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Maturity model of blockchain in e-commerce, Indonesia

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Abstract

The objective of this research is to develop a methodology for assessing the technological readiness of blockchain technology in the context of e-commerce supply chains. This research study explores its application in the domains of product information tracking and facilitating the exchange of information among users. The study was divided into three sections. First, the dimensions of blockchain were ranked using the Step-wise Weight Assessment Ratio Analysis (SWARA) approach. Second, a model was created to examine the feasibility of blockchain application in various areas. Third, the suggested model was evaluated utilizing questionnaire data acquired from an e-commerce supply chain, notably its digital record capabilities. The findings indicate that smart contracts, the Internet of Things (IoT), and transaction records are the most salient features of blockchain in e-commerce supply chains. Furthermore, the analyzed supply chain demonstrates a favorable position with digital records, facilitating blockchain adoption. This study underscores the significance of blockchain readiness in e-commerce supply chains and provides a systematic approach for assessing its maturity. The suggested paradigm provides useful insights for firms wanting to assess their blockchain adoption readiness. As a result, more successful implementation strategies for digital supply chain transformation can be developed.

Keywords: Blockchain, Maturity models, e-commerce, Supply chain management, SWARA.

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1. Introduction

Supply chain management encompasses the full range of activities involved in the movement of goods and services

from suppliers to clients, including the processes of design, engineering, procurement, production, and distribution. Typically, the supply chain is managed centrally, often using an enterprise resource planning system, which handles the flow of information. These systems are susceptible to failures, hacking, and corruption. Given that this procedure impacts the movement of goods, information, and cash, laws and regulations are established to safeguard the rights of individuals and customers. The United Nations has enacted legislation pertaining to security measures, data protection, healthcare, and financial restitution [1, 2].

Blockchain is a decentralized system that facilitates the dissemination of network transactions among its participants. Prior to the initiation of any activity, a majority of members and network nodes must authorize all network transactions in the form of block timings. It is of the utmost importance that members grant their approval regarding the content of the data block and its connection to the preceding block before incorporating it into the network. At present, blockchain technology has the capability to efficiently oversee the safeguarding of personal and customer rights. A blockchain is a digital and decentralized technology that records transactions in chronological order, with the goal of establishing permanent and anti-monopoly data [3, 4]. In light of the transformative potential of blockchain in various supply chain activities and operations, it is imperative to prioritize its integration into supply chain management. The utilization of blockchain, IoT, and artificial intelligence programs will indeed impact supply chain management. Blockchain technology facilitates the real-time monitoring of commodities and individuals from their point of origin throughout the entirety of the supply chain [5-8].

Blockchain provides all participants in the supply chain with the capability to access information about the actions taken, the timing of these actions, and the individuals responsible for them. Communication between individuals and organizations using blockchain distributed networks is more dependable. Blockchain networks serve as an effective means to mitigate corruption and human fallibility. Another benefit of blockchain technology in the supply chain is its ability to ascertain the identification of individuals and detect activities carried out by users [7, 9-11].

The application of technology, including artificial intelligence, the Internet of Things (IoT), and blockchain, can facilitate enhanced corporate efficiency in the domain of electronic commerce. The implementation of blockchain technology in the e-commerce supply chain facilitates the precise and transparent monitoring of products from the point of manufacture to the point of consumer delivery. Blockchain technology provides a secure and dependable means of accessing information for all participants involved in the e-commerce goods supply chain. Additional applications of blockchain in the e-commerce product supply chain include the utilization of smart contracts and the distribution of information across the network in a decentralized manner. Notable e-commerce platforms, including Amazon, Travala.com, and Shop.com, have initiated the integration of Bitcoin into their systems, although they are currently unable to accept it as a direct form of payment [2, 11-15]. This represents a broader trend of incorporating cryptocurrencies into payment systems and digital assets, which is becoming increasingly prevalent in the global market. This encompasses the acceptance of Bitcoin as a form of payment and the utilization of specialized tokens. Wedeals is an Indonesian e-commerce startup that employs blockchain technology to provide a variety of services, including hotel bookings, airline ticketing, event management, MSME product sales, car rentals, and more. The Wedeals application provides users with a convenient and efficient platform for searching for and booking tickets and accommodations. Additionally, Wedeals offers a range of functionalities, including points, membership, and merchant store capabilities, which can assist micro, small, and medium enterprises (MSMEs) in conducting diverse promotions and offering discounts. These features are designed to support users in their travel-related needs and are integrated with blockchain technology [11, 16-18]

The application of blockchain technology is intended to improve the security and quality of e-commerce products by increasing data transparency, enabling data traceability, enhancing security and quality monitoring, and reducing financial transaction costs. A further novel aspect of this research is the identification of the significance and hierarchy of blockchain dimensions in the field of e-commerce. Consequently, the primary concerns of this study revolve around the integration of blockchain technology into the e-commerce supply chain. How can the preparedness of blockchain technology be evaluated [11, 19-21]?

2. Material and Method

2.1. Blockchain Technology in E-Commerce Supply Chain

The advancement of technology is closely intertwined with e-commerce, particularly through the use of sensor devices and the Internet of Things (IoT) to provide remote access to information about items. Traditional tracking systems using wireless sensor networks (WSN) are a suitable method for monitoring and tracking e-commerce supply chains. Feng et al. have improved the process of tracking and ensuring transparency in chains by using a hybrid Internet of Things (IoT) model that relies on blockchain technology. In this architecture, consumers and other stakeholders can track network information in a decentralized manner. This tracking begins from the moment consumers place product orders and continues through delivery. Hash encryption algorithms are used to enhance network security. Several logistics information systems in the consumer goods supply chain capture data on orders and records but do not adequately prioritize characteristics such as visibility, traceability, and detailed auditability [7, 10, 11, 19, 20, 22-24]. Implementing blockchain technology in the supply chain allows data to be extracted from the activities of nodes in a transparent network, and all recorded data is established by agreement among network participants. Implementing a blockchain system on a standardized platform can increase the transparency of real-time information for stakeholders and customers. This will improve the accuracy of data and reduce the reliance on third-party monitoring and control of the network. Previous research has not explored the readiness of the blockchain model in the e-commerce supply chain. It is crucial to study blockchain technology in supply chain management. Therefore, the purpose of this study is to examine the framework and preparedness of blockchain technology in the supply chain within the e-commerce sector, with a particular focus on Indonesia. The Oles'ko'w-Szłapka and Stachowiak model has

been used in numerous research studies. Conversely, the five-level categorization of the Oles'ko'w-Szłapka and Stachowiak model is consistent with the classification of the Wang model [10, 19, 25-27].

