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The Role of Trust in Mediating The Effect of Blockchain and E-Payment on Logistics 4.0 and Supply Chain Capabilities in Thailand

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A B S T R A C T

Purpose: This study investigates the intricate interplay among e-payment, blockchain, and trust dynamics and their impact on logistics 4.0 and supply chain capabilities within the context of Thailand.
Design/methodology/approach: A sample population of 205 managers and executives from the logistics industry provided data, allowing for a robust analysis grounded in empirical evidence. Utilizing a causal model approach, the study employed structural equation modeling to evaluate the accuracy and fit of the theoretical framework to empirical data.
Findings: Results revealed significant relationships, highlighting the pivotal role of trust as a mediator between e-payment, blockchain, and logistics capabilities. Specifically, while e-payment positively influences supply chain capabilities and trust, its direct impact on logistic 4.0 capabilities is insignificant. Conversely, blockchain technology directly fosters trust and indirectly enhances logistics 4.0 and supply chain capabilities. Furthermore, trust emerges as a critical factor influencing the effectiveness of logistics operations and plays a central role in fostering transparency and operational efficiency.
Research limitations/implications: This underscores the importance of integrating blockchain technology to encourage trust and collaboration across the supply chain. However, challenges such as the need for supportive policies and accounting guidelines for SMEs must be addressed to fully leverage the benefits of blockchain in Thailand's logistics industry.
Originality/value: The findings emphasize the importance of secure payment infrastructures and blockchain technology in building trust and enhancing supply chain capabilities.

Keywords: Industry 4.0, Digital systems, Tracking, Smart logistics, Transparent

I. Introduction

The world is evolving exponentially in the Fourth Industrial Revolution (4IR), and the latest technologies and associated security criteria are changing exponentially. When it comes to security, however, one must consider the threats and issues that a particular technology faces. The dramatic expansion of the availability of supercomputers and their unmatched computing power will become a major challenge for the world in the near future (Gajjar & Acharya, 2020). The 4IR is defined by the convergence

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of multiple technologies, such as the Internet of Things (IoT) and Blockchain, resulting in the complete digitalization of supply chain networks (Casino et al., 2019). The 4IR appears to offer a once-in-a-lifetime chance to increase supply chain network sustainability (Dasaklis et al., 2020). Thailand 3.0 (advanced industry) is the assembly and production of goods like computer devices. In contrast, Thailand 2.0 (light industry) uses low-cost labor to transform raw materials into finished goods for manufacturing like textiles, and Thailand 1.0 (agriculture) uses farmer mechanization and increased yields. Finally, Thailand 4.0 and the 4IR, on the other hand, are the next step in Thailand's development (Jones & Pimdee, 2017).

The discipline of logistics has grown to keep up with social, industrial, and technological changes. Logistics 4.0 was recently created due to the 4IR and technology improvements in the twenty-first century. The development of Information and Communication Technologies (ICT) has made it possible to develop new data interchange protocols, integrate value chains horizontally and vertically, and create new business models (Radivojević & Milosavljević, 2019). Logistics 4.0 is a logistical system that allows for the long-term satisfaction of specific client expectations while reducing costs. Supply, production, and distribution are the three processes that comprise the three dimensions of Logistics 4.0, including logistics time, quality, and cost (Winkelhaus & Grosse, 2020). Also, logistics 4.0 capabilities can aid in collecting data from various sources, which can then be used to make better tactical decisions in reverse logistics. Inventory holding decisions, quality control of returned products, minimizing the time it takes to collect returnable goods, time to help a client and facility usage are all operational decisions in reverse logistics (Bag et al., 2020).

In the logistics industry, the issue of logistics presents a major obstacle to both domestic and international financial operations. This study aims to examine the peer transaction facility in e-logistics and address the inadequate traceability of current logistics operations. Furthermore, establishing a strong transaction foundation is necessary for integrating blockchain technology with electronic payment mechanisms. Therefore, the goal is to gain a better understanding of logistics 4.0 and the distinctive supply chain capabilities specific to Thailand.

II. Literature Reviews

A. E-payment

E-payment, involving electronic financial transactions without traditional paper instruments, offers various benefits, including cost savings, improved user convenience, and flexible payment options, enabling users to make online payments regardless of their location or time constraints. (Bordoloi et al., 2024; Cho et al., 2021). Customers who use prepaid cards for a certain sum enter their card numbers into retailer websites. Credit cards function as servers that authenticate users and check with the bank to see whether there is sufficient money. Additionally, a debit card is an electronic institution that completes the sale between the customer and seller. The debit card is the final piece of technology that brings the buyer and seller together in a successful transaction (Fatonah et al., 2018). Many different types of e-payments are available, including e-banking, mobile payments, e-cash, online banking, e-broking, and e-finance. However, academics have not yet produced a definition of an e-payment (Khan et al., 2017).

