IMPLEMENTATION OF BLOCKCHAIN TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT

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'I/We* acknowledge that have read this work and in my/our view* this work is sufficient in terms of scope and quality for the purposes of the award Bachelor of Technology Management (Supply Chain Management and Logistics)'

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This report is presented as a requirement for the degree of Bachelor of Technology Management (Supply Chain Management and Logistics) with Honours

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DECLARATION

This declaration is to clarify that all of the submitted contents of this project are original, excluding those that have been admitted specifically in the references. All of the work involved is based on my ideas and creativity. All contents of this project have been submitted as a fulfilment of the Bachelor of Technology Management (Supply Chain Management and Logistics) with honours. I hereby declare that this project is entirely my own, not included in the acknowledged references document or summaries.

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DEDICATION

I dedicate this project to God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge, and understanding. He has been the source of my strength throughout this program and on His wings only have I soared. I also dedicate this work to my parents – Ahmad Fazla Bin Abu Bakar and Zaleha Binti Ibrahim who have encouraged me all the way and whose encouragement have made sure that I give it all it takes to finish that which I have started. To my sisters who have been affected in every way possible by this quest. Big appreciation to my beloved supervisor, Dr. Murzidah Binti Ahmad Murad and panel, Pm Dr. Juhaini Binti Jabar who had guided myself throughout the research and my course-mate that assisted me in order to accomplish my research as well. Thank you. My love for you all can never be quantified. May God bless all of you

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ABSTRACT

Nowadays, blockchain technology sparked attention in the field of supply chains. This research report focused on the challenges and impacts of implementing blockchain technology in supply chain management. Given the increasing interest in blockchain's potential in the supply chain, this research aimed to provide a comprehensive understanding of blockchain implementation. By exploring practical applications, this research filled the gaps in the literature. A key challenge identified is the shortage of expertise in handling blockchain technology. The National Blockchain Roadmap 2021-2025, issued by the Ministry of Science (2022), stated that 56% perceived blockchain adoption due to a lack of in-house capabilities. The research has two objectives: (1) to identify the challenges associated with the implementation of integrated blockchain technology in the supply chain. (2) To investigate the impacts of leveraging blockchain technology in supply chain management. To obtain a deeper understanding and new insights, exploratory research was used, utilizing qualitative methods which are semi-structured interviews. In this research, 3 informants were interviewed online. The research findings were analysed using thematic analysis, which involved identifying, analysing, and interpreting the data acquired. This interview revealed the answer to the two research objectives indicated above. Through this research study, the knowledge gained guided practitioners in making informed decisions about implementing blockchain technology in supply chain management.

ABSTRAK

Pada masa kini, teknologi blockchain semakin mendapat perhatian dalam bidang rantaian bekalan. Laporan penyelidikan ini memberi tumpuan kepada cabaran dan impak pelaksanaan teknologi blockchain dalam pengurusan rantaian bekalan. Memandangkan minat yang semakin meningkat terhadap potensi blockchain dalam rantaian bekalan, kajian ini bertujuan untuk memberikan pemahaman yang komprehensif mengenai pelaksanaan blockchain. Dengan meneroka aplikasi praktikal, kajian ini mengisi jurang dalam literatur sedia ada. Salah satu cabaran utama yang dikenalpasti ialah kekurangan kepakaran dalam mengendalikan teknologi blockchain. Menurut *National Blockchain Roadmap 2021-2025* yang diterbitkan oleh Kementerian Sains (2022), sebanyak 56% menyatakan kekurangan kemampuan dalaman menjadi halangan utama kepada penerimaan blockchain. Kajian ini mempunyai dua objektif: (1) mengenal pasti cabaran yang berkaitan dengan pelaksanaan teknologi blockchain bersepadu dalam rantaian bekalan, dan (2) menyiasat kesan penggunaan teknologi blockchain dalam pengurusan rantaian bekalan. Untuk mendapatkan pemahaman yang mendalam dan pandangan baharu, kajian eksploratori dilakukan dengan menggunakan kaedah kualitatif iaitu temu bual separa berstruktur. Dalam kajian ini, tiga informan telah ditemu bual secara dalam talian, dan hasil kajian dianalisis menggunakan analisis tematik, yang melibatkan proses mengenalpasti, menganalisis, dan mentafsir data yang diperoleh. Temu bual ini berjaya menjawab dua objektif penyelidikan yang dinyatakan. Melalui kajian ini, pengetahuan yang diperoleh dapat membantu pengamal membuat keputusan yang lebih baik tentang pelaksanaan teknologi blockchain dalam pengurusan rantaian bekalan.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIXES

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

This paper will be divided into five chapters. The first chapter explained a brief summary of the study presented by this researcher. It includes the background of the study, the problem statement, the research question, research objectives, expected outcomes, and the significance of the study. The reader was provided with an idea of the key elements of why this research was conducted.

1.1 Background of Study

An essential component of current company operations is supply chain management (SCM), which covers the movement of products, services, and data from suppliers of raw materials to final customers (Raparthi, 2002). Every industry's supply chain has an extremely complex process so in order to increase production and increase profitability, all sectors must strengthen their supply chains (Gohil and Thakker, 2021). Some changes need to be adopted to address the challenges of the traditional supply

chain process, which is by adopting blockchain technology. Adopting blockchain is one of the most useful changes because it can improve the entire supply chain process.

Based on Teoh (2021), blockchain is defined as storing information that makes system hacking and cheating more difficult. The term "distributed ledger technology" refers to the process of virtually copying and distributing a ledger that contains every transaction that has ever occurred across all of the computer systems connected to the network. This decentralized system ensures that no one owns the data since individuals cannot control it (Yadlapalli et al., 2022). The blockchain serves as a distributed ledger (database) that allows supply chain participants to collaborate and generate, authenticate, validate, and safely store a variety of records, including transaction records, product details, localization data, certificates, and data from sensors and other linked devices.

Furthermore, as cited in Gohil and Thakker (2021), the product lifecycle management process is improved by blockchain technology and its interaction with additional technologies. Customers and other supply chain participants receive real-time feedback from it. By establishing a system of distributed agreement wherein any online transaction involving digital assets, past and present, may be confirmed at any moment in the future, it has the potential to completely transform the digital world (Apte and Petrovsky, 2016). Utilizing blockchain technology has several advantages such as facilitating traceability, improving transparency, and proving product origin (Agi and Jha, 2022).

Therefore, the integration of innovative technology into the supply chain has completely transformed process efficiency, but there are still issues that must be taken into consideration. The research problem related to this study will be further discussed in the part that follows, considering the background information provided.

1.2 Problem Statement

In the field of supply chain management, blockchain technology has lately sparked attention as a potential solution. Over the past several years, blockchain technology has become more and more significant and widely accepted (Agi and Jha, 2022). According to the National Blockchain Roadmap 2021-2025, Malaysia recorded a level of awareness of blockchain technology adoption is 49%, and the perception towards blockchain which is a critical strategic priority recorded at 40%. This shows that in recent years, Malaysia has demonstrated an increasing interest in blockchain technology, as seen by the numerous initiatives and projects being created across several industries (Aisyah et al., 2023).

Moreover, based on Rana (2021), healthcare, government, and society as a whole stand to gain much from blockchain technology, which might represent the next phase in the evolution of electronic government, save costs, and advance trustworthy procedures and records. Blockchain technology has notably improved transparency, privacy, security, accuracy, and value capture, in terms of cost savings and value networks. It has significantly increased data accessibility and reduced intermediation in digital operations (Palas and Bunduchi, 2021).

Additionally, the need for supply chain traceability and transparency has increased in the modern era to guarantee on-time delivery of goods, preserve product quality, and adhere to legal obligations. Information sharing between suppliers, manufacturers, logistics services, and end customers is important due to the heavy dependence on communication to maintain tasks on schedule (Imeri et al., 2019). In general, transparency is the free exchange of information (M. Khan et al., 2022a).

According to M. Khan (2022), majority of supply chains have employed blockchain technology to provide traceability as well as foster transparency. By offering a platform for direct communication amongst supply chain participants to communicate reliable and unchangeable information, enhances supply chain management and meets supply chain performance goals (Agi and Jha, 2022). Therefore, the existence of this blockchain technology greatly streamlines the information-sharing process for supply chain management in an organization.

However, there is an issue that supply chain management must face when implementing blockchain technology is shortage of expertise in developing and utilizing blockchain technology. The National Blockchain Roadmap 2021-2025, issued by the Ministry of Science (2022), stated that 56% perceived blockchain adoption barriers due to a lack of in-house capabilities. Also, a 2020 study revealed that 49% of participants cited the skills gap as their biggest challenge (Marisa Brown, 2023). The market for blockchain expertise is, and has been, extremely competitive. The cost and challenge of finding people in this field only make businesses' concerns about implementing blockchain technology and integrating it with old systems worse. Practitioners with some expertise have said that their inability to adopt new technology is caused by their lack of understanding of implementation issues (Gaur, 2020). Consequently, motivation for implementing blockchain technology has also decreased due to a shortage of competent and experienced personnel (Yadlapalli et al., 2022).

In conclusion, blockchain technology is still in its early years and faces a variety of technological, industry- and people-related difficulties (Wang et al., 2017). The integration of blockchain technology in supply networks can enhance efficacy in demand forecasting, inventory management, product origin tracking, and supply chain finance process management (Hald and Kinra, 2019). Companies are thus looking for more and more methods for implementing this blockchain technology in supply chains.

1.3 Research Objectives

The following are the research objectives of this study:

I. To identify the challenges associated with the implementation of integrated blockchain technology in the supply chain.
II. To investigate the impacts of leveraging blockchain technology in supply chain management.

1.4 Research Questions

Two research questions have been constructed from the problem statement of this research as per below:

I. What are the challenges associated with the implementation of blockchain in the supply chain?
II. What are the impacts of blockchain technology on supply chain management?

1.5 Expected Outcomes

The study is expected to analyze the challenges associated with the integrated blockchain in supply chain management. This research aimed to pinpoint the challenges enabling organizations to obtain a significant understanding. Organizations may take a proactive approach to respond to problems or minimize the effects of this study by recognizing challenges. This ensured smooth integration and use of blockchain, thereby strengthening the process of supply chain management in the organization.

Furthermore, investigating the impact of leveraging blockchain provided valuable insights into the transformative potential of this blockchain technology. By understanding blockchain technology's influence, organizations may improve data transparency and accountability across various stages of the supply chain. This allowed organizations to optimize processes and enhance the supply chain management process.

1.6 Significant of Study

The significance of this study was to close a gap in the academic literature by providing a comprehensive analysis of the challenges involved in integrating blockchain technology into the supply chain. It provided fresh insights into the challenges of blockchain integration in the context of supply chain management by combining previous research and actual data. These useful suggestions will help businesses optimize their supply chains, reduce the risks related to data security and information exchange, and make well-informed decisions about using blockchain technology.

As global supply chains become increasingly interconnected and complex, integrating technology advances like blockchain will be necessary to stay competitive. This study evaluated how blockchain affected supply chain management, enabling organizations to innovate and adapt to changing market conditions. Organizations were able to set themselves apart from the competition and obtain a competitive advantage in the global market by utilizing blockchain technology.