2.2. Dimension and Variable of Blockchain

The number of participants was determined by randomly distributing surveys via Google Forms over a period of three months. A total of 328 responses were received, and the validity and reliability of the data will be assessed through testing. The questionnaire assigns weights to each statement indication using the Likert scale approach, ranging from 1 to 4. This study examines the readiness for blockchain integration in the supply chain within the e-commerce industry. The research framework has several stages, with the first stage being the categorization of blockchain technology dimensions based on the five dimensions outlined by Ronaghi and Mosakhani [28]; Guntara and Nurfirmansyah [12]; Hellweg, et al. [25]; Astana [18] and Sinniati and Darma [29]. These dimensions are further divided into sub-dimensions and indicators.

1. The Smart Contract dimension consists of several sub-dimensions, namely knowledge development, knowledge sharing, attention to detail, contract ethics and security, customer identification, and image or reputation. Each sub-dimension comprises five questions to measure indicators [30-33].
2. The Transaction Records dimension has several sub-dimensions: Subsidy, Aggressiveness, Efficiency, Privacy, End Use, Continued Promotion, Purchasing Behavior, Reliability, and Service Capability. Each sub-dimension consists of five questions for the indicators [32, 34-39].
3. The Internet of Things dimension includes sub-dimensions such as innovation leadership, innovation and risk-taking, system availability, technology infrastructure, search engine optimization implementation, customer satisfaction, performance, and compliance. Each sub-dimension consists of five questions for the purpose of measuring indicators [40-46].
4. The Traceability Tag dimension and its sub-dimensions include mobilization, results orientation, stability, responsiveness, compensation, information management, customer first, customer value, and durability. Each sub-dimension contains five questions for the indicators [18, 20, 47-50].
5. The digital document dimension has several sub-dimensions, including establishing standards, team collaboration, fulfillment, end use, using social media for promotion, fostering customer loyalty, incorporating features, and improving aesthetics. Each sub-dimension contains five questions for the indicators [2, 51-56].

Several research projects have been conducted to investigate the use of blockchain technology in e-commerce companies. The factors included in this study are governance (G), organizational culture (OC), operations service (OS), information system (IS), strategy (S), customers (C), and products (P). The variables and dimensions are analyzed using validity and reliability tests to assess the quality of the respondent data. The SWARA method is then used to determine the level of readiness of each e-commerce platform. Finally, the cross-case method is employed to analyze the readiness levels of the three e-commerce platforms [11, 25, 26, 57].

Table 1.
Variable measurement.

Variable of strategy	
Dimension of smart contract [30, 34, 40].	
Indicators of knowledge building (KM)	
KM1:	Awareness Level → to evaluate the company's expertise in the field of blockchain technology
KM2:	Internal Knowledge Sharing → to evaluate the extent to which the organization disseminates its knowledge regarding blockchain technology
KM3:	External Knowledge Acquisition → to assess an organization's capacity to acquire knowledge about blockchain technology through external sources
KM4:	Research & Development Investment → to ascertain the extent of the company's investment in research and development pertaining to blockchain technology
KM5:	Blockchain Expertise Development → to evaluate the extent to which the company has developed its expertise in the field of blockchain technology
Indicators of Deployment Knowledge (DK)	
DK1:	Strategic Understanding → The organization's comprehension of the strategic potential of blockchain technology
DK2:	Training & Education → The accessibility and caliber of training for blockchain technology employees and stakeholders
DK3:	Knowledge Sharing → The dissemination of knowledge and experience related to blockchain technology is conducted across the entire enterprise
DK4:	Expertise Utilization → Organizations may elect to utilize external advisors or internal blockchain expertise
DK5:	Best Practice Adoption → The extent to which the company adheres to the established blockchain best practices
Dimension of Transaction Record [30, 34, 40].	
Indicators of Subsidy (S)	
S1:	Cost Efficiency → to evaluate the extent to which blockchain technology can reduce the costs associated with e-commerce operations, transactions, and other processes

S2:	Financial Support for Integration → to calculate the subsidies provided by the government, investors, and associated parties for the integration of blockchain technology in e-commerce
S3:	Incentives for Participation → to evaluate the incentives of users and stakeholders in the e-commerce blockchain ecosystem
S4:	Cost of Transition → to ascertain the financial implications of transitioning to a blockchain-based system
S5:	Scalability of Blockchain Subsidization → The extent to which subsidies or support may be subject to alteration in accordance with the growth of blockchain usage in e-commerce services
Internet of Things [30, 34, 40].	
Indicators of Innovation Direction (ID)	
ID1:	Strategic Alignment → to which the blockchain adoption approach aligns with the e-commerce company's long-term objectives and strategic vision
ID2:	The funding of research and development in the field of blockchain technology
ID3:	Innovation Culture → The organization fosters an innovative culture that encourages the creation, experimentation, and implementation of blockchain-based solutions.
ID4:	Collaboration with Ecosystem → A company-external partnership has been established with the objective of promoting blockchain-based ideas.
ID5:	Experimentation & Prototyping → The frequency and scale of testing and prototyping for blockchain e-commerce services
Dimension of Traceability Tags [2, 47, 51, 58].	
Indicators of Mobilize (M)	
M1:	Awareness & Organizational Acceptance → the use of blockchain technology in organization
M2:	Leader Commitment → senior management adopt a position of sponsorship with regard to blockchain technology
M3:	Technology & Infrastructure Capability → the extent to which the organization's IT infrastructure and IT resources are prepared for blockchain technology.
M4:	Collaborate with Ecosystem Partners → to examine the preparedness of e-commerce ecosystem partners in terms of collaboration and organizational capabilities
M5:	Regulatory & Compliance → to gain insight into the extent of knowledge and compliance with blockchain regulations
Dimension of Digital Documents [2, 47].	
Indicators of Standardization (S)	
S1:	Compliance to Standards → to ascertain whether there is a correlation between international blockchain standards compliance and the aforementioned variables
S2:	Data Interoperability → to examine the interoperability of blockchain systems with e-commerce operations' internal and external systems
S3:	Smart Contract Standardization → to develop smart contracts that fulfill the requisite standardization
S4:	Security Standardization → to make the security standardization
Variable of Organization Culture	
Dimension of Smart Contracts [31, 32, 59].	
Indicators of Attention to Detail (AD)	
AD1:	Accuracy of Data Recording → rigorous adherence to established protocols and procedures ensures the accurate and reliable recording of all transactions
AD2:	Verification & Validation Procedures → The process of verifying and validating each transaction before it is recorded on the blockchain is of paramount importance
AD3:	Error Detection & Correction → The data entry and block addition mistake detection and correction mechanisms are described in detail below.
AD4:	Compliance with Protocols → to ascertain whether blockchain protocols comply with the relevant standards
AD5:	Detail of Smart Contract Execution → to exercise caution when developing and executing smart contracts on blockchain-based e-commerce platforms
Indicators of Aggressiveness (A)	
A1:	Blockchain Technology Adoption Speed → The speed of blockchain technology adoption among e-commerce enterprises is gauged by this metric
A2:	Blockchain-based Product & Service Innovation → to ascertain the extent to which a company is capable of developing products and services based on blockchain technology
A3:	Spending on Blockchain Research & Development (R&D) → The allocation of financial resources toward the research and development of blockchain technology
A4:	Strategic Partnerships in the Blockchain Ecosystem → The role of the company in relation to blockchain developer alliances
A5:	Risk-taking New Technology → This assessment determines a company's proclivity to assume the risks associated with blockchain technology.
Dimensions of Internet of Things [41, 49, 60].	

