i-RIC 2024

INTERNATIONAL RESEARCH & INNOVATION CONFERENCE

PROCEEDING

"HARMONY IN DIVERsITY: FOsTERING UNITY
SUsTAINABLE REsEARCH AND INNOVATION SOCIETY"

24 & 25 JULY

2024

Organizer

ULBI Universitas Logistik & Bisnis Internasional

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PREFACE

It is a great privilege for us to present the proceedings of the International Research and Innovation Conference (i-RIC 2024) to the authors and delegates. We hope that you will find it useful, exciting, and inspiring. The International Research and Innovation Conference (i-RIC 2024) was held online from 24 to 25 July 2024, organized by Politeknik Nilai in collaboration with Universitas Logistik dan Bisnis Internasional (ULBI) with the theme, "Harmony in Diversity: Fostering Unity Sustainable Research and Innovation Society."

i-RIC 2024 aims to gather more researchers, students, government agencies, and private sectors in an event with a larger international impact. The organization of this program also serves as a platform for sharing research findings, ideas, and knowledge among members of polytechnics, community colleges, higher education institutions, public universities, as well as government and private agencies involved. Researchers, academics, and experts from various sectors will have a global stage at i-RIC 2024 to discuss the latest findings and research that support sustainable development goals. The conference aims to generate knowledge to make our world greener and better for us and our future generations.

There were 4 keynote speeches covering different areas of the conference. The first day started with Associate Professor Dr. Ir. Agus Purnomo (ULBI Indonesia) talk on "How to Boost Green Supply Chain Resilience?" and Professor Dr. Mohamed Kchaou (University of Bisha, Saudi Arabia; University of Sfax, Tunisia) on "Latex Based Membrane for Oily Wastewater Treatment Technology Process and Perspectives". The second day featured Professor Dr. Recai Kus (Selcuk University, Turkey) on "Load Optimization of AISI 1040 and AISI 5140 Joint" and Dr. Umawathy a/p Technamurthy (Universiti Kebangsaan Malaysia) with her talk on "Harnessing the Potential of Maker Education in Enhancing Student Learning Outcomes".

A total of 124 presenters participated in the parallel presentation sessions, which ran smoothly over the two-day event supported by 109 i-RIC 2024 organizing committees. This included 16 online presentation moderators, 42 reviewers, 19 judges, and all participants who took the time to attend the online sessions. A total of 124 research papers and 56 innovations were presented in this program across 7 fields, namely:

A. Engineering and Technology
B. Business Management
C. Education, Teaching, and Learning
D. Health and Life Sciences
E. Social Sciences
F. Information Communication Technology
G. Logistics and Supply Chain

Information regarding i-RIC 2024 can be accessed through the Program Book at https://heyzine.com/flip-book/521619ef82.html and overall results can be found at http://iric.polinilai.edu.my/.../confe.../results-innovation.

We would like to express our heartfelt thanks and sincere appreciation to all the authors for their contributions to this publication. We also express our gratitude and appreciation to all of the reviewers for their constructive feedback on the papers. Warmest thanks to the members of the organizing committee for their hard work and dedication in ensuring the success of the event.

Congratulations to everyone involved in making this conference a success.

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LOGISTICS AND SUPPLY CHAIN MANAGEMENT

"HARMONY IN DIVERsITY: FOsTERING UNITY
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From Farm to Fork: Leveraging Blockchain Technology to Improve Food Supply Chain Integrity in Indonesia

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Abstract

This research aims to analyze the potential implementation of blockchain technology in improving the transparency and traceability of Indonesia's food supply chain and strengthening national food security and resilience. The problem identified is the need for more visibility in the food supply chain, leading to uncertainty regarding the origin and quality of food products. This research methodology uses a quantitative approach with data obtained through questionnaires to the public aged 20-27 years. This population was chosen because this age group is active in the use of technology. The questionnaire used a Likert scale model with 18 questions to measure attitudes, opinions, and perceptions of blockchain applications. Primary data was obtained directly from respondents, while secondary data was taken from literature studies and previous research. The results showed that blockchain can increase transparency and traceability in Indonesia's food supply chain. Blockchain can reduce the risk of fraud, make it easier to trace product origin and increase consumer confidence in food quality and safety. In addition, blockchain also provides economic benefits to producers and distributors by reducing operational costs and increasing efficiency. This study concludes that the adoption of blockchain technology in the food supply chain in Indonesia can have a significant positive impact on national food security and resilience. However, achieving these benefits requires collaboration between the government, private sector, and educational institutions to overcome technical, regulatory, and academic challenges. This research makes an essential contribution to understanding the potential of blockchain and offers recommendations for practical implementation in Indonesia.

