Supply Chain Performance and Blockchain Technology of the Manufacturing Sector in Thailand

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Abstract

This research intends to model the mediating impacts of favourable conditions and innovativeness in blockchain technology on manufacturing supply chain performance. Partial least squares structural equation modelling was utilised to test the goodness of the model fit and assumptions by applying Smart partial least squares structural equation modelling data was acquired from 383 managers in Thailand's automotive industry utilising a stratified random sampling technique. Blockchain technology, a favourable environment, and innovativeness substantially boosted the manufacturing supply chain performance. Therefore, the mediation between favourable conditions and innovativeness in blockchain technology adoption was considerable in the manufacturing supply chain performance. The introduction of digital technology to improve the manufacturing supply chain performance can assist organisations in decreasing the cost of complicated procurement, production, and distribution processes through secured and efficient operations. To properly leverage the benefits of modern technologies, organizations also need to create an environment that encourages experimentation, teamwork, and the investment of resources in technological developments. To ascertain the manufacturing supply chain performance in accordance with the resource-based view theory, this study created a research model that integrated blockchain technology, conducive conditions, and innovativeness. The study's findings may aid businesses in creating a framework that incorporates innovation to enhance supply chain performance.

Keywords: Blockchain technology, facilitating conditions, innovativeness, manufacturing supply chain performance

1. Introduction

Because of the fourth industrial revolution, technology is becoming more and more significant in manufacturing enterprises (Oke & Fernandes, 2020). This is due to new disruptive technologies like blockchain technology (BT). Technological disruptions are crucial for enhancing supply chain performance (SCP) and competitive advantage in various industries. Businesses use the internet in their daily operations to run their businesses efficiently. Early blockchain ideas were first introduced in 2008, and without the use of intermediaries, they publicly documented certifiable transactions (Kim et al., 2020). A few years later, BT—a whole new technology—entered the market, improving the system and helping the business. System theory emphasizes task interdependencies to generate synergies (Negoita et al., 2018).

According to Zelbst et al. (2010), BT is regarded as a firm resource that enhances SCP. This study attempts to fill the vacuum left by previous research's lack of focus on BT utilization in assessing SCP, despite the fact that both of the technologies described potentially enhance corporate performance.

The usage of IT by organisations is rapidly increasing, especially in the midst of the COVID-19 pandemic (Vargo et al., 2021). The internet's capacity to deliver accurate and timely information across global networks has been extremely advantageous to businesses. Utilising technological breakthroughs would maximise the value of organisational outcomes, according to the concept proposed by Rehman et al. (2021). Previous researchers used supporting conditions to determine why people adopt technology. COVID-19 has produced significant supply chain disruptions and has had a negative influence on human health and business environments (Frederico, 2021). Due of commercial uncertainties, companies use digitalization technologies. Strong reverse supply chains may arise from BT integration, claim Hrouga et al. (2022). According to Egwuonwu et al. (2022), the global value chain will be improved when supply chain partners successfully integrate BT. It is unknown how the corporation may promote business innovation by enabling supply chain digitalization, despite the fact that a wide range of BT has been investigated (Rehman et al., 2021). The research problem is identified by including BT and manufacturing supply chain performance (MSCP) factors in the study model. However, as far as we are aware, no SCP research has been able to conceive the innovation and enabling conditions that lead to competitive advantage.

Research has disregarded MSCP since it is supportive and innovative (Mahakittikun et al., 2020). According to Tieman et al. (2019) and Fernando et al. (2021b), BT enhances halal supply chain management, providing businesses with a competitive edge and improving their performance (Sheel and Nath, 2019). To ascertain SCP, earlier researchers used BT (Rehman et al., 2021). BT is used in this experiment to calculate MSCP. This study also takes into account allowed situations and creativity to investigate MSCP. According to researchers, prior conditions are crucial (Zuiderwijk et al., 2015). By fusing innovativeness with advantageous circumstances, this study investigates MSCP. Previously, while determining SCP, BT, advantageous conditions, and innovativeness were not all considered simultaneously (Rehman et al., 2021). The research questions for this study are as follows:

RQ1. Does SCP depend on BT, facility conditions, and innovativeness?

RQ2. Does BT have an impact on innovativeness and conducive conditions?