B. Supply Chain Capabilities

Industry 4.0 is a framework for implementing cyber-physical integration concepts in manufacturing, supply chains, and logistics. Supply chain capabilities positively affect the financial performance of firms. Effective information exchange, better coordination, activity integration, and responsiveness lead to improved sales growth, market share, and profitability (Wu et al., 2006). Utilizing resources and information internally and externally is a part of supply chain capabilities, which can be used to obtain a competitive edge, suggesting that supply chain capabilities are essential for realizing the benefits of information technology (IT) investments (Ivanov & Dolgui, 2021; Wu et al., 2006). Considering it as a multidimensional construct with four dimensions in this study-information sharing, coordination, inter-firm activity integration, and supply chain responsiveness-enables it to be developed in collaboration with trading partners to meet the needs of the market in particular (Ivanov & Dolgui, 2021). The ability to collaborate on cross-functional tasks involving product or service design, purchasing, production, sales or marketing, and distribution, as well as inter-organizational tasks like sharing strategic information and coordinating between a focal firm and its supply chain partners, is reflected in each of the supply chain process requirements (Yu et al., 2018).

However, the comprehension of the supply chain has notably broadened since the early years of this century (Lambert et al., 2005). Integrating e-payment systems into supply chain operations serves as a dynamic force, significantly enhancing and positively impacting various dimensions of supply chain capabilities, that dynamic capabilities help firms innovate and adapt to changing conditions (Hikmah et al., 2023). This adoption is essential for both consumers and merchants. It serves as a crucial tool to streamline payment processes and exchange important payment-related information (IGUDIA, 2018). Additionally, it provides a multitude of benefits, including cost reduction and heightened customer satisfaction (Kwabena et al., 2019), as well as improved transparency and security in trade and transactions (Masihuddin et al., 2017). Notably, during the COVID-19 pandemic, e-payment played a crucial role by enabling customers to make payments without physical interaction, thereby contributing to the reduction in the spread of COVID-19 (Ani, 2020; Yakean, 2020). This study posits a hypothesis that e-payment positively influences supply chain capabilities.

Hypothesis 1a (H1a): The integration of e-payment systems positively enhances supply chain capabilities.

C. Logistics 4.0 Capabilities

Logistics 4.0 is about using advanced technologies like the Internet of Things (IoT), big data, blockchain, Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR) and automation to make supply chains smarter, more efficient, and transparent by integrating digital solutions into logistics operations (Radivojević & Milosavljević, 2019; Strandhagen et al., 2017). Logistics 4.0 is integral to Industry 4.0, employing digital technologies for market analysis, manufacturing optimization, and end-user connectivity. Digital logistics, central to Logistics 4.0, involves the digitization of operational processes, characterized by features like collaboration, connectivity, adaptability, integration, autonomy, and cognition, presenting a comprehensive solution. (Kayikci, 2018). The evolution of logistics from the first industrial revolution to the contemporary era showcases numerous changes in the industry over time (Wang, 2016). The impact of Logistics 4.0 on an organization's success is vividly seen through its influence on both financial and market performance. It is not just about observing and assessing Logistics 4.0 through its impact on financial and market performance but also understanding its broader implications. Financially, it involves not only retaining current consumers but also fostering growth in sales figures, boosting profit margins, and ensuring substantial returns on financial investments. Similarly, in terms of market performance, Logistics 4.0 goes beyond simply achieving an improved success rate in market penetration and increased market share (Bag et al., 2020). Additionally, the capabilities of Logistics 4.0 are multifaceted, encompassing aspects like timely deliveries, quality assurance, and cost-effectiveness (Winkelhaus & Grosse, 2020). Previous research indicates that advancements in logistics innovation can mitigate the adverse effects of supply chain risks (Bigliardi et al., 2021). Logistics 4.0 represents a paradigm shift that enables businesses to efficiently address individual customer needs without incurring supplementary expenses, such as fees associated with the physical transportation of cash. Under the umbrella of Logistics 4.0, diverse Information and Communication Technologies (ICTs) are employed, each tailored to specific facets of logistical operations. This exertion significantly influences pivotal functions, including transportation, inventory management, and material handling (Glistau & Coello Machado, 2018; Wang et al., 2020). Consequently, it is evident that e-payment systems play a pivotal role in augmenting the capabilities of Logistics 4.0.