Keywords: Blockchain, Transparency, Traceability & Food Supply Chain.

1. Introduction

The supply chain is a crucial component in various business sectors, facilitating the movement of goods and services in the context of globalization. In the Indonesian food industry, the supply chain plays a vital role in ensuring the availability of safe, high-quality, and affordable food for the community. However, the Indonesian food industry faces significant challenges in terms of transparency and traceability within its supply chain. Surayana points out that developing countries, including Indonesia, will face increasing challenges in the coming years. These challenges are related to achieving, maintaining, and improving food security and sustainability from 2015 to 2025, a timeframe that aligns with global conditions (FAO, 2011a; Food Security Agency, 2013). The graph below illustrates that Indonesia's average Food Security Index is lower than the global average of 62.2. Furthermore, the 2023 report from the Food and Agriculture Organization (FAO) states that Indonesia ranks 63 out of 113 countries in terms of food security in 2022.

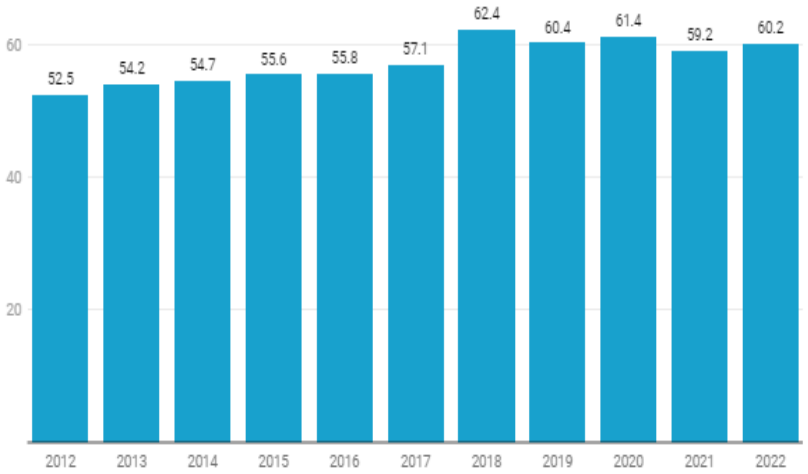

Fig 1: Indonesian Food Security Index
Souces: (GFSI, Economist Impact)

Two critical concerns often faced by stakeholders in the food supply chain are the absence of clarity and transparency in traceability. Transparency refers to the capacity to monitor and comprehend the movement of food and information from its source to the final destination, while traceability pertains to the ability to determine the origin, journey, and condition of food throughout the distribution process. The lack of traceability and transparency presents significant challenges in overseeing and managing the entire food supply chain. For instance, the inability to accurately trace the source of products can lead to the dissemination of potentially fatal diseases, harm to brand image, and financial losses.

The need for solutions to enhance transparency and traceability in the food supply chain is apparent due to concerns surrounding the safety of products and consumers. The utilization of blockchain technology to address this matter signifies a substantial shift in approach, transitioning from a centralized to a decentralized model. This is accomplished through the establishment of network consensus among servers operating blockchain software, which replicates and verifies transaction data. Consequently, if one server is compromised, the impact is mitigated by the fact that the majority of other servers maintain accurate data (Darmawan, 2017). Blockchain enables the prompt authentication and integrity verification of information by providing transparent evidence at each stage of the food supply chain, from production to distribution.

Blockchain technology, known for its decentralized nature, offers several advantages in the context of the food supply chain. These include enhanced transparency, robust data security, immutability of data, and real-time tracking capabilities. In comparison, traditional approaches like barcodes, RFID, and centralized supply chain management systems have been found to have limitations when it comes to the food supply chain. This is primarily because these systems rely on centralized operational software, which raises concerns about their susceptibility to attacks (Darmawan, 2017).

The aforementioned analysis demonstrates that this research provides a deeper understanding of the challenges faced by the Indonesian food supply chain. Additionally, it proposes innovative solutions that can be implemented to improve transparency and traceability within the industry. The aim of this research is to evaluate the utilization of blockchain technology, transparency, and traceability in ensuring food product safety and minimizing risks to society within the Indonesian food supply chain. The objective of this study is to assess the impact of

blockchain technology, transparency, and traceability on food product safety. Furthermore, this study seeks to investigate the influence of blockchain technology, transparency, and traceability on societal risk.