Indicators of Innovation & Risk Taking	
IRT1:	Blockchain Adoption Rate → The rate of adoption of blockchain technology at the divisional level
IRT2:	Investment in Blockchain Innovation → The allocation of financial resources toward the research and development of blockchain technology, as well as its practical applications.
IRT3:	Risk Management Strategies → to identify strategies that can be employed to detect, assess, and reduce risks associated with the implementation of blockchain technology.
IRT4:	Flexibility in Blockchain Adaptation → The adaptability of the firm's blockchain technology
IRT5:	Experimentation with Emerging Technologies → the typical frequency with which organizations test new blockchain technology
Dimensions of Traceability Tags [41, 49, 60].	
Indicators of Outcome Orientation (OO)	
OO1:	Improving Customer Trust → client trust in a blockchain-powered e-commerce platform
OO2:	Transaction Transparency → to which e-commerce transaction information is made available for public scrutiny
OO3:	Operational Efficiency → The efficacy of blockchain-supported e-commerce business operations
OO4:	Fraud & Error Reduction → to eliminate e-commerce fraud and errors.
OO5:	Customer Satisfaction → The degree of customer satisfaction with an e-commerce platform.
Indicators of Stability (S)	
S1:	System Availability → The frequency with which individuals may employ the blockchain system
S2:	Resilience to Disruptions → to assess the resilience of the blockchain system to both internal and external threats.
S3:	Data Consistency → to assess the consistency and accuracy of blockchain data across the entire network.
S4:	Scalability Capability → blockchain systems are capable of accommodating a greater volume of transactions without experiencing a corresponding decline in processing speed
S5:	Response Time → the time required for system transaction processing and user feedback.
Dimension of Digital Documents [30, 34, 40].	
Indicators of Team Orientation (TO)	
TO1:	Team Collaboration → to facilitate interdepartmental collaboration on the design and implementation of blockchain solutions.
TO2:	Stakeholder Engagement → to which stakeholders are involved in the decision-making process regarding the implementation of blockchain technology.
TO3:	Team Education & Training → to enhance the expertise of team members in the field of blockchain technology.
TO4:	Team-Based Approach to Problem Solving → to facilitate a collaborative approach to the discovery, evaluation, and resolution of challenges associated with the implementation of blockchain technology.
TO5:	Openness & Trust in Teams → The capacity of team members to place trust in one another and to engage in the free flow of information.
Variable of Operationalization of Service	
Dimensions of Smart Contracts [35, 44].	
Indicators of Contracts (C)	
C1:	Smart Contract Implementation → the scope of smart contracts in e-commerce.
C2:	Contract Transparency → All parties are permitted to view and access blockchain contracts, thereby ensuring transparency.
C3:	Dispute Resolution Mechanisms → The availability and efficacy of smart contract dispute resolution procedures are of significant interest to scholars and practitioners alike.
C4:	Contract Automation → The automation of processes related to the formulation, execution, and monitoring of e-commerce contracts.
C5:	Interoperability of Contracts → It is possible for contracts to interact with other blockchain platforms.
Dimension of Transaction Records [35, 44].	
Indicators of Efficiency (E)	
E1:	Transaction Speed → Benchmarks the completion time of blockchain transactions against that of older systems.
E2:	Transaction Fee → to quantify the costs associated with the settlement of blockchain transactions.
E3:	Resource Usage → A critical examination of the efficiency of blockchain transaction resources.
E4:	System Reliability → to identify and quantify errors and disruptions in blockchain transactions.
E5:	Process Automation → to which blockchain smart contracts have automated e-commerce transactions and operations.
Indicators of Privacy (P)	
P1:	Data Encryption → The data has been converted to an unreadable format.
P2:	Anonymity → The use of user anonymity for transactions is a common practice in the field of e-commerce.
P3:	Access Control → The restriction of access to and manipulation of blockchain data

P4:	Data Minimization → The collection and storage of data is undertaken for a specific purpose and is limited to that which is essential for that purpose.
P5:	User Consent → A statement regarding the gathering and usage of personal data.
Dimensions of Internet of Things [35, 44].	
Indicators of Availability of the System (AS)	
AS1:	System Uptime → The percentage of users employing blockchain systems
AS2:	Transaction Response Time → The processing and confirmation time for transactions on a blockchain network.
AS3:	Resistance to Attack → to maintain the operational status of a system and the integrity of its data, even in the event of an external attack or disruption.
AS4:	Scalability → to whether a system can accommodate a greater number of transactions and users without compromising its performance.
AS5:	Flexibility in Blockchain Adaptation → The adaptability of the firm's blockchain technology.
Dimensions of Traceability Tags [35, 44].	
Indicators of Responsiveness (R)	
R1:	Transaction Response Time → The duration of a blockchain-powered e-commerce transaction.
R2:	Ability to Handle Customer Requests → The velocity with which the system responds to inquiries from clients.
R3:	Flexibility in Modifying Transactions → The capacity to expeditiously and efficaciously modify extant transactions.
R4:	Real-Time Data Accessibility → The instantaneous accessibility of information and transaction data to users.
R5:	Speed of Adaptation to Market Changes → The ability of e-commerce platforms to respond rapidly to market demands and customer behavior is a crucial factor in their success.
Dimension of Traceability Tags [12, 35, 44, 54].	
Indicators of Compensation (C)	
C1:	Payment Transparency → This will facilitate access to and comprehension of blockchain-based payment and compensation systems by all relevant parties.
C2:	Transaction Speed → The time required for blockchain-based e-commerce transactions and associated compensation processes.
C3:	Security & Resilience → The security of blockchain transactions and user data.
C4:	Accessibility → The accessibility of the blockchain-based compensation scheme is a crucial aspect that must be considered.
C5:	Fairness in Profit Sharing → The fairness of the blockchain system in distributing advantages is a topic of considerable interest.
Dimension of Digital Documents [44, 54].	
Indicators of Fulfillment (F)	
F1:	Traceability → The product is fully traceable from the manufacturer to the consumer.
F2:	Transparency → All parties involved in the supply chain have the ability to view and verify order fulfillment data.
F3:	Smart Contracts Implementation → to examine the potential of smart contracts for streamlining fulfillment and payment processes.
F4:	Delivery Accuracy → to ensure the timely and precise delivery of products to the designated location.
F5:	Inventory Management → blockchain technology enables the effective management of inventories, ensuring the availability of the requisite product at the optimal time.
Variable of Information Systems	
Dimension of Smart Contract [36, 45, 57].	
Indicators of Safety and Ethics (SE)	
SE1:	Data Privacy Compliance → to demonstrate how effectively e-commerce platforms adhere to data protection and government regulations
SE2:	Security Protocols → to monitor data encryption, multi-factor authentication, and blockchain cryptographic techniques.
SE3:	Transparency and Traceability → a comprehensive and immutable record of transactions and the provenance of items, from their initial processing to their ultimate destination.
SE4:	Consumer Protection Mechanisms → methodology for evaluating consumer rights.
SE5:	Ethical Standards Adherence → the ethical standards observed by e-commerce platforms.
Dimension of Transaction Records [36, 45, 57].	
Indicators of End User (EU)	
EU1:	Transparency → to conduct a thorough examination and verification of their transaction history without the involvement of third parties.
EU2:	Security → to which users perceive the protection of their personal and transaction data.
EU3:	Transaction Speed → From the user's perspective, the transaction speed is of primary importance.