Hypothesis 1b (H1b): E-payment directly affects logistic 4.0 capabilities, enhancing the efficiency and effectiveness of modern logistics operations.

D. Trust

Trust is a multifaceted concept that transcends various academic domains, including social sciences, law, and computer science (Becker & Bodó, 2021). It encompasses relational attributes between individuals or institutions, shaping shared expectations and relationships within institutional frameworks. Trust, alongside security and privacy, serves as a cornerstone motivating individuals to embrace technology, whether through direct engagement or indirect influence. In the context of online transactions, the significance of customer trust becomes especially pronounced during the developmental stages of new systems (Albayati et al., 2020). Electronic banking systems dedicate efforts towards enhancing trust to mitigate the inherent risks associated with online purchases (Fortino et al., 2020; Matemba & Li, 2018). As highlighted in studies of security and trust in e-payment systems, e-payment methods play a pivotal role in ensuring security, reliability, scalability, anonymity, privacy, and risk management (Budiharseno et al., 2023; Kim et al., 2010; Kousaridas et al., 2008), particularly in logistic capability and supply chain capability contexts.

In the logistical area, trust is vital for internal organization operations as well as external customer and other logistics service provider contacts (Oláh et al., 2019; Oláh et al., 2017). According to studies on performance management, trust is a crucial component (Kramer, 1999). Logistics companies view trust as both essential and strategically important (Jang et al., 2022; Paliszkiewicz et al., 2014). Thus, trust makes it possible for businesses to successfully negotiate resource limitations, shifting consumer demands, increase financial performance, and worldwide competition (Amaroh et al., 2023, Jang et al., 2022; Erdogan & Çemberci, 2018). It has been found that blockchain technology can improve security and trust in this situation (Barenji, 2022). In order to cut expenses and boost efficiency, parcel logistics can also use trust-based models, similar to those found in services like Uber (Bartucz, 2021). Thus, it is crucial that logistics service providers.

The significance of perceived utility, perceived simplicity of use, and trust as important predictors of consumer's intention to choose e-payment systems over conventional means is further highlighted by research by Alshurideh et al. (2021). According to Salloum et al. (2019), the adoption of electronic payment systems in higher education has demonstrated advantages for academic institutions and students alike, cultivating dependability and confidence among participants. In conclusion, the adoption and successful deployment of e-payment systems depend heavily on the fundamental concepts of trust, security, and privacy. They impact supply chain and logistics capacities, as well as dependability and productivity across a range of industries, which in turn shapes the terrain of technology adoption and use. Our investigation looks at the connection between trust and additional elements like logistics.

Hypothesis 1c (H1c): E-payment has a direct positive influence on trust.

Hypothesis 2a (H2a): Trust has a direct positive influence on supply chain capabilities.

Hypothesis 2b (H2b): Trust has a direct positive influence on logistics 4.0 capabilities.

Hypothesis 3a (H3a): Trust mediates the influence of e-payment on supply chain capabilities.
Hypothesis 3b (H3b): Trust mediates the influence of e-payment on logistic 4.0 capabilities.

E. Blockchain

Blockchain technology has surfaced as a distributed ledger system that is decentralized and offers immutability, security, and transparency when recording transactions across several computers (Gorkhali et al., 2020). Its application spans various domains, including cryptocurrency, security, trust management, and ensuring data immutability (Shrestha et al., 2021). Despite being lauded for enabling a "trust-free" economy due to its secure and transparent design (Becker & Bodó, 2021), Blockchain still relies on social trust among stakeholders for effective operation. The benefit of a blockchain-based electronics supply chain is that it allows all participants to track, verify, and then select whether or not to approve or deny any single transaction (Guin et al., 2014; Iranmanesh et al., 2023, Xu et al., 2019). Moreover, blockchain has the lowest transaction costs and fastest processing times compared to traditional logistic services (Ni & Irannezhad, 2024). Additionally, since blockchain sums and encrypted identities are used to track all financial transactions, money laundering, corruption, terrorist financing, and other related crimes can be identified in all blockchain transactions. According to one of the viewpoints, the blockchain network property, therefore, might be a benefit of a new digital phenomenon for the logistics industry. Blockchain users can benefit from their genuine economic value since blockchains differ from centralized money (Hai & Quyet, 2023; Miraz et al., 2020). Trust plays a crucial role in high-risk environments, particularly in the workplace (Bratspies, 2018; Lee, Frank, & Ijsselsteijn, 2021; Sas & Khairuddin, 2015). It significantly influences consumer behavior indirectly, impacting corporate performance in areas such as user-friendly transactions powered by blockchain (Albayati et al., 2020; Demirkan et al., 2020; Fortino et al., 2020). Adopting and integrating blockchain technology in logistics operations can enhance customer trust and positively impact logistics 4.0 capabilities. Blockchain's decentralized and secure record-keeping system enhances transparency, trust, and traceability in supply chain networks (Gorkhali et al., 2020; Iranmanesh et al., 2023). However, there is a lack of studies on implementing supply chain transparency, adaptability, and agility in blockchain adoption among firms in Thailand.