In order to anticipate the MSCP, this study aims to take into account BT use, conducive conditions, and innovativeness. The structure of this study is divided into four parts. The introduction is covered in Section 1. The key ideas and theories are covered in detail in Section 2. Methodology, including measurements, sampling, and model estimate, is covered in Section 3. The discussion and conclusion, limitations, and prospects for further research are covered in detail in Section 4.

1.1 Research Objective

This research aims to model the mediating impacts of favourable conditions and innovativeness in blockchain technology on manufacturing supply chain performance.

2. Main Concept

2.1 Blockchain technology and supply chain performance

A new technology known as a blockchain was created as a result of advancements in distributed computation and cryptography. In a database known as BT, the blocks that store network data are organized chronologically (Pedersen et al., 2019). Through subsequent transactions, each user can contribute to the blockchain's publicly accessible data. Businesses must use centralized solutions for supply chain management (Akhavan & Namvar, 2021). According to Saberi et al. (2019), supply chain management researchers have found that BT helped uncover suppliers' inconsistent services and damaged products. Blockchain-based supply chains are more intelligent, connected, and scalable than conventional supply chain management, per recent studies. Additionally, they function more smoothly (Heiskanen, 2017). With its advanced distributed cryptography and computing techniques, BT ensures that data transmitted in the supply chain ledger can be viewed within the available supply chain networks (Zelbst et al., 2019). Walmart has benefited from BT adoption in collaboration with IBM (Yadav & Singh, 2020) and Maersk (Lal & Johnson, 2018). Businesses can use BT to monitor carbon trading and performance in an industrial context, according to Fernando et al. (2021a). BT improves halal supply chain management, giving companies a competitive edge and boosting their performance, claim Tieman et al. (2019) and Fernando et al. (2021b) (Sheel & Nath, 2019). Less attention was paid by the researchers to utilizing BT to ascertain SCP (Wamba et al., 2020). Blockchain can offer a safe forum for knowledge exchange to enhance SCP. Thus, this study investigates the connection between MSCP and BT adoption. According to this study, BT could enhance supply chain network coordination, visibility, and product traceability. The following notion was put out in this study:

H1. There is a strong correlation between BT and MSCP.

2.2 Blockchain technology, facilitating conditions and innovativeness

Enhancing corporate skills through the use of BT is a crucial instrument that could lead to better performance. "The degree to which it is believed that an organizational and technical infrastructure exists to support the use of the system" is the definition of facilitating conditions (Venkatesh et al., 2003). Facilitating conditions show how happy workers are with the organizational and technical infrastructure that makes using the system easier (Alazab et al., 2021). Alazab et al. (2021) claim that customers are more likely to find blockchain easier to use and, thus, be more active with the technology if they think there is sufficient organizational, technological, network, and human support available. They have also maintained that favorable circumstances affect how technology is used and how blockchain is adopted. Businesses must set up their workforces and supply the required infrastructure and funding in order to integrate Industry 4.0 into the industrial supply chain. If someone has technical know-how, training, and top management support, they can implement technology know-how throughout the supply chain (Kabra et al., 2017). To connect with members of the organization, for instance, BT maintains transactional data in blocks (Sheel & Nath, 2019). Facilitating conditions in this study include management interest in implementing digital technology, as well as the availability of resources, knowledge, and experience. Nevertheless, there wasn't much research on BT-assisted enabling situations.

Being innovative is a must for businesses since it is thought to be important for improved performance (Rehman et al., 2020b). The arrangement of key firm resources has been identified

by scholars as a significant technique that might foster innovation (Wallin et al., 2015). We contend that the implementation of blockchain-transparency characteristics in business processes can enhance operational efficiency. The following theories were put forth in this study:

H2. Facilitating environments have a positive correlation with BT.

H3. BT and innovativeness have a positive correlation.