1.7 Summary

This chapter outlines the structure of the study. The aim of the research is to explore more about the implementation of blockchain technology in Malaysia. Therefore, the researcher aimed to investigate the extent of challenges associated with the implementation of integrated blockchain technology and the impacts of leveraging blockchain technology in supply chain management.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter discussed the challenges associated with the integrated blockchain in the supply chain. It also discussed the impact of leveraging blockchain technology within the supply chain. The final section of this chapter covered the development of the research framework and hypothesis.

2.1 Blockchain Technology

Blockchain is referred to as a distributed database that records data transactions and makes it available to a network of independent individuals (Yadlapalli et al., 2022). According to Agi and Jha (2022), blockchain can also be called a peer-to-peer network which is used to create and manage distributed ledgers, or databases of records. Every transaction is recorded in its decentralized database, which is accessible to all participants (Rana et al., 2021). Users in a blockchain can communicate with one another and generate a wide range of records, including data from sensors, product information, certifications, location data, and transaction records (Agi and Jha, 2022).

The potential influence of blockchain might be attributed to the growing significance of data in the current business environment. This is because technology improves data security, immutability, distribution, time-stamped consensus, anonymity, and programming to meet the needs of individual businesses (Teoh et al., 2021). Essentially, a blockchain is a series of blocks, and thousands of validated transactions are contained in each block (Gohil and Thakker, 2021). Blockchain data recordings are called blocks, and the crypto-analytic hash function is used to link them together in a chain (Yadlapalli et al., 2022). Changes to recorded data cannot be made because of the hash function used to validate transactions on blocks (Wang et al., 2019).

Furthermore, it is challenging for an attacker to alter the contents in any block due to the blockchain's replication and the chain that is created between blocks using hash codes (Al-Farsi et al., 2021). Since there are several blocks joined in a single string (Gohil and Thakker, 2021). Additionally, creating a transferable identity is made possible by blockchain technology (Gohil and Thakker, 2021).

2.2 Blockchain Technology in Supply Chain

The production of goods and delivery from the procurement stage to the product stage are all included in the supply chain. Typically, a supply chain consists of separate businesses that are actively involved in the upstream and downstream movements of goods, services, money, and/or information from a source to a customer (Mentzer et al., 2001). Every industry's supply chain has an extremely complex design and structure (Gohil and Thakker, 2021). Effective management is essential to achieving optimized supply chain operations since supply chain management encompasses a wide variety of tasks across several domains (Al-Farsi et al., 2021). The figure below shows the process of supply chain management.

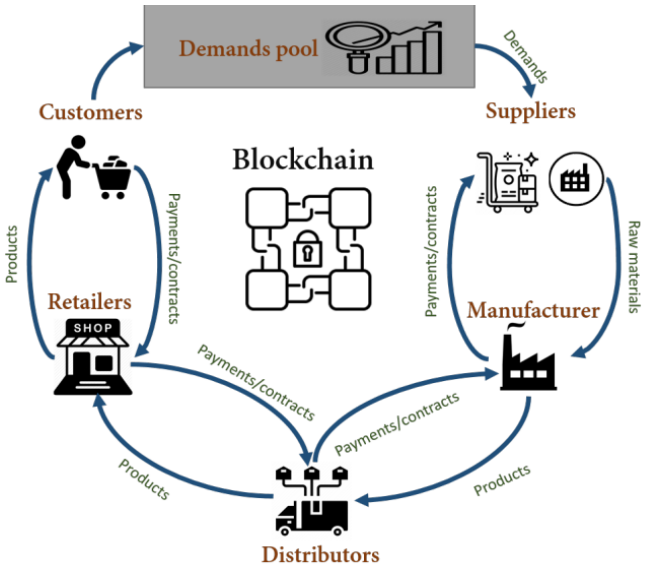

Figure 2.1: Supply Chain Process (Al-Farsi et al., 2021)

It seems that blockchain technology is a perfect solution to the current supply chain issues (Choi et al., 2020). In this sense, by giving supply chain members a direct channel of communication for the exchange of reliable and unchangeable data, blockchain technology promises to significantly enhance supply chain management and meet performance goals (Agi and Jha, 2022). A node matrix connects each industry's supply chain members to the blockchain. Consequently, it becomes simple for all members of the chain to communicate with one another and obtain accurate and reliable transaction data. It is possible to establish total decentralization of every link in the chain (Gohil and Thakker, 2021).

Furthermore, as a platform replacement, the blockchain enables users to connect to the business's systems and maintain their data visibility. Blockchain's distributed ledger allows individuals to communicate digitally inside a defined border, regardless of where they are (Choi et al., 2020a). According to Gohil and Thakker (2021), every time a transaction is completed between a party in the supply chain, all of the participants receive real-time operation tracking and may subsequently verify it. Once verified, they are uploaded to the blockchain server's public ledger, which is difficult to alter or hack. The supply chain organizations' investors and stakeholders can monitor the whole process. With regard to cost savings and value networks, which significantly increase data accessibility and reduce intermediation within digital processes, technology offers better transparency, privacy, security, accuracy, and value capture (Rana et al., 2021).

2.3 Blockchain Technology in Malaysia

Nowadays, the usage of technology has gained serious recognition as a result of several breakthroughs and cases of application. (Aisyah et al., 2023) claims that in recent years, Malaysia has demonstrated an increasing interest in blockchain technology, as seen by the numerous initiatives and projects being created across several industries. According to Aisyah (2023), the Malaysian government has acknowledged the promising potential of blockchain technology and has started some programs to encourage its use. The sectors of palm oil and agribusiness, Islamic finance, and renewable energy and utilities were three of the first to explore this area (Alita Sharon, 2018).

Additionally, two recent blockchain implementations in Malaysia are the co-launch of digital vaccination certificates for COVID-19 vaccine recipients (Bernama, 2021) and traceability in the palm oil sector by the Malaysian Palm Oil Council (Teoh et al., 2021). These are big projects that need a lot of funding. Based on Kementerian Pendidikan Malaysia (2018), also introduced e-Scroll, a blockchain-based platform, in 2019 to facilitate the issuance and verification of academic credentials. Blockchain technology is used by the platform to guarantee the integrity and validity of the certifications (Aisyah et al., 2023).

Other than that, the halal food industry is another possible large-scale blockchain use (Teoh et al., 2021). Although Malaysia presently only supplies 1% of the world's halal food demand, the halal food business is expanding globally (Jamari Mohktar and Jason Loh, 2021). Concerning the halal food supply chain, the public has traditionally debated problems such as cross-contamination, halal fraud, halal counterfeiting, logistical challenges, and the lack of progress toward an international halal standard (Helmi Ali et al., 2021). Therefore, by using blockchain technology, industry trust and transparency may be increased, and crises like the ones that have occurred in the last year can be avoided (Teoh et al., 2021).

In conclusion, Malaysia's adoption of blockchain technology across every sector of industries shows commitment to development and effectiveness. Malaysia has set an example of leveraging technology for economic and social progress. However, due to blockchain technology being a new technology, there may be a few

challenges to its supply chain implementation that must be overcome to fully realize its potential.

2.4 Challenges Associated with the Implementation of Blockchain Technology in the Supply Chain

This literature review shows there are five challenges associated with the implementation of integrated blockchain in the supply chain. The best indicators were selected and its already proved by the previous studies. The five challenges are technical expertise, top management support, financial resources, and privacy.

2.4.1 Technical Expertise

Since blockchain technology is still in its early stages, having employees with technical expertise is vital. Employees in blockchain technology are in great demand and earn excellent salaries. Thus, it is challenging to draw in and keep talent using blockchain technology (Yadlapalli et al., 2022). It is especially challenging to retain talent because of the market's volatility and the disruptive potential of many initiatives. Employee stock options may abruptly lose value, and competitors may come up with more alluring concepts (Sáez, 2020).

Moreover, blockchain technology implementation and utilization may be impacted by managers and employees lacking the necessary expertise to manage the technology (Atlam et al., 2018). The absence of a competent and experienced team to apply the technology has demotivated them to use it (Yadlapalli et al., 2022). In addition, according to Aswini Yadlapalli and Shams Rahman (2022), strategies should be developed by recognizing the workforce's problems, which include people who lack cross-industry work experience or who do not comprehend technology. The development of an internal digital skills program will improve employees' technology

proficiency. Therefore, technical expertise is essential for the successful implementation of blockchain technology.

2.4.2 Top Management Support

Another challenge associated with the implementation of blockchain technology is low top-management support. Since blockchain technology is continuously developing and changing, (Yadlapalli et al., 2022) believes that top management must provide various types of support for various elements. The top management must assist with its execution in several ways, including by committing to the project, assisting the team in overcoming challenges, and giving the group encouragement (Zhou et al., 2020).

Moreover, special care should be taken to reassure staff members that blockchain technology would enhance businesses and labor productivity rather than replace their jobs (Zhou et al., 2020). Having the backing of top management was also mentioned as being essential, especially for large firms looking to motivate employees to support a company-wide cultural shift and lessen resistance (Sáez, 2020). It is to guarantee that businesses stick to a long-term goal and use their resources as efficiently as possible to carry it through, a high level of support for particular IT developments is required (Garanina et al., 2022).

2.4.3 Financial Resources

Based on Gohil and Thakker (2021), implementing new, modern technology in a conventional supply chain may be fairly expensive, thus before choosing to implement any new technology inside the organization, an effective financial plan is advised. In order to cover the costs of deploying blockchain technology, the organizations must be financially stable (Zhou et al., 2020). Given the initial cost of

blockchain technology, business finds it difficult to consider employing it (Yadlapalli et al., 2022). Choi (2020) also stated that the management team's commitment and support may be hindered by the uncertain cost of deploying blockchain.

Accurate unit economics should also be prepared. When considering long-term investments in technology and their return on investment, a business must plan ahead (Gohil and Thakker, 2021). Due to the design being integral, any new additions would need synchronization of all the chain's blocks. This may be computationally costly, particularly for big blockchains, and it might prevent it from being implemented (Rana et al., 2021). Implementation costs can vary depending on some important elements, such as accounting and opportunity expenses, as well as hardware, software, hiring, and internal training (Choi et al., 2020a).

2.4.4 Privacy

The structure of blockchain technology raises a few fundamental privacy issues. Since blockchain technology is public, anybody with access to the public domain may view every transaction that is recorded using it (Rana et al., 2021). Product visibility throughout the supply chain has been made possible by blockchain technology. Privacy-related issues will arise because of the organization losing control over who is gaining access to the data (Yadlapalli et al., 2022).

Failure to protect privacy could result in consequences for the organization. Greater damages might result if unauthorized parties have access to sensitive information (S. Khan et al., 2022). According to Al-Farsi (2021), blockchain-based views all interacting components such as the implementation of the organization of business or computing processes as “blockbox’ with little information about actual operations, it provides customers and interacting stakeholders with adequate transparency. Customers and partners are more concerned about the privacy of their data as a result of the lack of transparency, and they may eventually lose faith in the way the system is run (Al-Farsi et al., 2021).

2.5 Impacts of Leveraging Blockchain Technology in Supply Chain Management

This literature review demonstrates the impacts of leveraging blockchain technology in supply chain management. The findings reveal three significant impacts associated with the implementation of integrated blockchain in the supply chain. These impacts have been substantiated by previous studies. The three impacts are enhanced traceability, security, and partnership.