Based on the provided information, we can formulate the following hypotheses (Figure 1):

Hypothesis 4a (H4a): Blockchain directly influences supply chain capabilities.

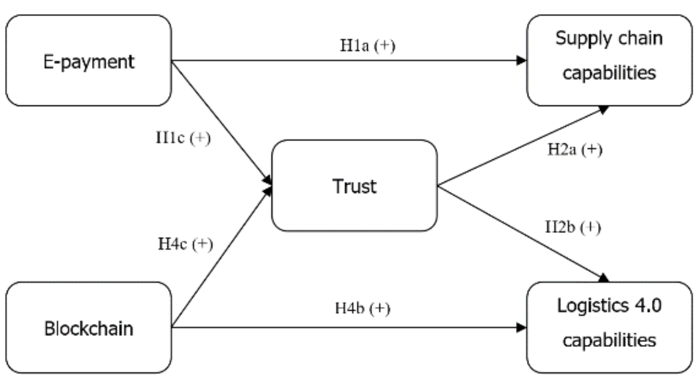

Figure 1. Proposed research model

Hypothesis 4b (H4b): Blockchain directly influences logistic 4.0 capabilities.

Hypothesis 4c (H4c): Blockchain technology is a catalyst for trust, shaping a landscape of reliability and security.

Hypothesis 5a (H5a): Trust is proposed to play a vital intermediary role in facilitating the relationship between blockchain technology and logistic 4.0 capabilities,

Hypothesis 5b (H5b): Trust is proposed to play a vital intermediary role in facilitating the relationship between blockchain and supply chain capabilities.

III. Methods

The study employed a quantitative methodology, specifically Structural Equation Modeling (SEM), in the study of blockchain adoption in Thailand, which was primarily driven by the research question's emphasis on causation. SEM, with its robust statistical foundation, allows for the examination of complex causal relationships between multiple variables (Kline, 2015), including those related to trust, e-payments, and supply chain management. This statistical-based approach facilitates rigorous hypothesis testing, enabling researchers to draw valid inferences about the relationships under investigation.

A. Population and Sample Size

The population consisted of entrepreneurs, company representatives, managers, or supervisors working in a Thai firm's logistics activities and supply chain management fields. This group is selected because they are directly involved in or have substantial knowledge and understanding of the dynamics and challenges of their firms.

The samples were obtained by simple random sampling. This ensures that every member of the population has an equal chance of being selected. This enhances the representativeness of the sample, reducing selection bias. The unbiased nature of simple random sampling ensures that sample statistics are good estimators of the population parameters, a critical aspect of SEM, which relies on precise parameter estimates (Kline, 2015). The sample group 1:n ratio of the indicators was used to establish the sample size, and the path analysis should be 200 samples or more as well as this number can violate the normality assumption (Hair et al., 2014; Hair et al., 2011; Hair et al., 2019). With these guidelines above, the valid sample size of this study is 200 respondents, calculated from 20 indicators.

B. Measures

The survey structure of the study comprised six distinct sections. Initially, demographic inquiries, consisting of four questions, were utilized to gather respondent's background characteristics. Subsequent sections included a comprehensive set of 60 questions, acting as proxies for key variables relevant to the study's focus areas, such as e-payment efficiency, blockchain technology adoption, trust levels, and logistics and supply chain management capabilities within the context of Industry 4.0. Employing a 5-point Likert scale throughout enabled respondents to express varying degrees of agreement or disagreement, enhancing the qualitative analysis of sentiments for research purposes. The primary aim of the study was to assess various aspects, including the adoption and impacts of blockchain technology, trust dynamics, and e-payment and logistics capabilities within Industry 4.0. By adopting a measurement from the research of Miraz et al. (2020) that was completed in the Malaysian context, the study seeks to improve upon existing approaches and provide new points of view on how these technologies are perceived and applied in the field. Additionally, Malaysia and Thailand share a focus on technology to enhance trust and supply chain management (Iranmanesh et al., 2023; Miraz et al., 2020).