This research makes a substantial contribution to the integration of blockchain technology for enhancing food safety in Indonesia. This aspect has not been thoroughly investigated within the local context. The main novelty of this study lies in its comprehensive approach, which combines three pivotal elements: blockchain technology, transparency, and traceability. The analysis of these elements seeks to examine their influence not only on the safety of food products but also on the mitigation of risks faced by Indonesians. By exploring the interplay between technological innovation and food safety in the context of a developing country with intricate supply chain dynamics, this study addresses a notable gap in knowledge.

The remaining portion of this article will be structured into discrete sections. The second section will analyze the literature that substantiates the research hypotheses. The third section will explicate the methodology employed to attain the research objectives. The fourth section will present the findings that address the research hypotheses. The fifth section will discuss the interpretation and reaffirmation of the research findings within the framework of existing theory or research. Lastly, the conclusion will be further developed by incorporating implications and potential avenues for future research.

2. Literature Review

The Impact of Blockchain Technology on Mitigating Risks to Society

A comprehensive investigation conducted by Shivangin Viral. T, Snatosh B. Rane, and Vaibhav S. Narwane (2024) and published in the esteemed Journal of Modern Supply Chain Research and Applications sheds light on the immense potential of incorporating blockchain technology and the Internet of Things (IoT) into integrated architectures and eco-friendly supply chains. The study highlights the crucial role that blockchain technology plays in enhancing transparency and traceability, thereby effectively reducing risks to society. By enabling precise tracking of product origins and journeys, blockchain technology serves as a preventive measure against the dissemination of potentially life-threatening diseases and safeguards consumers from the perils of unsafe products.

H1: The Utilization of Blockchain Technology Positively Impacts Risk Reduction in Society.

Blockchain Technology in Ensuring Food Product Safety

The potential application of blockchain technology in port management in Indonesia was explored by Indraprakoso and Haripin (2023) in their study published in the Sanskara Journal of Management and Business. Their findings revealed that blockchain technology has the capability to enhance real-time tracking, consequently leading to an improvement in food product safety. Given that blockchain technology allows for the verification of information authenticity and integrity throughout the entire food supply chain form production to distribution, it plays a crucial role in ensuring food product safety.

H2: *The Implementation of Blockchain Technology Positively Impacts Food Product Safety.*

Application and Preparedness of the Food Industry in Embracing Blockchain Technology

In their stdy published in the Imagine Journal, Renaldo Fajar Nugraha Susilo and Sya'ban Fauzan Athallah (2023) investigated the utilization of artificial intelligence (AI) across different stages of the food system in Indonesia. These stages include production, distribution, quality control, and resource management. While the primary emphasis of this research is on AI, it also highlights the

readiness of the food industry to adopt advanced technologies like blockchain in order to improve the sustainability of the food system.
H3: *Blockchain technology has the potential to significantly improve food product safety and effectively mitigate risks to the general public*

The Role of Traceability in Risk Reduction for Society
Studies conducted by Bailey (2005) and Golan (2004) demonstrate that the implementation of a comprehensive traceability system can effectively reduce risk for society. This is achieved through the facilitation of efficient product recall processes during emergency situations, as well as by providing consumers with transparent information regarding the products they consume. The traceability system enables the identification of potential issues and helps prevent the distribution of unsafe products.

H4: *The implementation of traceability measures has the potential to mitigate the risks to society.*

Transparency in Enhancing Food Product Safety
In a publication titled "Consumer Trust in Food Safety Requires Information Transparency" in the Australasian Journal of Information Systems, Tri Lam et al. (2018) highlight the significance of transparency in the food supply chain in facilitating a comprehensive comprehension of production and distribution processes. This, in turn, fosters consumer trust in the safety of food products. The authors emphasize the essentiality of such transparency to guarantee that consumers receive products that are both of superior quality and safety.
H5: *The disclosure of information regarding food products has a significant positive effect on their safety*

Transparency in Enhancing Food Product Safety
In the Journal of Innovations: Technology, Governance, Globalization, Frank Yannias (2018) introduces "A new era of food transparency powered by blockchain," wherein he posits that transparency within the supply chain can contribute to mitigating risks to society by offering pertinent and easily accessible data regarding the conditions and manufacturing procedures of food products. Consequently, this empowers consumers to make judicious and well-informed choices about the products they choose to consume.
H6: *The level of transparency significantly influences the societal risk in a positive manner.*