2.5.1 Traceability

Traceability is the ability of information to be monitored, tracked, and traced. Transparency and traceability technologies are becoming essential tools for information exchange and collaboration among stakeholders throughout the SC (Raymond et al., 2020). According to one study by M. Khan (2022), real-time tracking of business activities is made easier by having blockchain technology. Several supply chains have already started using blockchain technology to provide traceability and promote transparency.

Furthermore, traceability not only helps organizations manage their resources more efficiently through the use of modern traceability information systems, but it also provides information trails that improve supply chain efficiency (M. Khan et al., 2022a). A notable example of this accomplishment is the blockchain-based supply chain solution developed by SIMBA Chain and the University of Notre Dame created for Toks, a Mexican fast-food and casual restaurant chain. Toks has been able to increase the average farmer's revenue by 700% by eliminating multiple middlemen in the supply chain and tracking coffee bean distribution widely along its value chain thanks to the application (Njualem, 2022).

Besides that, despite the adverse effects of the COVID-19 pandemic, Lenovo's supply chain has exhibited remarkable fortitude. In the face of unforeseen production and work suspensions caused by pandemic control, supply chain decision-makers utilized blockchain technology to devise plans to switch production schedules in less than two hours, whereas the process had previously required at least several days. The success rate of the switch was 80% higher than before (Xia et al., 2023).

2.5.2 Security

Blockchain is a new technology that can help ensure the integrity required by supply chain exchange participants and increase efficiency (Rejeb et al., 2019). Blockchain technology shows an important level of security superiority over traditional security services and IoT systems related to its enhanced cybersecurity capabilities and overall performance (Kshetri, 2017). Businesses need to secure their data and information exchanges as well as the integrity of their physical belongings to guard against theft and various forms of criminal activity, such as diversion and counterfeiting, due to the complexity of supply chains and the growth of exchange partner relationships (Rejeb et al., 2019).

Moreover, blockchain-integrated supply chain solutions offer robust security and privacy measures that prevent unauthorized modification or exploitation of data records (Al-Farsi et al., 2021). Rejeb (2019) also emphasized that the blockchain system reduces the possibility of a single point of failure because of its decentralized approach. Simply put, blockchain technology mitigates the possibility of network failure and collapse in the event of a node crash. It has the potential to enhance the security of a supply chain by mitigating the majority of harmful assaults (Woodside et al., 2017).

Furthermore, blockchain technology can limit access to certain devices and reduce the chances of unauthorized access (Rejeb et al., 2019). As a result, the company risk will decrease dramatically as a result of the implementation of blockchain technology, which effectively detects and enforces audits to prevent fraud.

2.5.3 Partnership

Based on Kim and Shin (2019), supply chain management considers an effective and strategic alliance between a purchaser and its suppliers to be one of its most important success factors. Information transparency, information immutability, and smart contracts are a few of the benefits of blockchain technology that facilitate supply chain collaboration-required connectivity and dependability. Blockchain-based collaborative activities have the potential to provide an additional tier of partnership advantage to the supply chain, granting strategic benefits over market competitors in the form of partnership growth and efficiency.

The implementation of blockchain technology will increase the dependability of transactional data related to cash flows and product information among supply chain partners (Kouhizadeh an Sarkis, 2018). The transparency of information by blockchain technology improves the efficacy of collaboration among supply chain partners and fosters the expansion of partnerships (Kim & Shin, 2019).

Meanwhile, according to Xia (2023), if the blockchain applies to the entire supply chain of an end item, it will forthrightly transmit information to all authorized participants in the supply chain, including the suppliers of the item's components, whenever such information is required. This capability allows supply chain management to overcome enormous obstacles of bullwhip effect. Enhanced information transparency will contribute to the expansion of the supply chain partnership and enhance the performance of the supply chain alliance.

2.6 Conceptual Framework

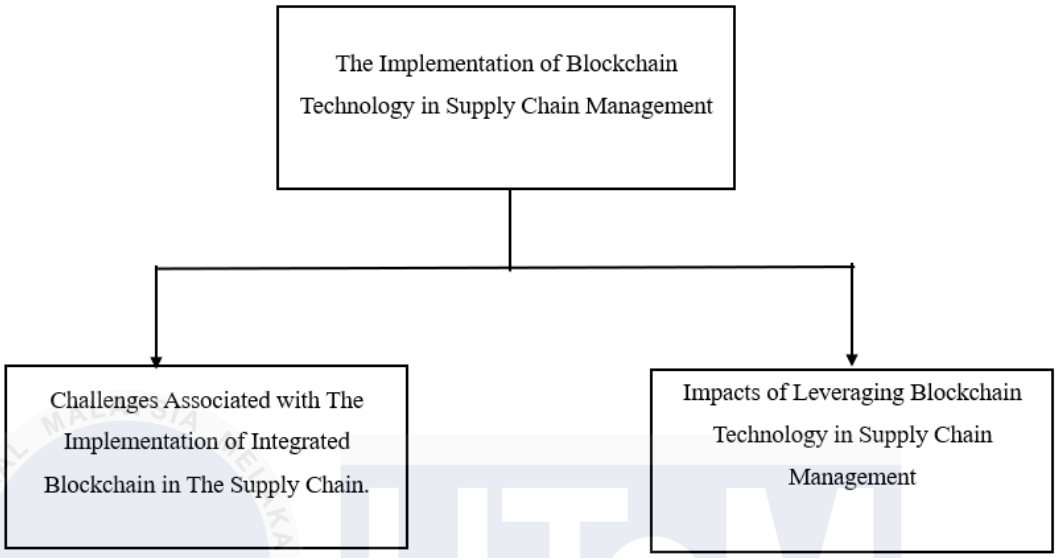

Figure 2.2: Conceptual Framework

A framework that directs one's research is known as a conceptual framework (Chukwuere, 2021). The conceptual framework offers a guide for the compilation of the literature used in the study (Collins and Stockton, 2018). The conceptual framework can be defined as providing accurate and relevant research results by utilizing theoretical ideas in the field of study and guaranteeing the validity of the research (Adom et al., 2018). In this case, the conceptual framework then provided the foundation for data analysis, interpretation, and discussion of the findings and outcomes (Hughes, 2019). Therefore, the conceptual framework used in this study is to get the findings that are essential to studying the challenges and impacts of the implementation of blockchain in supply chain management. The development of this conceptual framework will encourage further research on this topic.

2.7 Summary

In this chapter, the researcher presented an overview of challenges associated with the implementation of blockchain technology and the impacts of leveraging blockchain technology in this context. Previous studies were utilized as supporting ideas and facts, with most of the data sourced from journals, and articles. In the next chapter, the researcher will discuss the research methods and the research flow, detailing how the data is collected.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 INTRODUCTION

This research aimed to discover the challenges and impacts of leveraging the implementation of blockchain technology in supply chain management in Malaysia. This chapter discussed the chosen methodology and the steps taken to conduct the research to achieve the research's goals. Various sections in the chapter cover research design, data collection methods, sampling strategy, and data analysis.

3.1 Research Design

Research design, or simply the plan for the planned research effort, may be thought of as the structure of research; it is the "Glue" that ties all of the components of a research project together (Akhtar, 2016). Three types of methods can be applied in this research, which are qualitative, quantitative, and mixed methods. However, in the context of this research, the qualitative research method was considered the most suitable for understanding the challenges and impacts of implementing blockchain technology. Qualitative research aims to provide a deeper understanding of concepts, viewpoints, or experiences by collecting and examining non-numerical data (text,

video, or audio) (Ugwu and Val, 2023). Given the current study conducted on blockchain technology, it will be very suited to employ a qualitative research technique to help the researcher's understanding of the context (Andoni et al., 2019).

As for the research design in the research study, there are four, which are explanatory, exploratory, descriptive, and evaluative. The researcher used an exploratory design to gain a deeper understanding and new insights into the challenges and impacts of the implementation of blockchain technology in supply chain management. Exploratory research design is a method that used to explore research issues that have not been thoroughly examined before. By using an exploratory research design maximized the discovery leading to the description and understanding of an area. As a result, it was determined that the exploratory research design and the qualitative methods were suitable for achieving the research's aims and objectives.

3.2 Data Collection Methods

According to this research study, a combination of primary and secondary data are the main sources for data collection. Primary data depended on the research approach, whether it was qualitative or quantitative. In simple terms, if it was quantitative, then the collection of data was based on surveys. In contrast, qualitative data collection involves conducting interviews to gather more in-depth information. Therefore, in this research study, the researcher used both primary and secondary data.

3.2.1 Primary Data

Primary data is one of the important elements of the research study. The main reason for the collection of primary data was the lack of information to answer the research question. Through semi-structured interviews, the researcher gathered insights into the participants' experiences and opinions rather than a simple questions

and response approach regarding the challenges and impacts of implementing blockchain technology in supply chain management.

The researcher has developed a set of interview questions and an interview protocol. The researcher then sent an email and made calls to more than 50 companies to request participation in the research. Despite the extensive outreach, only three companies were willing to be interviewed and give their thoughts and experience in using blockchain technology. These companies were selected due to their involvement with blockchain making their insight valuable for understanding the real challenges and impacts of blockchain in the supply chain.

The interviews were conducted online via Microsoft Teams. Each interview was scheduled based on the interviewee's availability. The duration of each interview was approximately 30 minutes. Therefore, collecting primary data for this study aimed to obtain diverse and deeper information about the challenges and impacts of leveraging the implementation of blockchain technology in the supply chain.

3.2.2 Secondary Data

Secondary data collection was defined as data that had been collected by someone earlier. Secondary data can be collected from various sources such as journals, articles, books, websites, newspapers, and even government documents. It was easier to access compared to primary data. The collection of secondary data aimed to obtain information regarding previous studies or research on blockchain technology in supply chain management. Mainly, the researcher obtained the secondary data from the UTeM library database known as Emerald Insight as well as from Google Scholar where previous studies and published research on blockchain technology in supply chain management were reviewed.

3.3 Sampling Strategy

In this research, the researcher conducted a semi-structured interview with the companies that have implemented blockchain technology. To answer the interview questions, the participants must have a good understanding of blockchain technology in the supply chain to answer the questions given in the interview. Given that this semi-structured interview focused on blockchain technology in supply chain management, it is important to note that not all companies will be familiar with this technology, nor will they fully know its existence. Therefore, the interviews were distributed to knowledgeable people, and the most suitable target for this research is supply chain managers or employees from companies that have implemented blockchain technology in their supply chain. This is because supply chain managers or employees who have experience with blockchain technology have already been exposed to it. However, the target population of managers and employees who had implemented blockchain in supply chain management was large and required extensive testing. Therefore, the study interviewed supply chain managers and employees who have implemented blockchain technology in Malaysia as sample data for this study.

The researcher used the snowball sampling method, which is one of the most popular methods of sampling in qualitative research. According to Parker (2019), snowball sampling is when the participants who have an interview are then asked to suggest other connections who meet the research's requirements and who could be willing to participate in the interviews. The process continued as the participants suggested additional individuals who might be interested in participating. This process will continue until data saturation (Naderifar et al., 2017).