C. Data Collection

The study used the online questionnaire since Thailand had implemented measures to stop the COVID-19 outbreaks. Between May 2022 and September 2022, the data was collected. All participants were fully informed of the purpose of the study, and written informed consent was obtained from all participants. The protocol of this study was approved by the Burapha University-Institutional Review Board (BUU-IRB: HUU015/2565(E1)).

IV. Results

Respondent's demographic information, Table 1 presents the personal characteristics of the sample population (N=205). The demographic variables include gender and age distribution, along with information on the size of the businesses represented in the sample. For gender distribution, the sample consists of 128 males (61.5%). Regarding age distribution, the majority of participants fall within the age groups of 30-39 (41.8%) and 40-49 (43.8%). Smaller proportions are represented by the age groups of 20-29 (8.2%), 50-59 (3.8%), and those over 60 (1.0%). In terms of business size, 103 participants (50%) are affiliated with small to medium enterprises, while 102 participants (50%) are associated with larger enterprises.

Table 1. Personal characteristics of the sample

Characteristic		n	%
Gender	Male	128	61.5
	Female	77	37.0
Age (years)	20-29	17	8.2
	30-39	87	41.8
	40-49	91	43.8
	50-59	8	3.8
	over 60	2	1.0
Business size	Small/medium	103	50.0
	Large	102	50.0

A. Content Validity

The researchers assessed the caliber of research instruments based on concerns with content validity. The researchers presented the updated and enhanced instrument to five specialists in the field of study. The recommended minimum for the item content validity index (I-CVI) is 0.8 or higher (Partanen et al., 2017). The expert's opinions were divided into four scales: strongly disagree (1) to strongly agree (4), with the information obtained from the review of the experts used to calculate the Content Validity Index (CVI). To meet the criteria, the researchers considered a content validity index (CVI) value of 0.80-1.00 and a Content Validity for Scale (S-CVI) value of 0.96. As a result, researchers can use the questionnaire to collect research data. The reliability coefficient was held to be greater than 0.60, indicating that the results were within the acceptable range (Ramli, 2019).

B. Reliability

To test the reliability of each construct, Cronbach's alpha (CA) coefficients and Composite reliability (CR) values were calculated. CR provides an appropriate measure of internal consistency reliability. CA and CR values between .70 and .95 represent satisfactory to good reliability levels (Hair et al., 2017; Hair et al., 2019). Cronbach's alpha values for the constructs range from .844 to .892, indicating good reliability. Composite reliabilities range from .845 to .895, higher than the .70 threshold level of acceptability. The results of Table 2 show a generally high degree of internal consistency among the constructs.

Table 2. Factor loadings, Cronbach Alpha (CA), and composite reliability (CR)

Latent variables	Item	Factor loading	CA	CR
E-Payment	EP1	.86	.866	.869
	EP2	.85		
	EP3	.73		
	EP4	.71		
Blockchain	BC1	.90	.892	.892
	BC2	.91		
	BC3	.74		
	BC4	.72		
Trust	TR1	.79	.885	.890
	TR2	.82		
	TR3	.84		
	TR4	.82		
Logistic 4.0 capabilities	LC1	.80	.889	.895
	LC2	.80		
	LC3	.77		
	LC4	.77		
	LC5	.78		
Supply chain capabilities	SC1	.80	.844	.845
	SC2	.89		
	SC3	.72		

C. Validity

In scientific research, convergent validity is essential for ensuring that various items effectively measure the same underlying variable. The average variance extracted (AVE) is pivotal in assessing convergent validity in SEM. An AVE of .5 or higher is an adequate convergence (Hair et al., 2019). Furthermore, discriminant validity is the condition wherein researchers ensure that each indicator within the theoretical framework is statistically distinct. It signifies the ability to differentiate between two variables based on empirical measures, indicating how one variable truly differs from others within the model. In this study, the square root of the AVE was assessed following the guidelines outlined by Fornell and Larcker (1981). Our results show that AVE values for the factors range from .625 to .676. This threshold is typically eliminated to achieve the desired AVE. Moreover, the square root of the AVE for each variable was compared with the correlations between variables. It is crucial that the diagonal upper values, derived from the AVE, are greater than the corresponding below values within the same column and row. The results presented in Table 3 confirm that the standardized criteria for convergent validity and discriminant validity are met in this research.