2.3 Facilitating conditions, innovativeness and supply chain performance

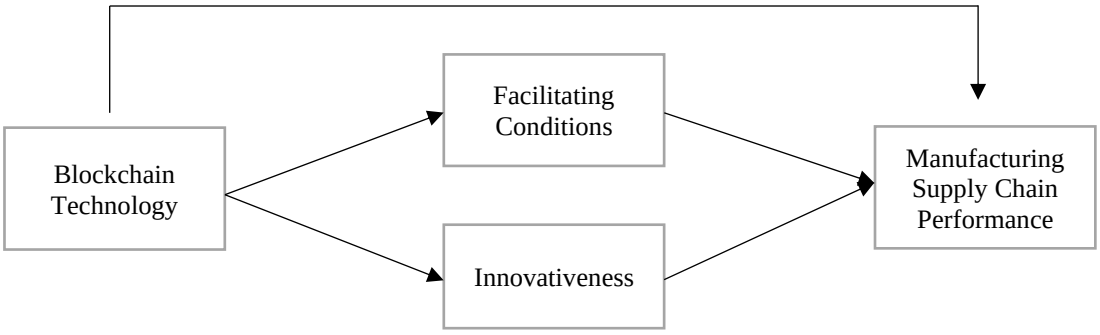
The RBV hypothesis states that organizational capacities significantly improve performance (Rehman et al., 2019a) Facilitating factors include the company's capacity to own the assets, expertise, and experience needed to run new technologies. Companies usually use the appropriate resources to improve their ability to stand out from the competition and maintain their competitiveness. Enhancing organizational performance requires configuring innovative capacities (Su et al., 2018). Innovativeness is a managerial skill that involves implementing new ideas, products, and services that have the potential to improve a business's performance and progress its growth (Rehman et al., 2020b). Nevertheless, there is a mixed link between innovation aptitude and corporate success (Kafetzopoulos & Psomas, 2015). This study makes the case that innovativeness predicts MSCP. This study examines MSCP by incorporating innovativeness and supportive factors. Previous researchers failed to consider innovativeness (Mahakittikun et al., 2020) and facilitating situations (Zuiderwijk et al., 2015) when determining MSCP. To reach SCP, the companies can adapt to the new technology. Better SCP may result from implementing the new technology that best suits the innovation goals. The following theories were put forth in this study:

H4. MSCP has a favorable correlation with facilitating conditions.

H5. MSCP has a favorable correlation with innovativeness.

2.4 Research Model

Figure 1. Research Model



3. Method

3.1 Measures

The four variables that make up the research model are (1) BT, (2) innovativeness, (3) conducive conditions, and (4) MSCP.

Six elements from Gupta (2017) comprise BT use; three items from Kim et al. (2010) comprise innovativeness; four items from Venkatesh et al. (2003) comprise conducive conditions; and four MSCP indicators were taken from Devaraj et al. (2007) and Sheel and Nath (2019). Ordinal scales are employed in this study, and participants are asked to respond to a questionnaire with five Likert scales.

3.2 Operational definitions

BT boosts overall operating efficiency, improves auditing capabilities, and increases privacy (Gupta, 2017). According to Tajeddini et al. (2006), innovativeness is the attribute of being creative. The relationship between risk and innovativeness is also influenced by market orientation. "Innovativeness" refers to an organization's cultural inclination for innovation, which includes its values and beliefs (Hurley & Hult, 1998). Innovativeness is the tendency of a company to be a technical innovator and a thought leader (Parasuraman & Colby, 2015). "The degree to which it is believed that an organizational and technical infrastructure exists to support the use of the system" is the definition of facilitating conditions (Venkatesh et al., 2003). According to Sheel & Nath (2019), SCP stands for supply chain operations speed, value generation, transaction cost, and service level.

3.3 Sampling

Thailand's automakers make up the study's population. Thailand is home to 383 automobile manufacturing facilities. Stratified random sampling was used to choose participants based on top management categories. The hierarchy levels of the managers served as the basis for the development of strata. Because scholars have proposed using BT to measure organizational effectiveness in the automotive industry, data was gathered from Thai car factories (Rehman et al., 2021). The population is small and well-known. Stratified random sampling, which has a lower estimation error in the study modeling, is a frequently employed sampling technique in supply chain literature (Fernando et al., 2022a). To achieve the inclusionary conditions, respondents had to be managers with sufficient expertise applying Industry 4.0 to improve the MSCP. Researchers utilize the filter question to make sure that only manufacturing companies that have adopted Industry 4.0 are included in the survey. Generally, the survey questions highlighted large manufacturing enterprises. Prior to distributing the questionnaires, this study included a pre-test to assess the validity and reliability of the instrument. In order to satisfy construct validity requirements, it ensures that the content of the measuring items is valid, understandable, and unambiguous. Based solely on established factors from prior research, the constructs were established using a five-point Likert scale (Rehman et al., 2020a).