In summary, the study used semi-structured interviews and snowball sampling techniques to collect data from supply chain managers and employees in Malaysia who have implemented blockchain technology. This strategy ensured the gathering of relevant and detailed data from knowledgeable sources. This enables a deeper understanding of blockchain's challenges and impacts on supply chain management.

3.4 Data Analysis

In this research study, the researcher used the qualitative method to obtain information and employed thematic analysis as a data analysis tool to analyze the interview data. Thematic analysis was a very helpful method for analyzing qualitative data since it usually breaks up texts based on themes, codes short passages, and then compiles the results (Rosairo, 2023). Based on Braun and Clarke (2006), thematic analysis is a technique for identifying, analyzing, and summarising patterns in data. It organized the data collection minimally and provides (rich) detailed descriptions. As the thematic analysis was frequently useful for identifying important components of massive data gathering, it helped the researcher manage data in an orderly manner, producing an in-depth and well-structured initial report for this research study.

Braun and Clarke (2006), provided six general phases to an overall analysis approach. The six general phases include becoming familiar with the data, general initial codes, searching for themes, reviewing themes, defining themes, and writing up the findings. The first step was to become familiar with the data collected from in-depth interviews. This step included going over the data over and over again and possibly writing it (Ugwu and Val, 2023). After familiarizing and listing the initial ideas of the data, the second step began, which was to generate initial codes.

The ideas and topics in the data will be identified and simply and quickly referred to through the use of codes (Ugwu and Val, 2023). Coding helped to organize a large amount of data into manageable bits of information. In this second step, each data item required full focus as go through it systematically. Unique features in the data were identified that could act as the foundation for frequent trends (themes) in the data collection (Braun and Clarke, 2006). As a result, the researcher switched from unstructured to structured data.

The third step involved searching for themes. This step consisted of grouping the various codes into prospective themes and compiling all the relevant coded data extracts inside the themes that have been found (Braun and Clarke, 2006). It refocuses the study on the wider level of themes rather than codes. According to Braun and Clarke (2006), at this stage, using visual presentations like mind maps or tables could

help to assist in the grouping of the code into themes and the researcher employed such tools to facilitate this process.

Next, reviewing themes was the fourth step of thematic analysis. The researcher checked the level of the coded data extracts to assess the theme's level of support and to ensure accurately represents the meaning discovered during the data collection (Braun and Clarke, 2006). It was essential that the information contained inside themes needs to be logical when taken as a whole and separately. At this point, the researcher arranged a thematic map of topics following the study's conceptual framework (Rosairo, 2023).

The fifth step was defining themes. In this step, the researcher refined the themes and examined the supporting evidence more carefully. The "Define and Refine" refers to figuring out the essence of each topic (as well as the themes in general) and what part of the data each theme captures (Braun and Clarke, 2006). Names must be clear, quick, and instantly convey to the reader the essence of the topic. Writing up the report was the last step of the thematic analysis. In this phase, the researcher compiled a report that included sufficient data extracts to demonstrate the theme's prevalence and sufficient proof found in the data (Rosairo, 2023).

As a result, thematic analysis improves the research process by transforming unstructured data into structured and meaningful insights. It deepened the understanding of the research topic as a whole by providing a comprehensive view of the challenges and impacts of blockchain technology in supply chain.

3.5 Summary

This chapter provided the entire overview of the research methodology used in this research study. It explained the process of identifying the research design, how data was collected, and the analysis process. This chapter suggested a data verification approach. Therefore, the full results were presented in Chapter 4.

CHAPTER 4

RESULTS

4.0 INTRODUCTION

In this chapter, it discussed the data analysis that has been collected from the interviews. The researcher has done semi-structured interviews via online meetings through Microsoft Teams in order to collect the data. After the data was collected from interviews, the transcript was written, and coding was done to analyse the data collected from the participants in this study. Three companies that had implemented blockchain technology were interviewed. This chapter is divided into three sections, which are the challenges and impacts of implementing blockchain technology and the participants' demographics.

4.1 Demographic Information

4.1.1 Informant 1

Informant 1 (I#1) has been working at ABC Company for approximately 4 years. He has completed a degree in higher education. And now, he has held a position as Head of AI, IoT, and Blockchain Experts at ABC Company. The company is an agriculture technology company whose core competencies encompass artificial intelligence (AI), supply chain traceability, and blockchain technology with a focus on oil solutions through secure software platforms.

4.1.2 Informant 2

Informant 2 (I#2) has been employed at NSB Company, which is a steel manufacturing company. She has been a supply chain specialist for roughly 4 years. She earned a degree in higher education in English Communication. NSB provides innovative, premium coated, and painted steel products to the building construction, manufacturing, and home appliance sectors in North America and ASEAN.

4.1.3 Informant 3

Informant 3 (I#3) has three years of experience as a regulatory executive at XYZ Company. She graduated with a degree in biology in higher education. The XYZ company is a pharmaceutical manufacturer that focuses on developing, manufacturing, and marketing pharmaceutical and nutraceutical products and distributing them globally to over 30 countries.

Informants	Working Position	How many years of experience?	Education Background
1	Head of AI, IoT, and Blockchain Experts	4	Degree
2	Supply Chain Specialist	4	Degree
3	Regulatory Executive	3	Degree

Table 4.1: Demographic Information of Respondent

4.2 Research Findings One: Challenges Associated with the Implementation of Blockchain Technology

Based on the data analysis, the challenges associated with the implementation of blockchain technology in the supply chain can be categorized into four themes, namely technical expertise, top management support, financial resources, and privacy. Table 4.2 presents the research findings on the challenges associated with the implementation of blockchain in the supply chain. Table 4.3 highlights the themes and the informants' support for each challenge.

CHALLENGES IMPLEMENTATION OF BLOCKCHAIN IN THE SUPPLY CHAIN		
SUB THEMES	**THEMES**	**MAJOR THEMES**
• High demand for blockchain professionals • Need for internal digital skills programs	• Technical expertise	• Challenges

• Fear of replacing human jobs with technology • Difficulty in aligning blockchain with long-term goals	• Top management support	
• Costs of Infrastructure and Hardware • Budget Allocation for Blockchain Training	• Financial resources	
• Concerns over Exposing Sensitive Data • Risk of Reputational Damage from Data Breaches	• Privacy	

Table 4.2: Themes and Subthemes of Finding One

Finding	**Themes**	**Informant's support**
Challenges implementation of blockchain	**Technical expertise**	I#1, I#2, I#3
	Top management support	I#2, I#3
	Financial Resources	I#1, I#2, I#3
	Privacy	I#1, I#3

Table 4.3: Themes and Informants' Support for Blockchain Implementation Challenges

4.2.1 Technical Expertise

Based on the data analysis, the researcher categorized technical expertise into high demand for blockchain professionals and the need for a digital skills program.

Themes 1	Sub Themes	Informant's support
Technical Expertise	High demand for blockchain professionals	I#1, I#2
	Need for internal digital skills programs	I#1, I#2, I#3

Table 4.4: Subthemes and Informants' Support for Technical Expertise Challenge

4.2.1.1 High Demand for Blockchain Professionals

The high demand for blockchain professionals is necessary to ensure the effective implementation of blockchain technology in organizations. Informant 1 mentioned that he believes that the blockchain expertise is insufficient therefore it requires the organization to provide them training. Informant 1 said:

"Not all the employees are blockchain experts, so we have to give them training... It's a new technology, right? So we want to give them classes." (I#1)

Informant 2 highlighted that the organizations faced difficulty finding skilled professionals with blockchain expertise. To address this challenge, the organization necessitated internal training programs to help employees adjust to the new technology and become familiar with its implementation. Informant 2 said:

"Once we adopt a new system like blockchain system... getting people comfortable with the new system, the new tech especially... we provide training sessions step by step so that they are not lost." (I#2)

4.2.1.2 Need for Digital Skills Program

The second subtheme for technical expertise is the need for a digital skills program. All three informants claimed the need for digital skills programs to ensure employees can effectively use blockchain technology. Informant 1 said that in order to upskill employees, training programs were introduced using blockchain-specific technologies like Go language.

"We use Go language, previously company used some PHP languages, and we just migrated some of the codes to Go." (I#1)

Meanwhile, informants 2 and 3 did not mention specific training the organization provided but their organizations invested in upskilling employees to give the employees training and workshops to help employees adapt to blockchain technology.

"We do give them training and I mean enough training and knowledge so that... they can gradually move to utilizing the investment we are doing so far." (I#2)

"Like for example, we had workshop tutorials and hands-on sessions that broke down the basics and also help employees to see how blockchain applied to their specific roles." (I#3)

4.2.2 Top Management Support

The second challenge in implementing blockchain technology is top management support. Top management support is essential to successfully implementing blockchain technology. Based on the data analysis, the researcher categorized top management support into two subthemes: fear of replacing human jobs with technology and difficulty aligning blockchain with long-term goals.

Themes 2	Sub Themes	Informant's support
Top management support	Fear of Replacing Human Jobs with Technology	I#3
	Difficulty in Aligning Blockchain with Long-Term Goals	I#2, I#3

Table 4.5: Subthemes and Informants' Support for Top Management Support

4.2.2.1 Fear of Replacing Human Jobs with Technology

The first subthemes for top management support is a fear of replacing human jobs with technology. The management needs to face the employee's concerns regarding their replacement of jobs. To ease this concerns, a gradual implementation approach was adopted to allow employees to adapt at their own pace. Informant 3 said:

"So actually many employees were worried about needing to learn a whole new set of skills and how it will impact their workflow. So we took a gradual approach, letting employees adjust at their own pace." (I#3)

4.2.2.2 Difficulty in Aligning Blockchain with Long-Term Goals

The next subtheme is the difficulty in aligning blockchain with long-term goals. Organizations need to revisit and alter their existing processes to accommodate the new blockchain technology. Informant 2 said:

"We had to ensure we invest in correct people and also when we adopt this new system, we need to get the right people as well and make sure that it fits or it is adapting to our current process." (I#2)

In the case of informant 3, the organization carefully plans the integration of blockchain into current workflows to minimize disruptions and preserve business alignment.

"The transition was actually carefully planned with a strong emphasis on integrating blockchains into existing workflows without disrupting the operation." (I#3)

4.2.3 Financial Resources

The third theme for the challenge associated with the implementation of blockchain is financial resources. Based on the data analysis, the researcher classified the content of financial resources into two subthemes which are costs of infrastructure and hardware and budget allocation for blockchain training. In general, informants mostly mentioned that blockchain technology is costly and seen as a long-term investment.