D. Structural Model Assessment

Research tools were developed using the causal model, which investigates textual models with intricate variables. The fundamental tenet of this approach is that the data-gathering tool must be a questionnaire and that it must be grounded in pertinent theories. A causal model using the Path Analysis method was developed and applied to the data. A Structural Equation Model (SEM) with a maximum likelihood (ML) method was used with a large number of variables to create a model that matched the empirical data (Schumacker & Lomax, 2016). Moreover, the ML estimator is more robust to nonnormality and can adjust the standard errors and fit indices for nested data (Hair et al., 2019). SEM was used to evaluate the model's accuracy, dependability, and fit (Hair et al., 2014; Hair et al., 2019). The measurement and structural model's fit indices indicated they were well-fitting to the data: $\chi 2/df$ < 5.0. The Tucker Lewis index (TLI), the Comparative Fit Index (CFI), and the Incremental Fit Index (IFI) were all higher than the suggested cut-off value of 0.90 (Hair Jr et al., 2014; Hair et al., 2019), while the Root Mean Square Error of Approximation (RMSEA) was lower than the suggested cut-off level of 0.07 (Steiger, 2007).

The study yielded a standardized root mean square residual (RMR) of 0.036, indicating a satisfactory fit. The CFI demonstrated a high level of fit at 0.992, while the RMSEA was 0.026, suggesting a good model fit. The CFI also supported the model's adequacy at 0.992. Moreover, the Relative $\chi 2$ was slightly elevated at 1.138, with a p-value of 0.122, implying a relatively acceptable (Hair et al., 2019). Furthermore, The R square values of the endogenous variables are assessed as follows: trust = .356, logistic

Table 3. Average variance extracted (AVE), square root of AVE, and factor correlation coefficient Notes: The bold values are the square root of AVE.

Latent variables	AVE	E-payment	Blockchain	Trust	Logistic 4.0 capabilities	Supply chain capabilities
E-payment	.625	**.790**				
Blockchain	.676	.511	**.822**			
Trust	.669	.546	.435	**.818**		
Logistic 4.0 capabilities	.631	.491	.470	.710	**.794**	
Supply chain capabilities	.646	.585	.422	.506	.477	**.803**

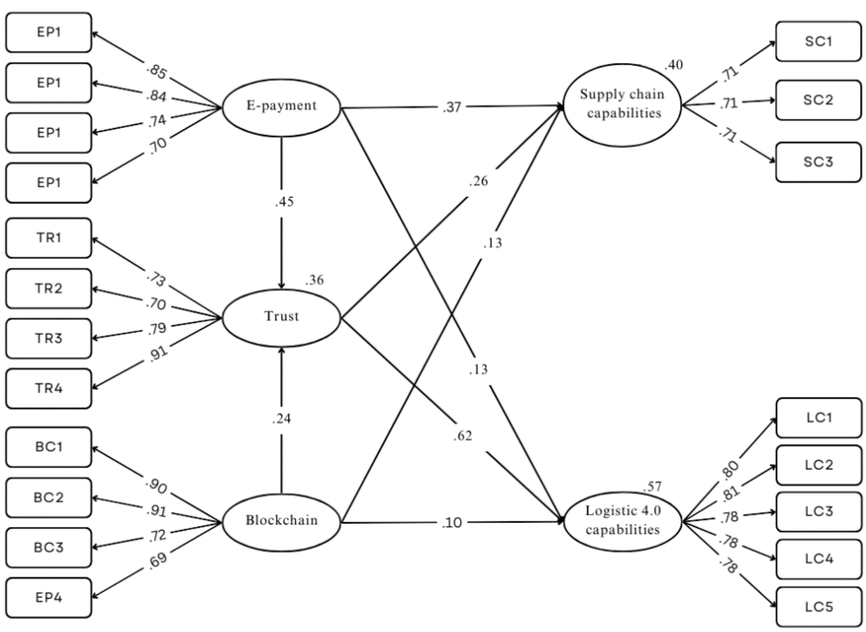

Figure 2. Structural equation results of the measurement model

4.0 capabilities of .396, and supply chain capabilities = .570. It is evident that the research model managed to explain 36% of the variance of trust, 40% of the variance in logistic 4.0 capabilities, and 57% of the variance in supply chain capabilities (Figure 2).

According to hypothesized model testing results (see Table 4 for more details), the standardized path coefficient from e-payment to supply chain capabilities and trust is significant. However, the standardized path coefficient from e-payment to logistic 4.0 capabilities is insignificant. It supports H1a and H1c but not H1b, suggesting that e-payment integration positively influences supply chain capabilities and trust but does not directly impact logistic 4.0 capabilities.