EU4:	Cost Efficiency → to reduce the costs borne by end users for transactions related to payment and delivery.
EU5:	Data Integrity → to which users trust the veracity and integrity of transaction data.
Dimension of Internet of Things, [45].	
Indicators of Tech Infrastructure (TI)	
TI1:	Scalability → The capacity of the system to accommodate an increased volume of transactions or users without compromising its performance.
TI2:	Interoperability → Blockchain systems may engage in interactions and data sharing with other systems and blockchains.
TI3:	Security Mechanism → to ensure the integrity, confidentiality, and cyberproofing of the infrastructure.
TI4:	Energy Efficiency → The utilization of blockchain technology in the context of energy infrastructure.
TI5:	Latency and Transaction Speed → to verify and process the blockchain transactions.
Dimension of Traceability Tags [20, 53].	
Indicators of Information Management (IM)	
IM1:	Data Transparency → the extent of data and information that authorized e-commerce parties may access on the blockchain.
IM2:	Data Security → to safeguard blockchain data against unauthorized access, manipulation, and cyberattacks.
IM3:	Data Provenance → The capacity to observe the provenance and alterations of blockchain data.
IM4:	Data Accessibility → The accessibility of data by approved blockchain parties.
IM5:	Data Governance → A set of principles for the administration, utilization and distribution of blockchain data.
Dimension of Digital Documents, [20, 53].	
Indicators of End User (EU)	
EU1:	Accessibility → The system provides user-friendly blockchain-based digital document access and usage.
EU2:	Transparency → The accessibility of digital document information.
EU3:	Security → to safeguard digital document data from unauthorized access and modification.
EU4:	Interoperability → to establish connections between digital documents handled on the blockchain and end-user systems and platforms.
EU5:	User Experience → to ascertain the level of satisfaction among end-users of digital documents stored on a blockchain.
Variable of Strategy	
Dimension of Smart Contracts [23, 32, 37].	
Indicators of Know your Customer (KC)	
KC1:	Identity Verification → Blockchain-based customer identification and authentication provides a unique, immutable data set.
KC2:	Data Privacy & Security → The protection of client data in accordance with the regulations pertaining to data protection.
KC3:	Immutable Recordkeeping The immutable blockchain records the data pertaining to the Know Your Customer (KYC) process.
KC4:	Efficiency of Compliance Checks → to evaluate the efficacy of blockchain-based Know Your Customer (KYC) data verification for client data.
KC5:	Interoperability → The transfer and verification of client data across disparate platforms and services.
Dimension of Transaction Records, [32, 37, 55].	
Indicators of Continuous Promotion (CP)	
CP1:	Frequency of Update → to ascertain the frequency with which a blockchain system or platform undergoes updates.
CP2:	User Adoption Rate → The percentage of new e-commerce consumers who utilize blockchain technology.
CP3:	Training and Support Programs → to evaluate the efficacy of the training and support initiatives for both users and developers.
CP4:	Integration with Other Technologies → to which blockchain systems can be integrated with AI and IoT in the context of e-commerce.
CP5:	Feedback Mechanism → to examine the extent to which customer feedback can enhance the quality of blockchain-based services.
Dimension of Internet of Things [12, 18, 54, 59].	
Indicators of Implement SEO (ISE)	
ISE1:	Search Visibility → A metric used to assess the ranking of a website on search engines based on the frequency with which specific keywords are used in queries.
ISE2:	Page Load Speed → The time required for a user's browser to load a web page.
ISE3:	User Experience → The user experience of e-commerce websites.
ISE4:	Bounce Rate → The percentage of visitors who navigate away from a page after viewing it for a brief period of time.
ISE5:	Keyword Optimization → content, meta tags, URL structure, keyword research, and implementation.
Dimension of Traceability Tags [12, 18, 42].	

Indicators of Customer First (CF)	
CF1:	Information Transparency → The public dissemination of product, transaction, and business process data to customers.
CF2:	Customer Data Security → The utilization of blockchain technology for the protection of consumer data.
CF3:	Enhanced Customer Experience → The use of blockchain technology has the potential to expedite transactions and enhance customer service.
CF4:	Customer Participation in the Process → Customer input, including that pertaining to products and services, is integrated into the decision-making process.
CF5:	Customer Satisfaction → A metric utilized to gauge client satisfaction with a blockchain-enabled e-commerce platform.
Dimension of Digital Documents [12, 18, 42].	
Indicators of Utilize Social Media for Promotion (USMP)	
USMP1:	Presence on Multiple Platforms → a greater reach and potential for engagement with a broader audience.
USMP2:	Engagement Metrics → to ascertain the extent of user engagement with the content in question.
USMP3:	Content Quality and Relevance → The quality and relevance of content on social media platforms.
USMP4:	Use of Blockchain for Transparency → to enhance the transparency and authenticity of promotional activities.
USMP5:	Targeted Advertising → The customization of social media advertisements based on demographic characteristics, interests, and behavioral patterns.
Variable of Customer	
Dimension of Smart Contracts [38, 43, 56].	
Indicators of Customer Experience (CE)	
CE1:	Transaction Transparency → The disclosure of transactions on an e-commerce platform.
CE2:	Data Security → The protection of customer and transaction data.
CE3:	Transaction Speed → The time elapsed between the initiation of the booking process and the issuance of a payment confirmation.
CE4:	Customer Experience → to ascertain the level of satisfaction among customers of e-commerce platforms.
CE5:	Ease of Access to Information → to facilitate customers' access to essential information.
Dimension of Transaction Records [38, 43, 56].	
Indicators of Purchase Behavior (PB)	
PB1:	Trust in Transaction → The level of user trust in the security and dependability of blockchain-powered e-commerce systems.
PB2:	Transparency and Traceability → The necessity for consumer transparency throughout the purchasing process.
PB3:	Ease of Payment with Cryptocurrencies → The ease with which users may utilize cryptocurrencies on e-commerce platforms.
PB4:	Purchase Decision Based on Verified Data → The utilization of blockchain technology for the authentication of data and the verification of customer purchases.
PB5:	Consumer Satisfaction with Smart Contracts → The degree of customer satisfaction with e-commerce smart contracts.
Dimension of Internet of Things, [38, 43, 56].	
Indicators of Customer Satisfaction (CS)	
CS1:	Transaction Transparency → The capacity of blockchain to make transaction data public.
CS2:	Customer Data Security → The data pertaining to customers is encrypted and decentralized on the blockchain system.
CS3:	Transaction Processing Speed → The rapid authentication and conclusion of blockchain transactions.
CS4:	Quality of After-Sales Service → The provision of expedient after-sales service is facilitated through the utilization of blockchain smart contracts.
CS5:	Delivery Certainty → Blockchain technology facilitates enhanced delivery tracking.
Dimension of Traceability Tags [38, 43, 56].	
Indicators of Customer Value (CV)	
CV1:	Transparency → to provide customers with access to accurate, unalterable transaction data.
CV2:	Security → to whether blockchain systems are capable of safeguarding consumers' personal and financial data from the threat of cyberattacks.
CV3:	Trust → to which customers have confidence in blockchain-powered e-commerce platforms.
CV4:	Efficiency → allows customers to benefit from the acceleration of transaction processing at a reduced cost.
CV5:	Customer Empowerment → The client is afforded greater control over data and transactions.
Dimension of Digital Documents [38, 43, 56].	
Indicators of Customer Loyalty (CL)	
CL1:	Trust and Transparency → The degree of confidence placed in blockchain-powered e-commerce platforms by their users.