Themes 3	Sub Themes	Informant's support
Financial Resources	Costs of Infrastructure and Hardware	I#1, I#2
	Budget Allocation for Blockchain Training	I#1, I#2, I#3

Table 4.6: Subthemes and Informants' Support for Financial Resources

4.2.3.1 Cost of Infrastructure and Hardware

The first subtheme is the cost of infrastructure and hardware. Blockchain implementation requires significant investment in infrastructure. Two informants mentioned that the cost of infrastructure and hardware is one of the challenges in terms of financial resources. Informant 1 said:

"Infrastructure is the biggest challenge of blockchain; it is very very costly." (I#1)

As blockchain technology is a new technology it requires a big investment therefore informant 2 also said:

"We know that blockchain seems like a big comprehensive thing so it is not cheap." (I#2)

4.2.3.2 Budget Allocation for Blockchain Training

The second subtheme is the budget allocation for blockchain training. Blockchain technology is an evolving technology, and it requires significant investment in human capital. To properly comprehend and use the technology, employees need training. Although it can put a strain on finances, allocating an adequate budget for hands-on sessions and workshops is essential. For example, Informant 3 said:

"We actually face a few challenges. As I said earlier, where many employees are still not familiar with blockchain technology, so there are actually training programs that make the technology accessible to everyone." (I#3)

Informants 1 and 2 highlighted that financial resources were allocated to training employees to ensure they had skills to adapt to blockchain. These training aimed to help employees transition smoothly and utilize the system effectively. Informant 1 and 2 stated:

"We want to give them classes." (I#1)

"We do give them training and I mean enough training and knowledge." (I#2)

4.2.4 Privacy

The last theme for challenges implementation of blockchain is privacy. Based on the data analysis, the researcher classified the content of privacy into two subthemes which are concerns over exposing sensitive data and risk of reputational damage from data breaches.

Themes 4	Sub Themes	Informant's support
Privacy	Concerns over Exposing Sensitive Data	I#1, I#3
	Risk of Reputational Damage from Data Breaches	I#3

Table 4.7: Subthemes and Informants' Support for Privacy

4.2.4.1 Concerns over Exposing Sensitive Data

The subtheme for privacy is concerns over exposing sensitive data. According to Informant 1, the organization put measures in place after realizing how sensitive the transaction data was. Informant 1 said:

"The transaction data is very highly sensitive... within the private, we use a hyperledger fabric." (I#1)

Informant 3 emphasized that the biggest concern of her organization is data privacy. Ensuring data security was a critical focus to prevent unauthorized access to sensitive information. All sensitive information needs to be protected and comply with the regulations. Informant 3 said:

"One of the biggest concerns to us is actually data privacy….For instance, when we roll out blockchain for tracking clinical trial data, we had to make sure that only the authorized personnel could assess the patient information." (I#3)

4.2.4.2 Risk of Reputational Damage from Data Breaches

The second privacy subtheme is the risk of reputational damage from data breaches. Informant 3 mentioned that balancing transparency with data privacy was one of the challenges addressed through strong security measures. Informant 3 said:

"We had to make sure that only the authorized personnel could assess the patient information even though it was recorded on an immutable ledger. It requires some careful planning to comply with the regulations and also still get the benefits of transparency." (I#3)

4.3 Research Findings Two: Impacts of Blockchain Technology

Based on the data analysis, three themes are submerged as the impact of blockchain technology in the supply chain which are traceability, security, and partnership. The traceability of the impact of blockchain can be categorized into two, namely real-time tracking of goods and services and improved supply chain visibility. Meanwhile, there were two identifiable categories for the security impact which are fraud prevention through immutable records and reduction in counterfeiting via authentication. On the other hand, partnership impact can be classified into enhanced collaboration via shared ledgers and strategic alliances driven by trust and transparency. Table 4.8 shows the research findings on the impacts of blockchain technology and Table 4.9 presents the themes and informants' support for each impact.

IMPACTS OF LEVERAGING BLOCKCHAIN TECHNOLOGY		
SUB THEMES	**THEMES**	**MAJOR THEMES**
• Real-time tracking of goods and services • Improved supply chain visibility	• Traceability	• Impacts
• Fraud prevention through immutable records • Reduction in counterfeiting via authentication	• Security	
• Enhanced collaboration via shared ledgers • Strategic alliances driven by trust and transparency	• Partnership	

Table 4.8: Themes and Subthemes of Finding Two

Finding	Themes	Informant's support
Impacts of leveraging blockchain technology	**Traceability**	I#1, I#2, I#3
	Security	I#1, I#2, I#3
	Partnership	I#1, I#2, I#3

Table 4.9: Themes and Informants' Support for Blockchain Implementation Impacts

4.3.1 Traceability

The first theme in the impact of blockchain is traceability. Based on the data analysis, the researcher categorized the traceability impacts into two, which are real-time tracking of goods and services and improved supply chain visibility.

Themes 1	Sub Themes	Informant's support
Traceability	Real-time tracking of goods and services	I#1, I#2, I#3
	Improved supply chain visibility	I#1, I#2, I#3

Table 4.10: Subthemes and Informants' Support for Traceability

4.3.1.1 Real-Time Tracking of Goods and Services

The first subtheme for traceability is real-time tracking of goods and services. Blockchain implementation enables transparency across supply chain modules such as mail and transporters. Informant 1 emphasized that the adoption of blockchain allows for a clearer view of each supply chain component, stating,

"*The transparency between the stakeholders will be like very high. Supply chain... so we have our own modules like a mail and then transporter and the stakeholders. Those kind of transparency will be higher."* (I#1)

Building on this, Informant 2 highlighted that blockchain enables efficient tracking of products from manufacturing to delivery, reducing dependency and enhancing real-time monitoring. Informant 2 said:

“By using blockchain, we can actually trace a product's journey from the manufacturer to the customer.” (I#2)

Furthermore, informant 2 also added:

"It allowed them to track everything in real time... they don’t have to be very dependent on us." (I#2)

Informant 3 agreed and added that blockchain ensures the safety and integrity of data, which in turn enables tracking clinical trials and manufacturing records in real-time. Informant 3 elaborated:

“*Blockchain technology gives us a secure, unchangeable record of all our product data, which makes it easier to track everything and speed up audits and investigations. Blockchain helps in tracking the entire life cycle of the whole product and ensures that all parties meet the necessary requirements."* (I#3)

4.3.1.2 Improved Supply Chain Visibility

The second subtheme for traceability is improved supply chain visibility. Data analysis revealed that all three informants mentioned that the role of blockchain implementation enhances supply chain visibility. The use of blockchain technology improves stakeholders' visibility in the supply chain which raises the accuracy of supply chain data. Informant 1 described how transparency strengthens stakeholder relations and accuracy. Informant 1 said:

"The transparency between the stakeholders will be very high.” (I#1)

Similarly, Informant 2 noted that blockchain provides clear and accessible verification processes that benefit supply chain operations.

"Suppliers and customers can verify records directly without any middleman involvement." (I#2)

Informant 3 described blockchain's ability to ensure all parties involved can monitor and verify goods' movements and maintain product authenticity in the market. Informant 3 stated:

"It's been great for tracking counterfeit drugs because it gives us full visibility of the supply chain to ensure that our products are genuine in the market." (I#3)

4.3.2 Security

The second theme of blockchain's impact is security. Based on the data analysis, the researcher categorised security into two subthemes: fraud prevention through immutable records and reduction in counterfeiting via authentication.

Themes 1	Sub Themes	Informant's support
Security	Fraud prevention through immutable records	I#1, I#2, I#3
	Reduction in counterfeiting via authentication	I#1, I#2, I#3

Table 4.11: Subthemes and Informants' Support for Security

4.3.2.1 Fraud Prevention through Immutable Records

The first subtheme for security is fraud prevention through immutable records. The blockchain's immutable ledger adds an extra level of security against fraud by preventing record alteration. Informant 1 highlighted how data immutability enhances protection:

"The transaction data is very highly sensitive data. So, we will use data from blockchain so it will be non-comparable. Each node has writable permission, and also all the data will be saved." (I#1)

Informant 2 emphasized that blockchain improves security by ensuring sensitive data was stored immutably.

"We maintain secure transaction records, and transparency plays an important role between the company and the customers." (I#2)

Informant 3 added that by using blockchain it has help in secure clinical trial data against tampering.

"We maintain an immutable record of all regulatory transactions, making it easier to demonstrate adherence to standards and quickly address discrepancies." (I#2)

4.3.2.2 Reduction in Counterfeiting via Authentication

The second subtheme for security is a reduction in counterfeiting via authentication. Private blockchains like Hyperledger Fabric secure data while maintaining authentication through write permissions for nodes. Informant 1 shared their approach to ensuring secure and authentic data.

“Within the private, we use a Hyperledger Fabric so each node has writable permission and also all the data will be saved.” (I#1)

Informant 2 mentioned how blockchain systems help streamline the verification process:

"With blockchain, we can verify shipment authenticity and quickly extract information without relying on others." (I#2)

Informant 3 supported this perspective and emphasized that counterfeit prevention is significantly strengthened through end-to-end visibility. Informant 3 observed:

"Blockchain helps track counterfeit drugs, providing full supply chain visibility to ensure our products are genuine in the market." (I#3)

4.3.3 Partnership

The last theme for blockchain impact is partnership. Based on Table 4.10, the researcher classified the content of partnership into two subthemes which are enhanced collaboration via shared ledgers and strategic alliances driven by trust and transparency.

Themes 1	**Sub Themes**	**Informant’s support**
Partnership	Enhanced collaboration via shared ledgers	I#1, I#3
	Strategic alliances driven by trust and transparency	I#1, I#2, I#3

Table 4.12: Subthemes and Informants’ Support for Partnership

4.3.3.1 Enhanced Collaboration via Shared Ledgers

Enhanced collaboration via shared ledgers is a subtheme for partnership. Collaboration among stakeholders is essential for blockchain's functionality and success. Informant 1 stressed the importance of including all stakeholders in the blockchain network. Informant 1 said:

"We have to make because all the stakeholders need to be included on the blockchain, then only it will be workable." (I#1)

Furthermore, transparent records provided by blockchain technology improve trust between supply chain partners. Informant 3 noted,

"Blockchain has greatly increased our transparency and confidence with supply chain partners, as both parties can easily track goods movements and compliance." (I#3)

4.3.3.2 Strategic Alliances Driven by Trust and Transparency

The second subtheme for partnership is strategic alliances driven by trust and transparency. Blockchain provides the organization with a competitive advantage through enhanced transparency and trust among stakeholders. Informant 1 described how transparency sets their organization apart:

"Other companies are not having blockchain technology. Supply chain, so we have our own modules... transparency will be higher." (I#1)

Transparency not only set organization apart but also fosters stronger trust between partners. Informant 2 explained how openness boosts confidence:

"This transparency allows partners and customers to see their data and how it's being used. That's how we build trust." (I#2)

Informant 3 added that she believed the trust-building effect of blockchain strengthens relationships. Informant 3 said:

"By ensuring everyone is in agreement with regulatory requirements and quality standards, blockchain contributes to stronger, more dependent relationships." (I#3)

4.4 Summary of the Findings

This chapter presents the research findings following the sequence of the research questions. Research Questions One was the challenges associated with the integrated blockchain in the supply chain. The researcher found that there are four challenges which are technical expertise, top management support, financial resources, and privacy. Technical expertise was divided into high demand for blockchain professionals and the need for internal digital skills programs. Meanwhile, top management support was divided into two subthemes which are fear of replacing human jobs with technology and difficulty in aligning blockchain with long-term goals. Financial resources were divided into costs of infrastructure and hardware and budget allocation for blockchain training. The last challenge which was privacy divided into concerns over exposing sensitive data and the risk of reputational damage for data breaches.