Furthermore, standardized path coefficients from blockchain to logistic 4.0 capabilities and supply chain capabilities are insignificant, unsupporting H4a and H4b. This suggests that blockchain does not have a direct positive influence on both logistic 4.0 and supply chain capabilities. However, as the standardized path coefficient from blockchain to trust is significant, H4c is supported. This indicates that blockchain technology positively influences trust.

Constantly above, the standardized path coefficient from trust to logistic 4.0 capabilities and supply chain capabilities are both significant, confirming H2a and H2b. This indicates that trust has a direct positive influence on both logistic 4.0 and Supply Chain Capabilities. Moreover, trust mediates the influence of e-payment on logistic 4.0 capabilities and Supply Chain Capabilities. Thus, H3a and H3b are supported. Similarly, trust shows the significant mediating relationship between blockchain and logistic 4.0 capabilities as well as between blockchain and supply chain capabilities that support H5a and H5b. This indicates that trust mediates the relationship between blockchain technology and both logistic 4.0 capabilities and supply chain capabilities.

V. Discussion

This study explores how business confidence influences e-payment, blockchain, and trust dynamics, and how logistics 4.0 and supply chain capabilities are integrated throughout different stages of business, aided by blockchain technology (Ertz & Boily, 2019). Thus, the ability to adapt to new technologies and creative concepts is crucial for business success. The analysis is based on empirical data obtained from managers and executives in the logistics industry. This provides a strong foundation for comparison with data from other sectors and a comprehensive understanding of the broader implications of logistics 4.0 and supply chain capabilities (Ghadge et al., 2020).

Table 4. Structural equation results of hypothesized model testing

Hypothesis	Relation	Estimate	S.E.	Result
H1a	E-payment → supply chain capabilities	.320***	.078	support
H1b	E-payment → logistic 4.0 capabilities	.120	.074	not support
H1c	E-payment → trust	.480***	.089	support
H2a	Trust → supply chain capabilities	.217**	.073	support
H2b	Trust → logistic 4.0 capabilities	.542***	.077	support
H3a	E-payment → trust → supply chain capabilities	.104*	.045	support
H3b	E-payment → trust → logistic 4.0 capabilities	.260**	.070	support
H4a	Blockchain → supply chain capabilities	.121	.073	not support
H4b	Blockchain → logistic 4.0 capabilities	.105	.068	not support
H4c	Blockchain → trust	.274**	.089	support

Notes: *** p<.001, ** p<.01, ** p<.05

Following the COVID-19 outbreak, Thailand's economy gained momentum from specific sectors, notably tourism, soft power, and its aspiration to become a global culinary hub. This economic resurgence provides the backdrop for the study's exploration of various factors influencing logistics 4.0 and supply chain capabilities. The study investigates a range of factors, including the adoption of new technologies and business models, to understand their impact on logistics 4.0 and supply chain capabilities within Thailand's changing economic landscape. It reveals that supply chain capabilities directly influence logistics 4.0 capabilities, reflecting Thailand's efforts to rejuvenate key economic sectors post-pandemic. Moreover, the study reveals the intertwined relationships among e-payment, blockchain, trust, logistics 4.0, and supply chain capabilities. While e-payment and blockchain exert both direct and indirect effects on trust, their relationship with logistics 4.0 is predominantly indirect. This thorough examination offers insights into the interconnected dynamics shaping Thailand's economic revival and advancements in logistics in the aftermath of the pandemic.

Although e-payment is widely used worldwide and offers numerous advantages such as cost savings, convenient payment options regardless of location or time, and flexibility, consumers still perceive it as lacking in enjoyment (Hai & Quyet, 2023). The definition of e-payment poses a challenge for scholars due to its diverse range of electronic delivery methods and versatile uses (Khan et al., 2017). The current study found that e-payment does not directly impact logistics 4.0 capabilities, it does have a significant positive effect on supply chain capabilities and trust. This means that even though e-payment might not directly change how logistics 4.0 operates, it still plays a crucial role in improving overall supply chain efficiency and building trust among stakeholders. These findings align with Jiang and Zhang (2008) research, which emphasizes how trust within organizations positively influences performance, especially in e-commerce logistics. It highlights the importance of having secure and reliable payment systems to foster trust within the logistics industry.