CL2:	Transaction Security → The combination of decentralization and encryption.
CL3:	Customer Engagement → The involvement of customers in blockchain ecosystems on e-commerce platforms.
CL4:	Personalization and User Experience → Blockchain technology can be utilized to protect and decentralize consumer data.
CL5:	Reward and Incentive Systems → the issuance of tokens or coins as a means of providing consumers with greater transparency and direct remuneration.
Variable of Product	
Dimension of Smart Contracts [33, 39, 46].	
Indicators of Image or Reputation (IR)	
IR1:	Customer Trust → The confidence of customers in the security and transparency of blockchain-powered e-commerce platforms.
IR2:	Operational Transparency → to disclose the procedures and information related to transactions.
IR3:	Perceived Security → the impact of blockchain technology on public perception of e-commerce platform security.
IR4:	Brand Integrity → The veracity of the company's blockchain implementation promises remains to be seen.
IR5:	Ecosystem Reputation → The advent of blockchain technology has prompted a shift in perspective within the business ecosystem.
Dimension of Transaction Records [33, 39, 46].	
Indicators of Reliability (R)	
R1:	Availability → to ascertain the extent of a blockchain system's operational continuity.
R2:	Fault Tolerance → It assesses the resilience of the blockchain system in the event of component failure or human error.
R3:	Consistency → to monitor the consistency of blockchain data throughout the network
R4:	Data Integrity → to assess the data integrity of blockchain technology.
R5:	Resilience → to evaluate the capacity of the blockchain system to recuperate from disruptions or assaults while maintaining essential functionality.
Indicators of Serviceability (S)	
S1:	Reliability → to assess the reliability and continuous service delivery of blockchain-based system.
S2:	Scalability → to assess the capacity of blockchain systems to accommodate an increase in transaction volume and user numbers as e-commerce services evolve.
S3:	Maintainability → A critical examination of the relative simplicity of blockchain maintenance and repair.
S4:	Security → The blockchain offers a robust cyberattack protection system for safeguarding user data and transactions.
S5:	Interoperability → to evaluate the compatibility of blockchain technology with non-blockchain systems.
Dimension of Internet of Things, [33, 39, 46].	
Indicators of Performance (P)	
P1:	Transaction Throughput → the processing of transactions over a specified time interval.
P2:	Latency → The interval between the transmission of a transaction and its processing and confirmation within the blockchain network.
P3:	Scalability → The ability of a chain to accommodate a greater number of users and transactions without compromising its performance.
P4:	Interoperability → The potential for blockchain technology to interact with and integrate with other systems.
P5:	Energy Efficiency → transaction processing, blockchain network security, and energy utilization.
Indicators of Compliance (C)	
C1:	Regulatory Adherence → to ascertain whether the blockchain system complies with the legal and regulatory requirements that have been established.
C2:	Auditability → The capacity of blockchain to record transactions that can be verified and audited by third parties ensures transparency and accountability in all user transactions.
C3:	Data Privacy Compliance → Blockchain technology is subject to the same data protection and local privacy laws that regulate consumer data storage, access, and protection.
C4:	Smart Contract Validation → to develop an efficient blockchain smart contract validation and certification process.
C5:	Governance Compliance → blockchain deployment can enhance corporate governance, risk management, and compliance-compliant internal control processes.
Dimension of Traceability Tags [33, 39, 46, 50].	
Indicators of Durability (D)	
D1:	System Resilience → The resilience of blockchain to interruptions and assaults.
D2:	Data Immutability → The resilience of data stored on a blockchain to changes in the underlying technology.
D3:	Longevity of Protocols → The durability and relevance of blockchain protocols.

D4:	Scalability Over Time → The blockchain's capacity for growth and the handling of an increasing number of transactions without a corresponding decline in speed.
D5:	Energy Efficiency → to achieve consensus on blockchain energy efficiency for the purpose of ensuring long-term sustainability.
Dimension of Digital Documents, [55].	
Indicators of Features (F)	
F1:	Interoperability → The capacity of a blockchain system to disseminate data.
F2:	Data Security → The security of data within a blockchain network.
F3:	Transparency and Auditability → The company openly tracks and verifies blockchain transactions.
F4:	Scalability → The capacity of blockchain to manage higher transaction volumes without affecting performance.
F5:	User Experience → The user experience on a blockchain-based e-commerce platform.
Indicators of Esthetic (E)	
E1:	User Interface Appearance → The visual quality and user interface design of blockchain-powered e-commerce applications.
E2:	Readability and Navigation → the content of the e-commerce platform readily comprehensible and navigable.
E3:	Interactivity → to which users engage with e-commerce applications.
E4:	User Experience → to ascertain the extent to which users are satisfied with blockchain-based e-commerce applications.
E5:	Brand Aesthetics → The visual presentation of an e-commerce brand, including its overall appearance and the appeal of its visual elements.