The second research question was the impacts of blockchain technology on supply chain management. The impacts of blockchain technology were categorized into three which are traceability, security, and partnership. The content of the traceability was divided into two which are real-time tracking of goods and services and improved supply chain visibility. Security impact was divided into fraud prevention through immutable records and reduction in counterfeiting via authentication. The final impact was partnerships were categorized into two which are enhanced collaboration via shared ledgers and strategic alliances driven by trust and transparency.

4.5 Summary

This chapter outlines the results obtained from the research questions. The results are displayed in order that aligns with the research question. The next chapter will delve into discussions and conclusions drawn from these findings.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.0 INTRODUCTION

In this chapter, the researcher summarises the research findings of this study on the implementation of blockchain technology in the supply chain. This chapter discusses the findings in relation to the research objectives and presents the study's contribution in terms of theory and practice. This chapter also discusses the various limitations of research and offers suggestions and directions for future research. The current study analyzed data collected from three in-depth interviews conducted with companies that have implemented blockchain.

5.1 Discussion of Research Findings

5.1.1 Challenges Associated with the Implementation of Blockchain in the Supply Chain

Research Objective 1

To identify the challenges associated with the implementation of integrated blockchain technology in the supply chain.

Based on the data analysis, there are a few challenges associated with the implementation of blockchain technology in supply chain management that have been uncovered from the perspectives of industries that have implemented it. The challenges associated with the implementation of blockchain are technical expertise, top management support, financial resources, and privacy.

From this current research, the challenges related to the implementation of blockchain in terms of technical expertise can be categorized into two which are the high demand for blockchain professionals and the need for digital skills programs. The informants mentioned that implementing blockchain poses challenges, particularly in the high demand for blockchain professionals. They highlighted that the lack of sufficient blockchain professionals requires the organization to invest in employee training to ensure smooth implementation. This finding aligns with Chang et al. (2020), who emphasized that specialized teams with a range of knowledge are needed for blockchain installation and services to function effectively.

Additionally, the need for digital skills programs was also highlighted by the informants as a critical challenge for ensuring employees can effectively utilize blockchain technology. They stressed the importance of upskilling employees through training and workshops. This finding is similar to the notion by Choi et al. (2020) who argued that enhancing employee awareness at all organizational levels through workshops and training is crucial for facilitating the adoption of blockchain

technology. In order for blockchain to be utilized effectively, organizations should meet internal requirements such as ensuring that employees possess the necessary technical skills. Hence, addressing the challenge of technical expertise requires a proactive approach so that organizations bridge the gap in technical expertise and ensure smoother integration of blockchain technology.

Furthermore, the research found two primary challenges related to top management support which are fear of replacing human jobs with technology and difficulty in aligning blockchain with long-term goals. The informant highlighted that the management must carefully handle concerns about how blockchain might impact employees' roles by reassuring them that blockchain implementation is intended to enhance organizational productivity. This finding is consistent with Zhou et al. (2020), who emphasized that special care should be taken to reassure employees that blockchain implementation is a platform to enhance organizations and labor productivity rather than a way to replace their jobs.

Moreover, the informants identified aligning blockchain technology with long-term organizational goals as a challenge for top management support. The informants emphasized that the challenge they faced was the need for organizations to revisit and adapt their existing processes to integrate blockchain effectively. This observation aligned with Koteska et al. (2017), who emphasized the difficulties in adapting blockchain technology with existing supply chain systems. Therefore, resolving top management issues strategically allows for a smoother integration of blockchain technology into organizational procedures.

Besides that, this research also identified financial resources as a significant challenge in implementing blockchain. Specifically, the cost of infrastructure and hardware and budget allocation for blockchain training were highlighted as key financial challenges of implementing blockchain technology. A number of important variables, including hardware, software, hiring, internal training, and opportunity and accounting costs, can affect implementation costs (Choi et al., 2020). Informants emphasized that blockchain technology requires substantial investment due to its complexity and acknowledged its comprehensive nature and financial commitment to require it effectively. This finding is similar to the notion by Schatsky et al. (2018),

who addressed that while blockchain technology offers potential cost-savings benefits in the long run, it involves considerable upfront investment costs.

In addition, the informants pointed out that the challenge of implementing blockchain in financial resources is budget allocation for blockchain training. All informants emphasized the importance of investing in human capital to ensure employees can effectively use and comprehend the evolving technology. This observation is in line with Zhou et al. (2020), who indicated that organizations must increase their investment in order to create a capacity to train and upskill their workforce. In order to facilitate the initiative, the organizations must also set aside enough time and resources. Consequently, overcoming financial resources necessitates careful budget planning to maximize the long-term benefits of blockchain technology.

In terms of privacy challenges, the informants expressed concerns regarding over exposing sensitive data and the risk of reputational damage from data breaches. Informant highlighted that data privacy was a major concern particularly when implementing blockchain due to fear of being invaded by unauthorized parties. This finding aligned with Corbet et al. (2020), who pointed out that the complete transparency of blockchain can raise exposure risks since hackers can track historical data and predict a customer's future behavior due to the blockchain's visibility of information.

Moreover, the informant emphasized the challenge of implementing blockchain in terms of privacy is the risk of reputational damage from data breaches. The informant highlighted the difficulty in balancing transparency with data privacy. This finding is similar to the notion by Kaaniche et al. (2020), who addressed that blockchain is well known for its transparency so it will create doubt about data security and a fear of unauthorized data access. Hence, strong encryption mechanisms are necessary to handle privacy issues and maintain confidence while protecting sensitive data.

In summary, the implementation of blockchain technology in supply chain management faces challenges related to technical expertise, top management support, financial resources, and privacy concerns. By addressing these issues requires significant investment in training, strategic alignment with organizational goals, and

balancing transparency with data security. Overcoming these challenges is essential to unlocking the full potential of blockchain technology and ensuring effective implementation in creating efficient supply chain systems.

5.1.2 Impacts of Blockchain Technology on Supply Chain Management

Research Objective 2

To investigate the impacts of leveraging blockchain technology in supply chain management.

Blockchain is regarded as one of the most important and relevant technological developments that will probably have significant impacts on society and business (Dubey et al., 2020; Olnes et al., 2017). The study classified that the impacts of blockchain technology on supply chain management can be classified into traceability, security, and partnership.

Traceability as highlighted by the informants was categorized into real-time tracking of goods and services and improved supply chain visibility. Based on informants, implementing blockchain technology enables the real-time monitoring and tracking of products throughout the processes. This finding is similar to the notion by M. Khan et al. (2022), who addresses that a blockchain-based traceability system for the supply chain allows the end user to access the entire history and source.

Moreover, informants also mentioned that blockchain improved supply chain visibility which makes it easier for all parties such as stakeholders, suppliers, and organizations to track and verify goods' movements. This capability aids in promptly resolving issues, thereby improving operational efficiency. This finding aligned with the assertion of Bosona and Gebresenbet (2013), where they emphasized that traceability allows for tracking and tracing, which promotes transparency. Through the offering of an information trail and the application of new traceability information systems, traceability evaluates the increase in a supply chain management's efficiency

and helps organizations manage their resources effectively. Therefore, blockchain's traceability feature enhanced operational outcomes in supply chain processes.

Other than that, the current study also found that significant impact of blockchain technology was its ability to enhance security. As stated by Xiao et al. (2020), blockchain security is predicated on the honest-majority premise, which states that the system is considered secure as long as the majority of consensus voting power is honest. The informants of this study mentioned two key aspects of blockchain's security impact were fraud prevention through immutable records and reduction in counterfeiting via authentication. The informants have highlighted that blockchain secures sensitive data through decentralized and encrypted systems. This observation aligns with the findings of Nugroho Susanto Putro et al. (2023), who emphasized that blockchain immutability via cryptographic hashing makes it very challenging to change past transaction records.

Additionally, the informants also noted that critical aspect of blockchain implementation reducing counterfeiting through authentication mechanisms. They highlighted that private blockchains ensure data security by granting write to specific nodes which will lead to maintaining data authenticity. This is similar to the findings that stated that the distributed ledger maintains data integrity and guards against unwanted changes by tracking transactions across a network of participants in a tamper-resistant manner (Brunila et al., 2021). Informant 3 also mentioned that blockchain technology allows effective tracking of counterfeit drugs and ensuring product authenticity in the market. This is linked to research showing that pharmaceutical companies may readily trace the origin of their medicines using distributed ledger technology, thereby resolving the long-standing worldwide problem of counterfeit drugs (Gupta, 2019).

Furthermore, this research also identified partnership enhancement as a significant impact of blockchain technology in the supply chain. Enhanced collaboration via shared ledgers and strategic alliances driven by trust and transparency was crucial for demonstrating the security impacts of blockchain technology. The transparent records provided by blockchain technology were noted to improve the confidence among supply chain partners as they allow for easy tracking of goods movement and compliance. This aligned with Kim & Shin (2019) who noted

that the information transparency made possible by blockchain technology increases the effectiveness of supply chain partners' collaboration process, which fosters the expansion of their partnership.

Moreover, the informants emphasized that strategic alliances were driven by trust and transparency through the use of blockchain technology. The informants noted that blockchain transparency differentiates the organizations and fosters stronger trust among the partners. This is similar to the findings of Reyna et al. (2018), who emphasized that blockchain technology adds to the trustworthiness of shared information since it includes essential characteristics for supply chain collaboration, like information openness and immutability. The information transparency of blockchain ensures the swift and consistent distribution of information to all members within the network. Thus, blockchain fosters stronger partnerships by enhancing collaboration, building trust, and ensuring transparency through its shared ledgers and immutable records.

In summary, blockchain technology transforms supply chain management by improving operational efficiency, ensuring data security, and fostering collaborative partnerships. Its integration offers a robust framework for addressing existing challenges in the supply chain system while promoting trust and transparency among all stakeholders.

5.2 Achievement of Research Aims and Objectives

This research aims to investigate the challenges and the impacts of blockchain technology implementation in supply chain management. Two research objectives have been identified to further the goals of this research study. The following section outlines how each of the objectives will be achieved.

5.2.1 Fulfilment of First Objective

The first objective is to identify the challenges associated with the implementation of integrated blockchain technology in the supply chain. The challenges are mostly on the point that organizations have an impact on their business because of implementing blockchain technology. This study has found 3 respondents who implemented blockchain technology in their organization and the current challenges they experienced such as a) technical expertise, b) top management support, c) financial resources d) privacy. These four main challenges are the findings from the question towards the informant for the current challenges in implementing blockchain technology. Based on the findings, each informant has a quite similar opinion regarding the challenges they faced when implementing it. This makes the data findings more accurate due to they have similar opinions about the challenges.

The informants emphasized that one of the major issues was the lack of blockchain experts. Organizations must make investments in training and upskilling initiatives. This includes creating programs for digital skills to enable staff members to use blockchain technology efficiently. Insufficient top management support emerged as a challenge, particularly in addressing employee concerns about job displacement and aligning blockchain with long-term organizational goals. As for financial resources challenges, organizations faced high initial costs for infrastructure, hardware, and training. Informants also highlighted the concerns over exposing sensitive data and the risk of reputational damage from breaches underscoring the

importance of secure implementation practices. In order for businesses to completely benefit from blockchain technology in supply chain management, several issues must be resolved.