4. Results and Discussion

4.1 Model estimation

Using Smart PLS, the goodness of model fit and hypothesis testing were conducted using partial least squares structural equation modeling (PLS-SEM). PLS-SEM is regarded as a variance-based non-parametric method. When empirical data is skewed or lacking normalcy

assumptions, PLS-SEM has been judged suitable. When there are missing values, a small sample size, or problems with data normalcy, the PLS-SEM model's conclusions are thought to be more accurate than those of regular least squares (Hair et al., 2020). The measurement and structural model of this investigation were analyzed using PLS-SEM.

According to Hair et al. (2014), the measurement model addresses the quality of each individual assessment item, including discriminant validity, convergent reliability, and internal consistency reliability. According to Hair et al. (2020), factor loadings for each item should be at least 0.708 in order to show that the construct explains more than 50% of the variation of the indicator. When two unrelated factors shouldn't be associated statistically, this is known as discriminant validity (Rehman et al., 2019b). Fornell and Larcker (1981) proposed a classical metric, while Henseler et al. (2015) proposed heterotrait-monotrait (HTMT) a few years later. The Fornell and Larker technique is inappropriate when the construct loadings differ somewhat, which is why traditional metrics should be replaced. According to this study, the HTMT value is less than 0.85 for unrelated components and less than 0.90 for connected constructs. This criterion was met, as seen in Table 1.

Table 1: Convergent validity

Constructs	Items	Factor loading	AVE	CR	R^2	VIF
Blockchain technology utilization	BTU1	0.876	0.656	0.920		2.101
	BTU2	0.856				
	BTU3	0.878				
	BTU4	0.856				
	BTU5	0.804				
	BTU6	0.735				
Facilitating conditions	OPT1	0.857	0.745	0.948	0.269	1.375
	OPT2	0.912				
	OPT3	0.876				
	OPT4	0.884				
Innovativeness	INV1	0.778	0.676	0.846	0.098	1.276
	INV2	0.798				
	INV3	0.823				
Supply chain performance	SCP1	0.798	0.573	0.824	0.645	
	SCP2	0.886				
	SCP3	0.852				
	SCP4	0.806				

4.2 Regression model test

Smart PLS was utilized to evaluate hypotheses using structural models. 5,000 subsamples were used for bootstrapping the analysis of this study. The p-value and t-value were examined for testing hypotheses. It is deemed significant and the hypothesis will be accepted if the t-value is more than +1.96 and the p-value is less than 0.05.

Table 2. Results of Hypotheses Testing

Hypotheses	Paths	*B* value	*t-values*	*p-values*	Remarks	f^2
H1	BTU-SCP	0.298	2.687	0.012	Yes	0.122
H2	BTU-FC	0.159	2.767	0.023	Yes	0.212
H3	BTU-INV	0.142	3.507	0.005	Yes	0.024
H4	FC-SCP	0.193	7.078	0.000	Yes	0.037
H5	INV-SCP	0.209	2.774	0.046	Yes	0.143

5. Conclusion

The COVID-19 pandemic and digital disruption strengthened the manufacturing supply chain. Manufacturing firms must effectively manage their resources if they want to be flexible and quick in SCP. Digital platforms must be used to connect human and machine in the supply chain and performance. Predicting BT, innovativeness, enabling conditions, and MSCP in the automotive industry is the aim of this study model. The data indicates that blockchain technology greatly enhances MSCP, which is in line with Susanty et al.'s (2019) finding that IT practices help organizations come up with innovative ideas.

The application of BT shows a high association with MSCP and supports H1. According to Ivanov et al. (2019), BT improves demand forecasting, inventory management, and the creation of backup plans in case demand changes. Additionally, BT increases the size and scope of inventory tracking and tracing (Hofmann et al., 2017) while exhibiting honesty and transparency (Fernando et al., 2021). The use of BT to determine SCP was not as important to the researchers (Wamba et al., 2020). This study confirmed that RBV theory is applicable. Researchers contend that the use of BT, a special corporate resource, is responsible for the improvement of MSCP.