2.3. The SWARA Method

The SWARA approach was used to assess participants' views on five dimensions of blockchain and seven variables. The process of using the SWARA approach involves several steps [59]:

1. Aggregate the expert scores for each criterion and calculate the average score for each viewpoint. Then arrange the criteria in descending order based on their values, from highest to lowest.

$$\bar{t}_j = \frac{\sum_{k=1}^{r} t_{jk}}{r} \quad (1)$$

2. Establish Comparative Value (Sj): Organize primary factors in a research study by importance.
3. This step determines the coefficient (Kj) using the given formula:

$$k_j = s_j + 1 \quad (2)$$

4. Reevaluating *qj* Weights The following steps outline the process of determining weight values:

$$w_j = \frac{x_{j-1}}{K_j} \quad (3)$$

5. Weighting Stages: This stage represents the final step in determining the comparative importance of criteria using the following formula.

$$q_j = \frac{w_j}{\sum w_j} \quad (4).$$

As described below, the next step in the process is to determine the value of each blockchain dimension in relation to the research factors.

$$B_i = \frac{\sum_{n=1}^{7} d_n}{MPP} \; x \; 100\% \quad (5)$$

Where as: Bi = Degree to which blockchain applies to i
Dn = Dimension score
MPP = Maximum Point Possible

By assigning weights to each dimension and calculating accordingly, the maturity of blockchain technology can be determined.

$$M = \sum_{i=1}^{5} x_i \, B_i \quad (6)$$

Where as: M = Blockchain maturity level
xi = Blockchain Application i Weight
Bi = Each dimension average weight

The maturity of the above calculations is assessed using the Olez'ko-Szlapka and Stachowiak blockchain readiness model. The rationale for using this model is its frequent application in numerous studies. The model consists of five maturity levels, which are presented in Table 2 [59]:

Table 2.
Blockchain readiness standard.

No	Level	Characteristics	Degree of Maturity
1	Ignoring	I am not aware of blockchain applications that improve information flow.	0 ≤ M < 20
2	Defining	Know about blockchain applications that improve information flow but do not use them.	20 ≤ M < 40
3	Adopting	Some blockchain applications that improve information flow have been implemented.	40 ≤ M < 60
4	Managing	Many blockchain applications that improve information flow are being implemented.	60 ≤ M < 80
5	Integrated	All possible blockchain applications that improve information flow are implemented.	80 M < 100

3. Result and Discussion

3.1. Result

The questionnaires were analyzed using validity and reliability tests in a statistics model. A Spearman rank correlation value greater than 0.3 indicates questionnaire validity, while a Cronbach alpha value greater than 0.6 indicates questionnaire reliability. Table 3 presents the results of these tests.

Table 3.
Validity and reliability test result.

No	Variables	Validity Test	Reliability Test
1	Governance	0.34 – 0.89	0.910
2	Organization Culture	0.31 – 0.84	0.701
3	Operations Service	0.32 – 0.90	0.684
4	Information System	0.32 – 0.93	0.762
5	Strategy	0.34 – 0.93	0.937
6	Customers	0.34 – 0.85	0.737
7	Products	0.31 – 0.90	0.763

As illustrated in Table 3, all Spearman's rank correlation values are greater than 0.3, ranging from 0.31 to 0.93. This indicates the presence of valid data. Additionally, the acquisition of Cronbach's alpha values is greater than 0.6, ranging from 0.684 to 0.937. This suggests the reliability of the data. Next, the questionnaire data is calculated using the SWARA method. The results of the calculations with five blockchain dimensions are shown in the following calculation table.

3.2. Shopee Platform Users

The following table presents the results of data processing using the SWARA technique.

Table 4.
Blockchain dimension calculation results at E-Commerce Shopee.

No	Dimension	Sj	Kj	Wj	Qj
1	Traceability Tag		1	1	0.279
2	Smart Contract	0.201	1.201	0.833	0.232
3	Internet of Things	0.199	1.199	0.694	0.193
4	Digital Document	0.199	1.199	0.579	0.161
5	Transaction Records	0.198	1.198	0.483	0.135

Based on Table 4, the data presented in the table identifies the traceability tag, smart contract, and Internet of Things as the most important blockchain applications in e-commerce on the Shopee platform. The next step is to calculate the blockchain maturity assessment model, taking into account each dimension of the variables derived from the research. Table 5 shows the calculated results of the questionnaire, indicating the level of implementation for each dimension of blockchain in the supply chain.

Table 5.
Shopee E-Commerce Blockchain Variable Calculation Results

No	Dimension	G	OC	OS	IS	S	C	P	B
1	Smart Contract	2.58	2.90	2.54	2.88	2.90	2.95	2.60	69.04
2	Transaction Records	2.47	2.88	2.74	2.92	2.95	2.33	2.68	67.72
3	Internet of Things	2.77	2.42	2.84	2.77	2.88	2.54	2.94	68.45
4	Traceability Tag	2.34	2.76	3.10	2.34	2.92	2.88	3.16	69.62
5	Digital Document	2.48	3.16	2.78	2.56	2.88	2.56	2.67	68.18
						Weight Maturity			68.60

According to Table 5, Shopee's e-commerce platform has achieved a weighted value of 68.60. Based on the data, the maturity level of blockchain is categorized as "managing." As a result, numerous blockchain applications are being developed to improve the flow of information.

3.3. Tokopedia Platform Users

The results obtained using SWARA are shown in the following table:

Table 6.
Calculation results of blockchain dimensions in E-commerce Tokopedia.

No	Decision variable	Sj	Kj	Wj	Qj
1	Digital Document		1	1	0.278
2	Traceability Tag	0.199	1.199	0.834	0.232
3	Internet of Things	0.198	1.198	0.696	0.193
4	Transaction Records	0.198	1.198	0.581	0.161
5	Smart Contract	0.193	1.193	0.487	0.135

According to Table 6, Digital Document, Traceability Tag, and Internet of Things are identified as the most important blockchain applications in e-commerce on the Tokopedia platform. The next step is to calculate the blockchain maturity assessment model, taking into account each dimension of the variables derived from the research. The table shows the estimated results of the questionnaire, indicating the level of acceptance for each dimension of blockchain in the supply chain.

Table 7.
Calculation results of Tokopedia e-commerce blockchain variables.

No	Dimension	G	OC	OS	IS	S	C	P	B
1	Smart contract	1.75	2.01	1.98	1.99	2.01	1.99	2.17	49.65
2	Transaction Records	1.67	2.02	2.06	2.04	1.99	**1.54**	2.03	47.72
3	Internet of things	1.95	**1.53**	1.93	1.95	1.99	1.98	2.09	47.90
4	Traceability tag	1.56	1.96	2.29	**1.55**	2.04	2.02	2.33	49.11
5	Digital document	1.68	2.33	1.98	2.03	2.02	2.03	2.01	50.28
						Weight Maturity			48.86

The evaluation of the blockchain technology maturity model for Tokopedia's e-commerce platform in Table 7 resulted in a weighted value of 48.86. Based on the table, the maturity level of blockchain is categorized as "managing." Therefore, several blockchain applications that improve the flow of information are being implemented.

3.4. Lazada Platform Users

The following table shows the results of data processing using the SWARA technique.