Moreover, prior research indicates that e-payment significantly contributes to trust-building within the logistics industry by strengthening service quality and reinforcing core business values. This idea is supported by the pivotal roles of perceived risk and trust in e-payment adoption, which help mitigate risks and promote trust within logistics operations (Nguyen & Huynh, 2018). Additionally, previous studies have highlighted the beneficial effects of electronic supply chain management and sophisticated payment mechanisms on supply chain efficiency (Chen et al., 2006; Mahmood et al., 2002) as well as IT-enabled supply chain capabilities are seen as unique, valuable, and difficult to imitate, which can provide a sustained competitive advantage for firms. These capabilities transform IT-related resources into higher value (Wu et al., 2006). However, despite the potential advantages of e-payment, many businesses still rely on traditional paper checks due to concerns about technology costs, security, and the need to adapt existing practices (Chakravorti & Davis, 2004). In an era marked by increasing cyber threats and data breaches, trust emerges as a critical factor influencing the adoption and effectiveness of digital payment in logistics operations. Organizations that prioritize the development of secure payment infrastructures are likely to gain a competitive advantage by fostering trust and confidence among customers, partners, and other stakeholders.

Our research findings indicate that blockchain plays a dual role in shaping logistics. Firstly, blockchain directly cultivates trust through its decentralized architecture and advanced encryption techniques, ensuring transaction records' integrity and security (McGill et al., 2018). For an authentication scheme built upon the KERBEROS standard, which demonstrates efficacy in terms of response time and encryption efficiency (Ashraf et al., 2023), a blockchain-based logistics management framework leveraging the asymmetric encryption method is proposed to enhance security and privacy (Ugochukwu et al., 2022). Additionally, a lightweight key protocol tailored for smart logistics is introduced, employing a combination of hash functions and XOR operations to authenticate sensor nodes and fortify the security of wireless communication (Zhu et al., 2020). Secondly, blockchain indirectly enhances logistics 4.0 capabilities by facilitating seamless collaboration across functional and organizational boundaries. This enables smoother operations across various stages of the supply chain (Yu et al., 2018). Additionally, tracking entrepreneurs throughout the supply chain can guarantee the integrity of electrical devices. To enable such tracking, each electronic component needs to have a specific identification (Guin et al., 2014; Xu et al., 2019). In addition to these advancements, the decentralized and transparent nature of blockchain challenges the necessity for trust between parties, potentially diminishing the reliance on intermediaries (Ristaniemi & Majcher, 2018).

Trust is a critical factor in the effectiveness of logistics and supply chain management, and it is the central focus of this research. It is evident that trust has a significant indirect impact on consumer behavior, which in turn affects the profitability of organizations (Albayati et al., 2020; Amaroh et al., 2023; Demirkan et al., 2020; Fortino et al., 2020). To enhance their logistical effectiveness and gain the trust of investors, logistics entrepreneurs should consistently promote and develop blockchain technology due to its decentralized nature (Winkelhaus & Grosse, 2020). Implementing blockchain technology plays a crucial role in enhancing supply chain capabilities and facilitating Logistic 4.0, which builds trust among industry players and promotes transparency (Akram & Bross, 2018; Jiang & Zhang, 2022). This suggests that blockchain has significant potential to improve trust and transparency in logistics and supply chain operations. Moreover, this emphasizes the intricate relationship between trust, transparency, and operational efficiency in logistics and supply chain management. Organizations can enhance transparency, security, and efficiency throughout the entire supply chain by fostering trust-based relationships and leveraging technologies like blockchain. This comprehensive approach ultimately leads to improved operational performance, increased customer satisfaction, and a competitive edge in the marketplace.

VI. Conclusion and Implications

The research shows how important it is to understand how e-payment systems, blockchain technology, and trust are connected in Thailand's logistics sector. When companies understand and use these connections, they can handle the challenges of the digital world better. This helps them come up with new ideas and stay competitive in today's global market, which is becoming more digital and connected. Also, the study points out how collaboration, trust, and new technology are crucial in making logistics activities better and supporting business plans. Thai business practitioners must change how they work to use blockchain and e-payment systems well. Doing this helps build trust with partners or customers, making logistics and supply chain operations better.

Looking ahead, more exploration in this area has the potential to make Thailand's logistics landscape more efficient and technologically advanced. Specifically, integrating blockchain could create many opportunities for cross-border e-commerce, especially in payment and supply chain management. Using blockchain's decentralized and transparent nature can make transactions smoother and increase security, which is important for cross-border trade. However, there are still challenges to overcome in the journey towards digital transformation. One challenge is the need for specific accounting guidelines for small and medium-sized enterprises. Also, it is important to create supportive policies and regulations to encourage more businesses to adopt blockchain and integrate it into existing logistics systems. Overcoming these challenges will be crucial for fully realizing the benefits of blockchain technology in reshaping Thailand's logistics industry.

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