H2 and H3 were promoted by BT use, which also positively affected innovativeness and favorable conditions. The results of Zelbst et al. (2010), who argued that BT is a helpful instrument for building business competencies that boost a company's competitiveness, are supported by this study. The results addressed research gaps by simulating the effects of BT use on innovativeness and conducive surroundings. The results align with the RBV theory, which maintains that organizational resources largely drive organizational capabilities.

This study found that facilitating settings boosted H4 and improved MSCP. Palau-Saumell et al. (2019) assert that favourable conditions influence technology uptake and improve performance. Innovativeness has a positive correlation with SCP and supports H5. Rehman et al. (2020b) claims that innovativeness significantly increases organizational effectiveness.

5.1 Theoretical implications

This work made several theoretical contributions. First, the study draws attention to notable nexus variations in MSCP. Second, it also applies to those who solely looked into how supply chain transparency was affected by BT adoption. Lastly, this study demonstrates that MSCP can be predicted using the nexus model that incorporates BT, enabling situations, and innovativeness. The results supported Rehman et al. (2021) by demonstrating the importance of BT adoption in raising the MSCP. This study also looked into the previously disregarded connection between BT and SCP (Zelbst et al., 2010). Innovativeness and favorable circumstances are essential for enhancing SCP, according to this study. This outcome has been validated by Iddris (2016). Additionally, their research revealed that a firm's capacity for innovation could foster its inventiveness in the setting of the supply chain. Lastly, this study

emphasizes how innovativeness and favorable environments mediate the relationship between MSCP and BT adoption. According to RBV theory, a firm's capabilities—such as innovativeness and facilitating conditions—elucidate the relationship between its resources, such as BT and MSCP. This ground breaking study uses RBV theory to combine BT, innovativeness, facilitating condition, and MSCP into a single study.

5.2 Managerial implications

The COVID-19 pandemic has forced the manufacturing sector to embrace digitization as the new standard. As mentioned earlier, the change has resulted in a paradigm shift away from centralized and integrated systems and toward distributed and shared systems, which allow for the participation of many network users. To facilitate this conversion and for secure data access, the BT must be integrated. The study has a number of managerial implications. BT can be used by top-level management to improve the efficiency of complex transactions, lower costs, enhance the security and privacy of information systems, facilitate audits, and strengthen system security. Management must thus acknowledge that BT is a valuable asset to the business. Second, to optimize the advantages of these technological developments, it is advised that senior executives create a single technology infrastructure that includes BT and other linked systems. This kind of framework improves the effectiveness and quality of the production system by promoting cooperation among stakeholders and allowing the unrestricted flow of information. Thirdly, it's critical to promote the use of digital technology and cultivate an atmosphere that values creativity. It is recommended that senior management take a keen interest in new technology and invest in training initiatives to equip employees with the requisite abilities. Furthermore, it is crucial to promote knowledge transfer among employees in order to facilitate the broad integration and usage of digital technologies (Setthachotsomabat et al., 2024). Fourth, in order to successfully implement new technology, the company must possess the necessary resources, expertise, and experience. The process may entail recruiting competent personnel, allocating adequate funds, and establishing a nurturing learning environment that stays abreast of technological advancements. Finally, businesses must create an environment that supports favorable conditions for enhancing the SCP. This entails welcoming and adjusting to industry shifts and disruptions, promoting innovation, and establishing solid bonds and cooperative efforts throughout the supply chain. Governments can promote the adoption of Industry 4.0 technologies by providing incentives, luring investments, and assisting with administrative tasks. This aids and facilitates the procedure.

5.3 Limitations and future research

The research design of this work has several drawbacks. First, the cross-sectional nature of the study means that it cannot conclusively say that BT adoption, innovativeness, and enabling conditions with respect to MSCP in the industrial sector will be true over time. As a result, our theoretical framework can be repeated for the foreseeable future, and further research can show that the results are consistent. The direct impacts of BT, creativity, and supporting MSCP are investigated in this study. In order to identify MSCP, the authors suggest that future studies incorporate additional managerial characteristics, such as learning between businesses and upper management support. Future researchers can collect data from companies outside of the automotive industry and incorporate other factors like risk tolerance and innovation capacity to determine MSCP.

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