Table 8.
Blockchain dimension calculation results at Lazada E-commerce.

No	Decision variable	Sj	Kj	Wj	Qj
1	Digital document		1	1	0.278
2	Traceability tag	0.199	1.199	0.834	0.232
3	Internet of things	0.198	1.198	0.696	0.193
4	Transaction records	0.198	1.198	0.581	0.161
5	Smart contract	0.193	1.193	0.487	0.135

Based on Table 8, digital documents, traceability tags, and the Internet of Things are the most important blockchain applications in e-commerce on the Lazada platform. The next step is to calculate the blockchain maturity assessment model, considering each dimension of the factors identified in the research. The table shows the estimated results of the questionnaire, indicating the level of acceptance for each dimension of blockchain in the supply chain.

Table 9.
Lazada E-commerce blockchain variable calculation results.

No	Dimension	G	OC	OS	IS	S	C	P	B
1	Smart contract	1.36	1.59	1.85	1.54	1.59	1.52	1.91	40.55
2	Transaction records	1.42	1.64	1.76	1.60	1.52	1.27	1.79	39.28
3	Internet of things	1.61	1.25	1.64	1.61	1.54	1.85	1.79	40.30
4	Traceability tag	1.34	1.73	2.09	1.32	1.70	1.64	2.13	42.70
5	Digital document	1.44	2.13	1.78	1.90	2.24	1.90	1.84	47.22
						Weight Maturity			41.45

The assessment of the blockchain technology maturity model for Lazada's e-commerce platform in Table 9 resulted in a weighted score of 41.45. Based on the data, the blockchain maturity level is categorized as "managing." As a result, numerous blockchain applications are being developed to improve the flow of information.

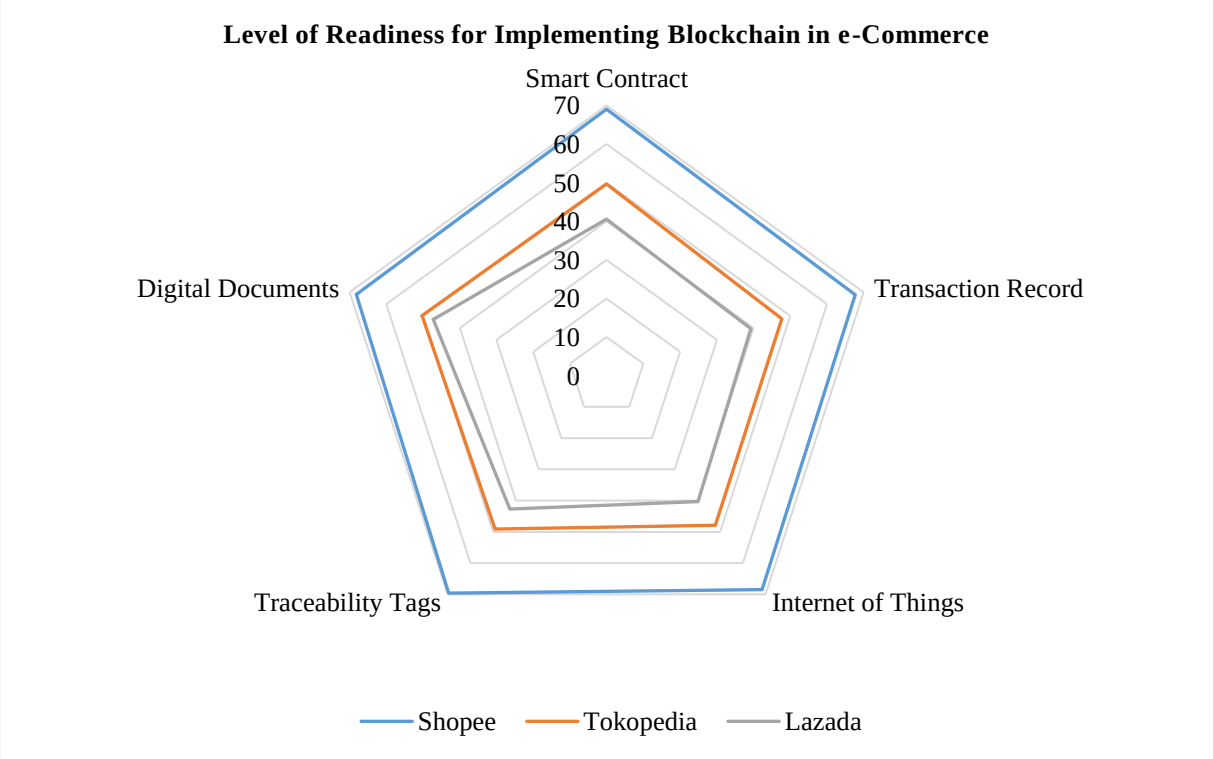

Figure 1.
Level of Readiness for Implementing Blockchain in e-Commerce

As illustrated in Figure 1, the Shopee platform is at the managing stage, while the Tokopedia and Lazada platforms are at the adopting level. The maturity values obtained in the smart contract dimension range from 40.55 to 69.04, in the transaction record dimension range from 39.28 to 67.72, and in the Internet of Things dimension range from 40.3 to 68.45, respectively. The maturity values for the acquisition of traceability tags ranged from 42.7 to 69.62, while those for the acquisition of digital documents ranged from 47.22 to 68.18.

Table 10.
Blockchain Cross Case Analysis on E-Commerce Shopee, Tokopedia, and Lazada

SHOPEE		
Maturity Level	**: 68.6 (Managing)**	
Smart Contract	: 2.54 →	Contract→ C4: 2.36 (Var. of Operation System)
Transaction Record	: 2.33 →	Purchasing Behavior → PB4: 2.19 (Var. of Customer)
Internet of Things	: 2.42 →	Innovation & Risk Taking → IR4: 2.19 (Var. of Organizational Culture)
Traceability Tags	: 2.34 →	Mobilize → M1:2.12 (Var. of Government)
Digital Document	: 2.48 →	Standardization → ES3: 2.12 (Var. of Government)
TOKOPEDIA		
Maturity Level	: 48.86 (Adopting)	
Smart Contract	: 1.75 →	Knowledge Sharing → KS4: 1.41 (Var. of Government)
Transaction Record	: 1.54 →	Purchasing Behavior → PB4: 1.41 (Var. of Customer)
Internet of Things	: 1.53 →	Innovation & Risk Taking → IR4: 1.41 (Var. of Organizational Culture)
Traceability Tags	: 1.55 →	Technology Infrastructure → TI3: 1.59 (Var. of Information Systems)
Digital Document	: 1.68 →	Standardization → ES3: 1.32 (Var. of Government)
LAZADA		
Maturity Level	: 41.45 (Adopting)	
Smart Contract	: 1.36 →	Knowledge Sharing → KS5: 1.09 (Var. of Government)
Transaction Record	: 1.27 →	Purchasing Behavior → PB5: 1.09 (Var. of Customer)
Internet of Things	: 1.25 →	Innovation & Risk Taking → IR5: 1.09 (Var. of Organizational Culture)
Traceability Tags	: 1.32 →	Information Management → IM1: 1.05 (Var. of Information Systems)
Digital Document	: 1.44 →	Standardization → ES3: 1.04 (Var. of Government)

As illustrated in Table 10, there is a necessity to enhance certain indicators within the government variables. This includes the incorporation of knowledge exchange indicators within the smart contract dimension and standardization indicators within the digital document dimension. With regard to the customer variable, the purchasing behavior indicator's transaction record dimension necessitates enhancement. Additionally, the innovation and risk-taking indicator within the Internet of Things dimension requires refinement. The information system variable, on the other hand, must undergo improvement within the traceability tags dimension.