5.2.2 Fulfilment of Second Objective

The second objective of this research was to investigate the impacts of leveraging blockchain technology in supply chain management. The findings indicate that blockchain technology has a profound impact on three areas which are traceability, security, and partnership. Traceability was significantly enhanced as blockchain enables real-time tracking of goods and services. The transparent perspective of supply chain activities that blockchain offers, according to informants, improves decision-making and lowers inefficiencies. Improved visibility also ensures that all stakeholders are able to verify product authenticity and track the entire lifecycle of goods.

Security was another major impact with blockchain's immutable ledger offering robust protection against fraud and unauthorized modification. Informants highlighted that technology safeguards sensitive data and reduces the likelihood of data breaches. Blockchain also fosters stronger partnerships through shared ledgers that improve collaboration and transparency. Trust and transparency are key drivers of strategic alliances as they lead to the confidence of stakeholders in the system's integrity. These impacts show how blockchain technology could transform supply chain networks by making them safer, more effective, and more cooperative.

5.3 Significant of Study

The study of analyzing the challenges and impacts of implementing blockchain technology in the supply chain brought benefits to numerous organizations in Malaysia. Organizations gain valuable insights into the challenges and impacts of blockchain technology, analyzed by the researcher. This will enable them to proactively prepare for and address potential challenges to ensure smooth implementation. Businesses, in particular, benefit from understanding how blockchain enhances traceability, security, and partnership as highlighted in the study. Moreover, students can get access to research papers for reference when conducting research or studying blockchain technology. This research approach ensured that the implementation of blockchain technology positively impacted organizations, industries, and students, ultimately contributing to Malaysia's overall economic growth.

5.4 Limitation of Study

The research provides some useful insights and knowledge regarding the implementation of blockchain technology in supply chain management. However, several limitations were encountered during the research conducted. A primary limitation was the difficulty in obtaining a sufficient number of interviewees as many companies were reluctant to participate. This reluctance can be attributed to the fact that most organizations prefer to maintain privacy regarding the technology's implementation. As a result, the research was limited in its scope as the small sample size may not fully represent the broader range of challenges and impacts faced by the companies. This limitation may impact the depth of the findings and the overall applicability of the results.

Another limitation of this study is that blockchain technology is still seen as a new and developing innovation in Malaysia. Many companies, particularly small and medium-sized enterprises (SMEs), are still lacking knowledge and understanding of blockchain technology. The researcher faced challenges in obtaining diverse perspectives as the implementation of blockchain in supply chains is still limited to a few large companies with the resources and expertise to adopt this technology.

5.5 Recommendation for Future

After acknowledging the study's limitations, the researcher suggested some recommendations for future research on related topics. The first proposal is that the next researchers could explore the level of awareness and knowledge about blockchain technology in Malaysia. This would help to identify why many companies in Malaysia remain unfamiliar with or hesitant to adopt blockchain technology. Understanding these barriers could provide valuable insights for fostering wider adoption.

Additionally, future research conducting similar studies could consider employing quantitative research methods to achieve more comprehensive findings. Through quantitative research, such as surveys can help to gather specific and measurable data while enhancing respondent engagement. In general, the survey will improve respondent engagement and input which will allow for a better understanding of major challenges and impacts of blockchain implementation in supply chain management. By analysing the outcomes, future researchers can make more objectives and reliable assessments.

5.6 Conclusion

In conclusion, this chapter discusses summarizing and concluding the data analysis, provides suggestions to overcome limitations, and proposes recommendations for future study. The research successfully addressed the objectives and answered the research questions outlined in Chapter One. The data collection results provided valuable insights and enabled the study to draw meaningful conclusions.

The research identified some major challenges, including the shortage of technical expertise, limited top management support, significant financial resource requirements, and privacy concerns. Addressing these issues involves targeted employee training programs to bridge the technical expertise gap, fostering a supportive management culture to align blockchain initiatives with long-term goals, strategic financial planning to manage high initial costs, and implementing robust encryption protocols to safeguard data and mitigate privacy risks.

In terms of impacts, the study emphasized blockchain's ability to revolutionize supply chain management through enhanced traceability, security, and partnerships. Blockchain enables real-time tracking of goods and improved supply chain visibility, fostering transparency and operational efficiency. The technology's immutable records and authentication mechanisms bolster security by preventing fraud and reducing counterfeiting. Additionally, blockchain strengthens partnerships by promoting trust and collaboration among stakeholders through transparent and secure data exchanges.

Moreover, this study presents practical recommendations to guide organizations in implementing blockchain technology. Despite inherent limitations related to resources and research constraints. This research serves as a valuable foundation for future inquiries into blockchain technology in Malaysia. The practical implications derived from this study can inform organizations seeking to implement blockchain effectively. As Malaysia's industries continue to evolve alongside technological advancements, a deep understanding of these determinants and a strategic response to emerging challenges and impacts will be crucial for organizations aiming to thrive in the increasingly competitive landscape.

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APPENDIXES

APPENDIX A

Gantt Chart of Final Year Project (FYP) 1

Research Activities and Planned Milestone	Time Scale (Week)														
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Study Week	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
Briefing FYP and Approach Supervisor								M							
Search for FYP Topic								I							
Meeting with Supervisor								D							
Title Confirmation															
RO & RQ Construction								S							
Discussion on Chapter 1								E							
Submission Chapter 1								M							
Discussion on Chapter 2															
Submission Chapter 2								B							
Discussion on Chapter 3								R							
Submission Chapter 3								E							
Checking Chapter 1, 2 & 3								A							
Submission on Chapter 1, 2 & 3								K							
Presentation FYP 1															

APPENDIX B

Gantt Chart of Final Year Project (FYP) 2

Research Activities and Planned Milestone	Time Scale (Week)														
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Study Week	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
Briefing FYP 2								M							
Discussion of Interview Questions								I							
Development of Interview Questions								D							
Submission of Interview Questions															
Data Collection (Interview)															
Development Transcript								S							
Chapter 4: Thematic Coding								E							
Writing of Chapter 4: Results								M							
Recheck Chapter 4															
Writing of Chapter 5: Discussion								B							
Submission and Correction of Chapter 5								R							
Check overall research								E							
Finalise and Submission of Research								A							
Prepare Poster for Viva								K							
Presentation FYP 2															
Correction Report															
Submission FYP 2															

APPENDIX D

Consent Form

[IMPLEMENTATION OF BLOCKCHAIN TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT]

CONSENT FORM

I have read, or have had read to me, and I understand the Information Sheet. I have had the details of the study explained to me, any questions I had have been answered to my satisfaction, and I understand that I may ask further questions at any time. I have been given sufficient time to consider whether to participate in this study and I understand participation is voluntary and that I may withdraw from the study at any time. **Signing this form means that you have agreed to be a part of the study.**

	Please tick box	
	YES	NO
• I confirm that I have read and understand the information sheet for the study and have had the opportunity to ask questions		
• I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.		
• I agree to take part in the above study.		
• I agree to the interview being audio recorded		
• I agree to the interview being video recorded		
• I agree to the use of anonymized quotes in publications		

Declaration by Participant:

I _____ hereby consent to take part in this study.

_____ Date: _____
(Signature of participant)

_____ Date: _____
(Signature of researcher)

Contact Information

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APPENDIX E

Interview Protocol

Fakulti Pengurusan Teknologi dan Teknousahawanan
Universiti Teknikal Malaysia Melaka

SEMI-STRUCTURED INTERVIEW PROTOCOL

Project Title:

IMPLEMENTATION OF BLOCKCHAIN TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT

1. Interviewer Name	
2. Participant ID#	
3. Participant's name	
4. Participant's position	
5. Interview Date (dd/mm/yyyy)	☐☐ / ☐☐ / ☐☐☐☐
6. Participant agrees for interview to be digitally recorded	Yes ☐ No ☐
7. Time Interview Began (hhmm-24hr clock)	☐☐☐☐
8. Time Interview Ended (hhmm-24hr clock)	☐☐☐☐

Semi-structured Interview Guide

- Room setup – locate in a quiet place to improve the recorded sound quality. The interview may be conducted at the interviewee's office or premise (to suit the interviewee's convenience).

- Follow the following steps to complete the interview session:
  - **Step 1:** Complete Q1 – 5 above before the interview.
  - **Step 2:** Read Section A below to participant.
  - **Step 3:** At the beginning of the interview, introduce yourself; thank participant for taking part in the interview.
  - **Step 4:** Request permission from interviewee to record the conversation; tick the appropriate box for Q6.
  - **Step 5:** Turn on audio recorder if acceptable, document time the interview begins in Q7 above, and conduct an interview.
  - **Step 6:** Complete demographic questions that can be find in Section A.
  - **Step 7:** Proceed with the interview questions.
  - **Step 8:** At the end of the interview, thank the participant and ask if she/he has any further questions; document the time the interview ended in Q8 above.
  - **Step 9:** Ask if the participant is interested in being re-contacted with study results; if yes, document appropriate email. Inform participant that her/his email address will not be linked with her/his study data.

Interviewer: Please read the following to participants at the beginning of the interview.

SECTION A: Information about this study

Opening remarks:

Assalamualaikum/Hello/Good day, thank you for taking time out of your busy schedule to speak with me today. My name is NurFarha Arina Najwa binti Ahmad Fazla, and I am a student from the Faculty of Technology Management and Technopreneurship at Universiti Teknikal Malaysia Melaka. I understand you have many commitments, and I am genuinely grateful for your willingness to share your valuable time and insights with me.

Before we begin, I'd like to tell you more about the research I'm conducting. This study is titled **'Implementation of Blockchain Technology in Supply Chain Management'.** It explores the challenges and impacts of integrating blockchain within supply chains. Specifically, I aim to explore the challenges organizations encounter during blockchain implementation and the impacts of implementing blockchain in supply chain management. This research seeks to uncover practical insights that may help shape the future of blockchain applications in supply chains.

As described in the consent form provided to you earlier, participating in this interview is voluntary. You can choose not to answer a question or stop the interview at any time.

With your permission, I would like to audio-record the interview. The audio-recording will be stored on a secure server and destroyed after the findings of this research are published. Despite being taped, I would like to assure you that the discussion will be anonymous. The tapes will be kept safely in a locked facility until they are transcribed word for word. The transcribed notes of the focus group will contain no information that would allow individual subjects to be linked to specific statements. It would help if you tried to answer and comment as accurately and truthfully as possible. However, if you do not want the interview audio recorded, I will take detailed notes throughout the interview instead.

The interview is expected to take around 30 to 45 minutes.

Can I turn on the audio recorder now?
[If yes, begin audio recording now.]
[If no] That's okay, I'll take detailed notes as we talk.

Do you have any questions for me at this point? Information about who to contact if you have questions about the study after our time today, can be found in the informational sheet.
[If yes, answer the participant's questions, then complete the demographic questions.]
[If no, proceed with completing the demographic questions.]

Ok, let's get started!

APPENDIX F

Interview Questions

SECTION A: DEMOGRAPHIC QUESTIONS:
Before we dive into the main questions, I'd like to start with a few demographic questions.

- **Please introduce yourself briefly.**
- **Can you tell me your age or age group?**
  - If you prefer, you can just tell me the range, such as 25-34, 35-44, and so on.
- **What's your current position or job title, and what are your primary responsibilities?**
  - This helps us understand your role within the organization.
- **How long have you been working in this field?**
  - You can answer in years, or ranges like '1-3 years,' or 'more than 10 years.'