In consideration of the earlier presented hypothesis, it becomes apparent that numerous factors contribute to the absence of lucidity and openness within the Indonesian food supply chain. The utilization of blockchain technology presents a viable resolution to these predicaments, as attested by the triumphs of prior research studies in showcasing the efficacy of this technology in surmounting these obstacles. The hypothesis can be broadly articulated as follows: the indirect impact of blockchain technology, transparency, and traceability on the safety of food products and the ensuing risk to society. Drawing from this elucidation, the ensuing conceptual framework can be derived:

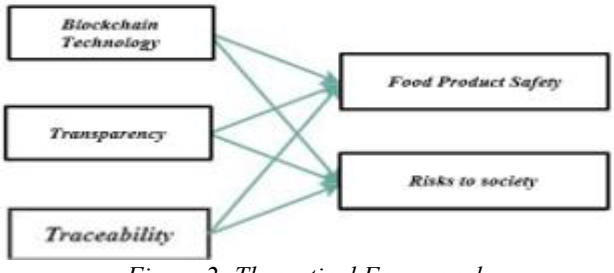

Figure 2: Theoretical Framework

3. Methodology

Research Design

The current investigation utilizes a cross-sectional methodology as its temporal framework. Specifically, data is gathered from a subset of the population in the form of a sample of respondents to assess their viewpoints on the subject being studied. The data collection process occurs only once, without any subsequent repetitions (Sekaran & Bougie, 2013).

Data Source and Sampling Techniques

The data utilized in this study consist of quantitative data, specifically numerical values that will be derived through data analysis. The data were collected from questionnaires distributed to the research population. The data sources in this study are divided into two categories: primary data and secondary data. Primary data were directly obtained from respondents through the questionnaires. The questionnaire was constructed using a Likert scale to facilitate the measurement of attitudes, opinions, and perceptions pertaining to the research topics.

The questionnaire consists of 18 questions, each with five response options. Secondary data refers to information obtained indirectly, such as from relevant literature and previous research related to the current study. As defined by Sugiyono (2015:119), the term "population" refers to a broad category encompassing objects or subjects that possess distinct qualities and characteristics, which researchers utilize for study and eventual conclusion drawing. For the purposes of this research, the chosen population consists of individuals from the general public, aged between 20 and 27 years, representing diverse social circles. This specific population was selected due to their active engagement with new technology and digital innovation within this age range, as well as to encompass a wide range of perspectives from different groups, thus enriching the analysis.analisis.

4. Result

The PLS-SEM methodology is utilized to evaluate the research model, which consists of two distinct components: the inner model and the outer model. The examination of the outer model is conducted to validate and ensure the reliability of the variables used. In order to establish convergent validity, it is necessary to achieve a factor loading value of at least 0.7 and an average variance extracted (AVE) value of at least 0.5. Moreover, discriminant validity was assessed by confirming that the correlation between latent constructs exceeds the square root of the AVE (Fornell-Larcker criterion). The reliability of the model was assessed using composite reliability (≥ 0.70) and Cronbach's alpha (≥ 0.70).

Outer Structural Model Results

The findings presented in Table 1 demonstrate that each indicator fulfills the criteria for convergent validity, as the AVE values are higher than 0.5 and the factor loadings are higher than 0.7. Moreover, the results indicate that discriminant validity has been established based on the Fornell-Larcker Criterion. Additionally, the values of Cronbach's alpha and composite reliability (rho_a and rho_c) for all variables were above 0.7, indicating a high level of internal consistency and reliability. These analysis results suggest that all tested variables possess satisfactory validity and reliability. Consequently, the outer structural model of this study is suitable for further analysis without requiring the distribution of any additional questionnaires.

Table 1: Validity and Reliability of the variabels

	Cronbach's alpha	Keandalan komposit (rho_a)	Keandalan komposit (rho_c)	Rata-rata varians diekstraksi (AVE)
Keamanan Produk Pangan	0.903	0.906	0.932	0.775
Risiko Terhadap Masyarakat	0.723	0.728	0.844	0.644
Teknologi Blockchain	0.765	0.819	0.841	0.574
Traceability	0.848	0.894	0.908	0.767
Transparansi	0.733	0.784	0.836	0.572

Table 2: Fornell-Larcker Criteria (Diskriminant Validity)

	Food Product Safety	Risk to Society	Blockchain Technology	Traceability	Transparency
Food Product Safety					
Risk to Society	1.001				
Blockchain Technology	1.022	0,933			
Traceability	0,633	0,693	1.066		
Transparency	0,959	1.020	1.113	0,861	

Inner Structural Model Results

The evaluation of the model is grounded in the utilization of the R-squared value (coefficient of determination), T-statistic value, and P-value. As depicted in Table 3, the R-Squared value of the food product safety variable is 0.892, while the R-Squared value of the risk variable to the community is 0.604. Additionally, the adjusted R-squared value of the food product safety variable is 0.882, while the adjusted R-squared value of the risk variable to the community is 0.568. A higher R-Squared value denotes that exogenous variable exert a significant influence on endogenous variables.