3.5. Discussion

In order to address the challenges associated with the organizational culture variable in the Internet of Things dimension, specifically regarding innovation and risk-taking, the proposed approach entails the formulation of a new business model and the diversification of offerings. The procedure for executing the strategy of creating a new business model and diversifying services includes the following steps: first, the blockchain maturity level must be assessed; second, a new blockchain-based business model must be formulated; third, services must be diversified utilizing blockchain; fourth, the technology must be tested and validated; fifth, supporting infrastructure must be established; sixth, scalability and expansion must be ensured; seventh, marketing and educational strategies must be devised; and finally, regulatory compliance must be guaranteed.

A study indicates that a digital maturity model tailored for manufacturing is crucial for assisting e-commerce enterprises in preparing for the use of blockchain technology [41]. Each stage of blockchain maturity in the e-commerce supply chain underscores the importance of data security, a pivotal element for the sustainable integration of blockchain technology across the enterprise [44]. The advancement and implementation of blockchain at elevated maturity levels within the e-commerce service supply chain, particularly concerning interoperability, security, and operational efficiency [45].

The optimal methodology for addressing customer-related factors, transaction record dimensions, and buying behavior indicators is the adoption of NFT technology, which has the potential to significantly enhance the customer experience. The procedure for implementing NFT technology to enhance the customer experience comprises the following steps: customer needs assessment, NFT concept formulation, blockchain integration, transaction system deployment, marketing and education, data measurement and analysis, feedback and iteration, scalability and expansion, and monitoring and evaluation.

This is consistent with the findings of Sigalingging and Rapina [32], which posit that the deployment of blockchain technology may facilitate improvements across the e-commerce service supply chain. The integration of blockchain technology into the e-commerce service supply chain would provide a more secure, efficient, and transparent environment, thereby enhancing financial services and fostering overall e-commerce development [35]. The analysis and assessment of organizational maturity through the use of maturity and capability models can facilitate the creation of more efficient and transparent procedures within the e-commerce service supply chain, enhance client value, and promote sustainable company growth [36].

In order to address the challenges associated with the changeable information system, traceability tag dimensions, and information management indicators, the plan entails the implementation of data decentralization. The steps to execute a data decentralization strategy include: an analysis of the needs and objectives of the organization, the selection of an appropriate blockchain platform, the design of the system architecture, the collection of data and the development of smart contracts, the testing and validation of the system, the training and outreach of relevant personnel, the implementation and monitoring of the system, the evaluation of the system, and the implementation of continuous improvement, along with the scalability and expansion of the system.

This is consistent with the findings of the study conducted by [49], which asserts that the implementation of blockchain technology in the context of e-commerce service supply chains entails the consideration of cultural factors, potential barriers, and facilitators of technology adoption within the organizational context. The use of e-commerce tactics with blockchain technology may facilitate customer behavior via electronic word-of-mouth (eWOM), thereby augmenting market share and overall company success [18]. E-commerce enterprises may leverage blockchain technology to enhance transparency, efficiency, and service quality. This will foster consumer trust and satisfaction while also cultivating long-term loyalty, thereby positively influencing corporate performance [50].

4. Conclusion

In Indonesia, the maturity level of e-commerce blockchain implementation is currently at the adopting level. The Shopee platform is at the managing stage, while the Tokopedia and Lazada platforms are at the adopting stage. To improve the maturity level of blockchain implementation on the Shopee platform, it is important to consider government variables related to mobilization and standardization, customer variables related to purchasing behavior, organizational culture variables related to innovation and risk, and operating system variables related to contracts.

To enhance the maturity of blockchain implementation on the Tokopedia platform, it is essential to consider a range of variables, including those pertaining to government standards and knowledge sharing, customer purchasing behavior, organizational culture and innovation, and information system technology infrastructure. In order to enhance the maturity of blockchain implementation on the Lazada platform, it is essential to address the following variables: government variables pertaining to standardization and knowledge sharing, customer variables related to purchasing behavior, organizational culture variables concerning innovation and risk, and information system variables associated with information management.

4.1. Limitations

The government of Indonesia is currently engaged in the development of comprehensive legislation and standards

related to blockchain technology for the purpose of regulating electronic commerce. The presence of disparate regulatory frameworks across various e-commerce platforms has the potential to hinder the uniform implementation of blockchain technology. The reluctance of consumers to comprehend and have confidence in blockchain-based transactions may impede the adoption of this technology. To facilitate a smooth transition to blockchain-based systems, it is essential to provide incentives and educational resources.

Organizational resistance to change, particularly regarding risk-taking in blockchain deployment, has the potential to impede progress in the field. Businesses may prioritize short-term operational efficiency over the long-term advantages of blockchain integration. The existing IT infrastructure may not be adequately optimized for blockchain integration, which could result in compatibility concerns. The high implementation and maintenance costs of blockchain systems might be financially burdensome, especially for platforms at the adoption stage.

4.2. Suggestion

In order to ensure a robust and stable legal environment, it is imperative that the government promulgate more explicit and detailed blockchain legislation. The standardization of blockchain protocols across all e-commerce platforms is a crucial factor in facilitating expedited adoption and integration. E-commerce companies have the potential to develop educational initiatives aimed at informing clients about the advantages of blockchain technology, such as its security and transparency features. The adoption of blockchain-based transactions by customers can be promoted through incentive programs offering benefits such as cashback or loyalty rewards.

It is incumbent upon companies to allocate resources toward the development of training programs and workshops that aim to foster a comprehensive understanding of blockchain technology among their staff members. This initiative is particularly crucial in the context of elucidating the potential benefits that blockchain can offer. Moreover, the formulation of a risk management strategy that is tailored to the adoption of blockchain technology has the potential to assuage concerns regarding security and operational hazards. In order to facilitate seamless integration with blockchain technology, platforms must modernize their IT infrastructure. This process should be accompanied by measures to ensure interoperability with legacy systems. The implementation of smart contracts, which facilitate automated and transparent transactions, has the potential to enhance operational efficiency and security.

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