids in the elimination of late, damaged, and incomplete orders to end consumers; and aids in proper inventory management. Using blockchain cuts out the need for middlemen, which makes the supply chain simpler and speeds up the design and development of new products by making teams more efficient and letting them see what everyone else is doing. The application of smart contracts over blockchain in the supply chain can decrease extra costs and delays, resulting in a more efficient supply chain; smart contracts enable transactions. Blockchain technology makes it possible for parties to coordinate their transactions. Due to the many benefits of using blockchain, companies should use it in their supply chain manufacturing. Furthermore, the blockchain's application should not be limited to a small number of workers; more workers should be trained in its use and implementation.

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