Table 3: R-Squares (Determinant Coeffisient)

	R-square	Adjusted R-square
Keamanan Produk Pangan	0.892	0.882
Risiko Terhadap Masyarakat	0.604	0.568

R_Sq = R Square; R_Sq_A = R Square Adjusted

To establish the significance of the relationship between variables at the 5% significance level, two criteria must be met: the t value should exceed 1.65, and the P value should be less than 0.05. The marginally lower adjusted R-squared value suggests that the model has been adjusted to accommodate the number of variables used. In summary, the analysis of this research model demonstrates that the exogenous variables have a significant impact on the endogenous variables, both directly and indirectly. The high R-Squared values indicate that the model can explain a substantial amount of variation in the endogenous variables, thus lending strong validity to the structural model in this study. Upon comparing Table 4 and Figure 3, it becomes evident that all accepted hypotheses indicate a direct or mediated positive relationship between the variables. For example, the noteworthy associations between Blockchain Technology and Food Product Safety, as well as between Transparency and Risk to Society, demonstrate a pronounced influence of exogenous variables on endogenous variables.

Table 4: The Conclusions of the Hypothesis Testing for all Research Hypotheses.

	Sampel asli (O)	Rata-rata sampel (M)	Standar deviasi (STDEV)	T statistik (|O/STDEV|)	Nilai P (P values)
Teknologi Blockchain -> Keamanan Produk Pangan	1.112	1.128	0.151	7.377	0.000
Teknologi Blockchain -> Risiko Terhadap Masyarakat	0.331	0.302	0.260	1.270	0.204
Traceability -> Keamanan Produk Pangan	-0.319	-0.310	0.146	2.191	0.028
Traceability -> Risiko Terhadap Masyarakat	-0.008	0.040	0.173	0.046	0.964
Transparansi -> Keamanan Produk Pangan	0.061	0.063	0.102	0.596	0.551
Transparansi -> Risiko Terhadap Masyarakat	0.483	0.486	0.227	2.132	0.033

Hypo = Hypothesis; β = Path Coefficients O = Original Sample; SDD = Standard Deviation; T_Sta = T Statistics; P_Va = P Value; Hy_TC = Hypothesis Testing Conclusion; Acp = Accepted

Table 4 demonstrates that the green value signifies the hypothesis that has been accepted, whereas the red value signifies the hypothesis that has been rejected. This analysis suggests that blockchain technology has an impact on the safety of food products, but it does not have an effect on the risks to society. The variables associated with traceability have a significant influence on product safety, but they do not have an impact on the risks to society. On the other hand, the transparency variable has no effect on product safety, but it does affect the risks to society.