SECTION B: BACKGROUND QUESTIONS

1. Can you describe your role and your experience with blockchain technology in your organization?
2. How would you describe your organization's approach to adopting blockchain in the supply chain?

SECTION C: CORE QUESTIONS

RO 1: **The challenges associated with the implementation of integrated blockchain technology in the supply chain.**

3. What are the biggest challenges your organization has faced while implementing blockchain technology in supply chain management?
4. What challenges have you noticed in terms of employee adaptation and training for new technologies?
5. Do you think more training or a change in company culture could help address some of these challenges?
6. How do you think these challenges could be addressed to improve blockchain implementation in supply chain management?

RO 2: **The impacts of leveraging blockchain technology in supply chain management.**

7. What impact has blockchain technology made on your supply chain management efficiency?
8. Has blockchain technology provided any competitive advantage for your organization in the supply chain industry?
9. Do you think blockchain has improved trust or transparency with your supply chain partners compared to competitors?
10. What role does data security play in your organization's blockchain implementation strategy?

APPENDIX G

Sample Interview Transcript 1

SAMPLE TRANSCRIPT 1

Interviewee: Mr. Micheal Joswa, Head of IT in IoT and Blockchain Experts (4 years, Agriculture Tech)

Date & Location: December 6, 2024, Online via Microsoft TeamsTime

List of Acronyms: MJ=Micheal Joswa, IN=Interviewer

Technical Expertise Top Management Support Financial Resources Privacy Traceability Partnership Security

IN: Can I know what are the biggest challenges your organization has faced by implementing blockchain?

MJ: First of all because application is like fully pre-built. So we just need to like aggregate the data. Infrastructure is the biggest challenge of blockchain it is very very costly. So to visualize the nodes and everything on the private blockchain it is very costly. And after that, we just change all of our base code to support blockchain. Additional app is previously working fine. So we just migrating the data. So, the extra cost is a big deal.

IN: Alright. What about the challenges in terms of employee adaptations on the blockchain?

MJ: Blockchain, yeah, because right now not all the employees are blockchain experts, so we have to give them a training. We use Go language, previously company use some PHP languages and we just migrated some of the codes to Go, we need to train them. It's a new technology, right? So we want to give them classes.

IN: Alright, training and classes. So, just now you say that the challenges that you face is more on the financial term. So how these challenges could be addressed to improve the blockchain implementation?

IN: Okay, now what about the impact of leveraging blockchain technology?

MJ: Okay so the impacts like security that's all. I think the transparent between the each stakeholders will be like very high.

IN: Okay, has blockchain technology provide any competitive advantage for your organization?

MJ: Yeah, like a transparent. The transparent between the stakeholders it's give you like some point.

IN: Can you give example of how blockchain has helped differentiate your company from your competitor?

MJ: Em majorly like other companies are all not having blockchain technology. Supply chain so we have our own modules like a mail and then transporter and the stakeholders. Those kind of transparency will be higher. This will help with other competitors doesn't have that kind of solution.

IN: So do you think blockchain has improved trust and transparency with you supply chain partners?

MJ: Yes

IN: So, by having trust from your partners, is there any collaboration that you make?

MJ: Yeah, we have to make because all the stakeholders need to be included on the blockchain, then only it will be workable.

IN: What role does data security play in your organization?

MJ: Yeah, the transaction data is very highly sensitive data. So, we will use data from blockchain so it will be noncomparable. But within the private, we use a hyper ledger fabric so each nodes have have a writable permission and also all the data will be saved.

IN: Thank you for taking your time to share your insight with me today. Your perspective are very precious and will be greatly contribute to my understanding on this topic. So, before we ending, can I know what's your position in the organization?

APPENDIX H

Sample Interview Transcript 2

SAMPLE TRANSCRIPT 2

Interviewee: Mrs. Nur Syazwani binti Zolkafli, Supply Chain Specialist, (4 years, Steel Manufacturing Company)
Date & Location: December 13, 2024, Online via Microsoft Teams
List of Acronyms: MS = Mrs. Syazwani, IN = Interviewer

Technical Expertise Top Management Support Financial Resources Privacy Traceability Partnership Security

IN: Can you introduce yourself?
MS: I am Nur Syazwani (Wani), a Supply Chain Specialist with 4 years of experience in the steel manufacturing industry. My responsibilities include procurement, logistics, inventory, and stakeholder management.
IN: Can you describe your experience with blockchain in your organization?
MS: We are starting to use it to track where our products come from and make sure everything is also legit and legal. I think it's been very helpful for keeping things very transparent, especially when it comes to verifying suppliers and tracking shipments.
IN: How does your organization approach blockchain adoption?
MS: My organization did was, we would see it's a way of solving problems. We do something like preventing fraud and also to improve trust with our clients. But we are not rushing it for now because I know this is a long-term investment. So, we know it can be very expensive and it takes time to take everyone on board and understand the process or the changes that happening.
IN: What challenges have you faced in implementing blockchain?
MS: So I think one was the cost. We know that blockchain seems like a big comprehensive thing so it is not cheap. We had to ensure we invest in correct people and also when we adopt this new system, we need to get right people as well. And also make sure that it fits or it is adapting to our current process. It connects to the what I mentioned before, like one of the challenges is the people so. Once we adopt a new system like blockchain system in this case, so we do need to train people, so I think getting people comfortable with the new system, the new tech especially.
IN: How are these challenges addressed?

MS: I think if there's an improvement that I could think of is in terms of cost because there's not much we can do other than see that as an investment. That's how actually my organization pursue or actually convice the management to go with. So for employees, we do give them training and I mean enough training and knowledge so that you know they can slowly and gradually move to utilizing.

IN: What impacts has blockchain had on efficiency?

MS: So we of course less errors that I can see, especially when it comes to tracking shipments and verifying info, because it's all in there, we can actually just extract it rather than you know getting to reach out so many people just to get one info. So, I think that transparency they were talking about let us monitor better and once we get to rectify that, we can solve easily and I think in a faster manner. Security features that blockchain system has like the data inscriptions and decentralized storage. So, it has made our supply chain more secure and protected in a way.

IN: How has blockchain affected trust and transparency with partners?

MS: If we are talking about trust with our partners, I think absolutely we have that already. ht. We don't only train our people but we do inform our suppliers, our customers that we are having these. That they also have transparency to, you know, have a transparency of the shipment for instance. So it's a real-time. It allowed them to track everything and so they don't have to be very dependent to us. So for example, by using blockchain we actually can trace a products journey from the manufacturer to the customer so we can ensure the quality standards of every step.

IN: What role does data security play in your blockchain strategy?

MS: I think data security actually ensures that our transaction and our information sensitive like transition the details and inventory records that should be confidential. So they are protected, safely protected, obviously. So, it doesn't only protect the data from unauthorized access that also guarantees that every transaction is transparent but and traceable. See, but this transparency allow partners and also customer to see actually their data and how it's being used.

IN: That's all for today. Thank you for taking your time to share your insight with us today. Your perspectives very precious and will greatly contribute to my topics.

APPENDIX I

Sample Interview Transcript 3

SAMPLE TRANSCRIPT 3

Interviewee: Miss NurFarha Batrisyia binti Ahmad Fazla, Regulatory Executive (3 years, Pharmaceutical Company)

Date & Location: December 14, 2024, Online via Microsoft Teams

List of Acronyms: MB=Miss Batrisyia, IN=Interviewer

Technical Expertise Top Management Support Financial Resources Privacy Traceability Partnership Security

IN: So can you introduce yourself?

MB: Hi and very good morning. My name is NurFarha Batrisyia binti Ahmad Fazla and currently I'm working as a regulatory executive and I have three years working experience. And mostly my job is managing the regulatory submission, new registration, renewal and variation to the health authorities bodies worldwide.

IN: Can you describe your role and your experience with blockchain technology in your organization?

MB: I actually focus on making sure that we met all the necessary regulation and blockchain technology has been a game changer for that because it gives us a secure, unchangeable record of all our product data which make it so much easier to track everything and also speed up audits and investigations. And blockchain also has helped us in order to streamline the paperwork for product registration. And on top of that, it's been great for tracking counterfeit drugs, because it gives us full visibility of the supply chain in order to ensure that our products are genuine in the market.

IN: How would you describe your organization's approach to adopting blockchain?

MB: Company adopt blockchains focus on improvising our supply chain efficiency and security. And I believe this approach was systematic, beginning with identifying areas like traceability and counterfeit prevention. So the transition was actually carefully planned with a

strongemphasize on integrating blockchains into existing workflow without distributing the operation. And this forward thinking approach has actually allowed us to enhance transparency, maintain data integrity and also strengthen the trust with our both regulator and partners in order to stay ahead in the pharmaceutical industry in Malaysia.

IN: Okay, what are the biggest challenges your face while implementing our blockchain?

MB: So since blockchain technology is a newly system developed in our management, the main challenge that we had was making blockchain work with our old system. Since our older system processes were built for such advanced technology, so we had to put in a lot of effort to make everything to fit together smoothly. So one of the issues was the learning curve. Blockchain was new for many of us. So we had to run training sessions to every department in order to ensure that everyone actually understands how it works and how to use the system actually. And blockchain technology also, one of the biggest concerns to us is actually data privacy. And due to this reason, we also had to figure out how to balance transparency with data privacy but actually blockchain is a great for our visibility but we need to ensure our sensitive info stay protected and comply with the regulation.

IN: What challenges have you noticed in terms of employee adaptions and training for the new technology?

MB: Adapting employees to the new technology, we actually face a few challenges. Many employees are still not familiar with the blockchain technology so there are actually training programs that make the technology accessible to everyone. We had workshop tutorials and hands on session. One concern about how the technology will change their work. So actually many employees were worried about needing to learn a whole new set of skills and how it will impact their workflow. So we took a gradual approach, letting employees adjust at their own space and also offering ongoing support.

IN: What impact has blockchain made on your organization efficiency?

MB: So blockchain technology has improved transparency in tracking and also managing clinical trial data and product sourcing. Allowing the department to monitor and verify the movement of goods from . Blockchain providing an immutable ledger that records all transactions which makes it easier for us to demonstrate adherence to regulatory requirements without the need for manual audits. Allowing for quicker resolution of this discrepancies.

IN: Okay, has blockchain technology provide any competitive advantage for your organization?

MB: Actually blockchain technology provides a secure, transparent way to manage and also tracking the compliance system. So we can maintain an immutable record of all regulatory transactions and making it easier to demonstrate adherence to the standards and also quickly address any discrepancy and this also has not only streamline our complier processes but it actually build trust with our partners and supplier.

IN: Do you think blockchain has improved trust and transparency with your partners compared to other competitor?

MB: So in comparison to our rivals, I do think that blockchain actually has greatly increased our transparency and confidence with our supply chain partner. Actually both parties may more easily track. So by ensuring that everyone is in agreement with regulatory requirements and quality standards. Actually, this has enhanced our transparency contribution to the development of stronger more dependent relationship with partners.

IN: Okay That's all for today. Thank you for taking the time to share your insight with us today. Your perspective is very precious and will greatly contribute to my Topic.