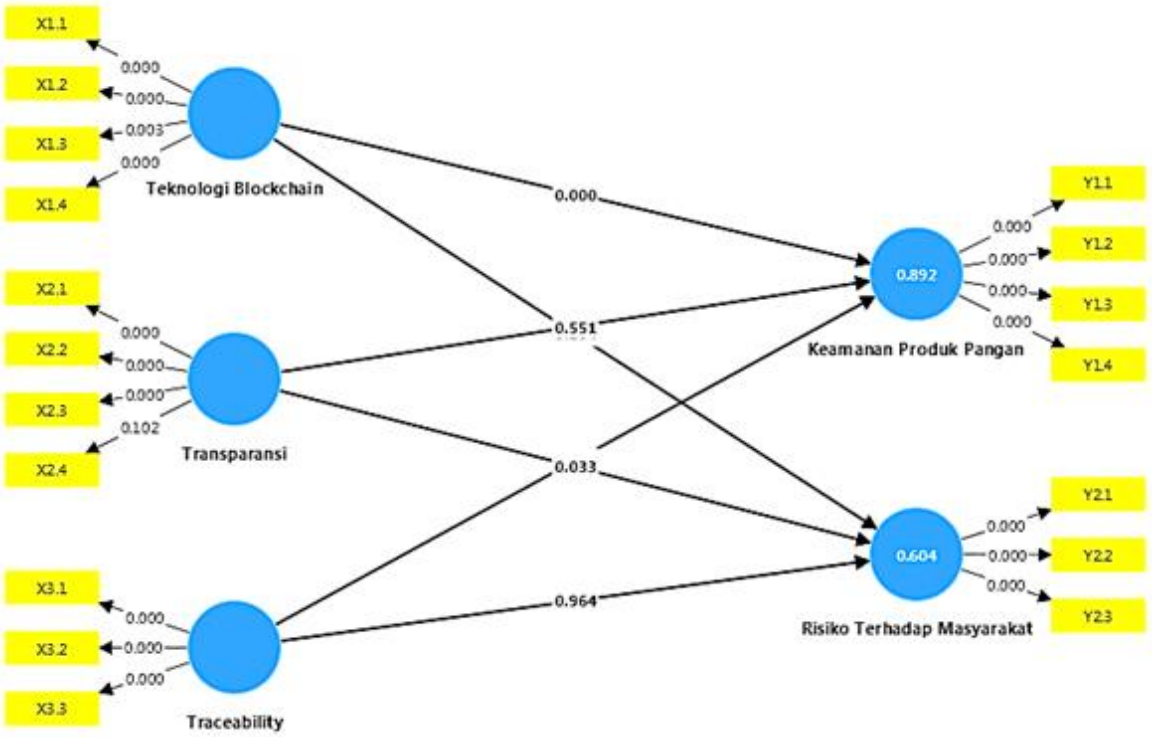

Fig 3: The Summary of the model from Bootstrapping result: Path coefficient, Factor Loading, and T-Values

5. Discussion

This study aims to explore the potential of blockchain technology in enhancing transparency and traceability in the Indonesian food supply chain. This, in turn, can contribute to improving the safety of food products and mitigating societal risks. The independent variables considered in this study consist of blockchain technology, transparency, and traceability. On the other hand, the dependent variables are food product safety and risk to society.

The findings of the previous analysis provide evidence supporting Hypothesis 1 (H1), which suggests that blockchain technology has a positive and direct impact on the safety of food products. The utilization of blockchain technology in ensuring food product safety offers numerous advantages. These benefits include streamlining each stage of the supply chain, effectively tracking the movement of products from one point to another, enhancing food safety by eliminating counterfeit items, reducing financial risk and promoting trade, and facilitating business progress in financial services.

By implementing blockchain technology in food product safety, consumers are empowered to gain a comprehensive understanding of the entire production and distribution process. Consequently, consumers can evaluate the quality of ingredients utilized in production, ensuring they meet the required standards. Moreover, consumers can also determine if inferior quality ingredients are used. The merits of employing blockchain technology in food product safety

encompass improved safety and reliability in assuring product quality. Nevertheless, in addition to the aforementioned advantages, integrating blockchain technology with existing systems poses certain drawbacks, namely high costs and complexity. Nonetheless, through ongoing development of optimal solutions, blockchain technology possesses the potential to become an integral component of the food industry in the future (Permana, 2024).

Blockchain, being a decentralized peer-to-peer platform, holds great potential for application in complex food supply chains. A blockchain technology model called Deep Improving Commute Experience (DeepICE) demonstrates the superior performance of the proposed model when compared to existing approaches. Unlike many other industries, the food production sector is characterized by a complex value chain that requires careful attention to handling and storage. The use of blockchain technology has the capacity to improve the trustworthiness, efficiency, and security of shared data among participants in the supply chain network.

Transportation and temperature are two factors that can significantly impact the quality and freshness of food products. The unique attributes of blockchain technology, such as instantaneous information exchange, robust cybersecurity, transparency, reliability, traceability, and increased visibility, contribute to the optimization of supply chain operations. Blockchain technology is a distributed database and an innovative tool in the supply chain, particularly in processes such as production, distribution, and marketing. Based on the preceding discussion, it can be concluded that integrating blockchain technology with the traceability process in the supply chain is of significant importance. This integration allows for the authorization of information relevant to consumers, thereby enhancing transparency and accountability within the sector.

The findings of Hypothesis 3 (H3) suggest that traceability has a positive and direct impact on the safety of food products. In recent years, there have been numerous instances of harmful substances being found in food items, which has raised awareness about the importance of implementing traceability systems in the food industry's production processes. Traceability systems play a crucial role in ensuring the safety and quality of food products. By implementing a traceability system, the production and distribution of unsafe and low-quality products can be minimized.

Moreover, a traceability system can aid in reducing the production and distribution of unsafe and low-quality items. In the food industry, traceability systems can be categorized into six main elements: product traceability, process traceability, genetic traceability, input traceability, disease and pest traceability, and traceability measurement, which focuses on agriculture and the food supply chain. Thus, traceability can enhance consumer confidence in the safety of food products. The implementation of a traceability system enables continuous process improvement and mitigates potential safety hazards. Considering these factors, it can be argued that traceability systems are crucial for ensuring the safety of food products (Handayani et al., 2019). The implementation of a traceability system holds significant importance for food product safety, as well as for ensuring quality and accurate labeling of food items. The implementation of such a system offers various benefits for food producers, consumers, and the government.

According to Moe (1998), CIES-The Food Business Forum (2005), and GSI (2007) as cited in Sudibyo (2012), the benefits for food producers are as follows:

1. It facilitates the food industry or company in adhering to the regulatory stipulations of the respective country.

2. The company demonstrates its ability and willingness to promptly take action to withdraw the product from the market and safeguard the established brand reputation in cases where there is non-compliance with product quality or food safety standards.
3. One approach to mitigating the expenses linked to product recalls involves prioritizing the recovery, disposition, and reconditioning of products that are still accessible in the market.
4. The objective of this study is to identify and mitigate potential issues that may arise during the production process, while ensuring that the corresponding responsibilities are appropriately assigned to the individuals capable of addressing them.
5. The aim of this study is to identify and resolve any potential issues that may arise throughout the production process, while ensuring that the appropriate accountability is assigned to individuals capable of addressing them.
6. It is crucial to establish a transparent framework that encompasses all the necessary elements, including a clear provision for identity.
7. The aim of this study is to minimize the occurrence of infectious disease outbreaks in livestock populations.
8. It is crucial to protect the entire food chain from the adverse impacts of animal and livestock diseases.
9. The objective of this study is to ensure the availability of food products to consumers and to preserve established product markets and consumer confidence.
10. It is recommended to create products that are either unique in the market or aligned with consumer preferences.

As previously discussed by Bailey (2005), FSA (2002), and Golan (2004) in Sudibyo (2012), traceability offers numerous advantages for consumers, which are as follows:

1. In the event of an emergency, the implementation of product recalls will prove to be a more effective method for ensuring food safety.
2. The system enables consumers to easily avoid particular food products and ingredients, such as those that trigger allergies or intolerances to specific foods, or those that are incongruous with their chosen lifestyle preferences.
3. The system enables consumers to make more informed decisions about food products based on objective data about the nutritional and other attributes of a range of food items produced by different companies.

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The system enables consumers to make more informed decisions about food products based on objective data about the nutritional and other attributes of a range of food items produced by different companies. A well-designed traceability system will facilitate the following:

1. The objective of this study is to minimize the financial burden associated with product recalls in the market. (Product Recall).
2. It is crucial to undertake corrective actions in order to prevent the recurrence of a product recall in the future.

3. It is vital to identify potential concerns and establish measures aimed at averting penalties arising from production errors.
4. It is of utmost significance to bolster consumer trust in the brands manufactured.

It is imperative to improve the effectiveness of the production process and quality control, specifically concerning the utilization of production raw materials, product attributes, and data on the quantity of raw material inventory.

The results of Hypothesis 6 (H6) demonstrate that transparency has a positive and direct impact on societal risk. Transparency within the supply chain allows businesses and consumers to understand the various processes involved in the production and distribution of goods. Supply chain transparency encompasses knowledge of the geographical location, manufacturing processes, labor practices, product journey, and environmental impacts. The aim of supply chain transparency is to provide consumers with comprehensive access to information regarding the production and distribution processes of goods. This is advantageous for both manufacturers and consumers as it allows consumers to assess whether the product, they are purchasing poses any potential risks to their health and safety. Supply chain transparency also promotes responsible actions among businesses and consumers, enabling them to align their decisions with their values and goals. For consumers, supply chain transparency offers relevant information for their purchasing and consumption choices.

Transparency plays a crucial role in fostering the development of sustainable supply chains. With more companies embracing environmental and social initiatives, transparency becomes a valuable instrument for attaining their objectives and reassuring their consumers. On one hand, heightened transparency in supply chains can facilitate the transition towards more sustainable commodity production systems. By shedding light on the intricacies of supply chains, transparency empowers various stakeholders to identify and address risks, improve conditions on the ground, and evaluate progress made thus far. The complex nature of global supply chains undeniably contributes to concealing questionable and unsustainable production practices (Gardner et al., 2019). To mitigate the societal risks associated with food supply chains, food chain suppliers should prioritize increasing transparency through the following measures:

1. Mapping the Supply Chain
   The attainment of transparency commences with a comprehension of the different constituents and stakeholders implicated. A thorough comprehension of each participant can foster the establishment of more resilient supply chains, characterized by heightened visibility and diminished societal hazards related to supply chains. The adoption of supply chain management systems, capable of precisely tracing and governing the complexities inherent in contemporary, globalized supply networks, serves to expedite the achievement of transparency.
2. It is advisable for the company to establish partnerships with suppliers.
   Collaborating with suppliers plays a crucial role in fostering the integration of ethical and environmental standards. Moreover, it serves as a preventive measure against information gaps that hinder sustainability and transparency endeavors. One effective approach for validating practices is the implementation of periodic audits, which can be carried out internally or by an external entity. These audits encompass various domains, such as labor standards, environmental impacts, emissions levels, quality control, and other relevant factors. Audits are an integral part of risk management as they provide a mechanism for ensuring that operations and activities align with predetermined expectations.

3. Implementing Technology Solutions
   Several companies are currently exploring methods to enhance transparency by utilizing blockchain technology, which employs digital ledgers to securely and openly record transactions. Implementing this technology can effectively mitigate the occurrence of fraudulent activities and guarantee the ethical sourcing and production of goods and services.
4. Using Data
   Supply chain data collected from diverse sources can yield valuable insights into operational efficiencies, potential risks, and areas that require improvement. Real-time data plays a crucial role in enabling companies to promptly adjust and respond to supply chain challenges. Supply chain control towers serve as a nexus for multiple data-driven information sources, enhancing overall visibility and decision-making capabilities.
5. Publicizing Information to Society
   Supply chain transparency is contingent upon both internal and external information availability. Companies employ a range of strategies to enhance consumers' and stakeholders' comprehension of various aspects of the supply chain. Notably, product labeling and packaging can be devised to emphasize details regarding product origin, ingredients, and manufacturing procedures. Moreover, company websites and other online platforms facilitate the disclosure of supply chain information, such as audit summaries and sustainability or corporate responsibility reports, thereby enabling individuals to gauge the associated risks when consuming food products provided by the company.

6. Conclusion and Implications

This study investigates the utilization of blockchain technology in enhancing the transparency and traceability of the food supply chain in Indonesia. The findings of the conducted analysis demonstrate that blockchain technology yields a favorable impact on transparency and traceability by enhancing the safety of food products and mitigating risks to the public. This outcome is substantiated by the standardized beta (B) coefficient values of 0.719 and 0.652, indicating a positive influence, as well as a significance value below 0.005, suggesting a significant effect in the implementation of blockchain technology. Furthermore, the calculated T-values, exceeding the T-table values, provide further confirmation of the statistical significance of these findings.

The research findings presented in this study have significant implications for the future. The adoption of blockchain technology can enhance transparency and traceability, leading to increased consumer confidence in the safety and quality of food products. Moreover, this technology can bolster the brand image by reinforcing trust. Additionally, the implementation of blockchain can yield cost reductions for companies involved in the food supply chain by minimizing the need for manual audits and diminishing the risk of errors or data manipulation. Furthermore, the outcomes of this research can serve as a foundation for policymakers to devise regulatory frameworks that facilitate the integration of blockchain technology in the food industry, thereby enhancing food safety standards.

Further research is required to investigate the integration of blockchain with other technologies, such as artificial intelligence (AI) and the Internet of Things (IoT), to enhance the efficiency and transparency of the food supply chain. Examining the economic and social ramifications of blockchain implementation, including conducting cost-benefit analysis for various stakeholders, also presents an essential and captivating area for future investigation.

However, it is important to acknowledge the limitations of this study. One notable limitation is the restricted sample size, which only includes individuals from the general public within the age range of 20-27 years. As such, the findings may not fully represent the perceptions of the wider population. Additionally, given the fast-paced advancements in blockchain technology, it is crucial to consider that the results of this research might need to be reviewed or reevaluated in light of evolving times and the specific technological developments within the food supply chain.

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