

BAM 2023 CONFERENCE



BUSINESS
SCHOOL

The impact of Blockchain technology capability on supply chain management improvement

Xiaotain Xie

University of Surrey

Glenn Parry

Surrey Business School

Birgit Altrichter

Surrey Business School

The impact of Blockchain technology capability on supply chain management improvement

Xiaotian Xie^{1*}, Glenn Parry², Birgit Altrichter³

^{1,2,3}Surrey Business School, University of Surrey, United Kingdom

*x.xie@surrey.ac.uk

g.parry@surrey.ac.uk

birgit.altrichter@surrey.ac.uk

The impact of Blockchain technology capability on supply chain management improvement

Abstract: The recent interest in Blockchain technology has led many companies to leverage it to enhance supply chain performance. However, deep insights regarding how organisations build blockchain technology capability (BTC) and how BTC can help attain a competitive advantage are lacking in the literature. To address these questions, the study draws on the resource-based view (RBV) and recent work in blockchain technology proposes a BTC model. Through Delphi studies, this study identifies various resources that in combination build BTC. Then this study uses partial least squares structural equation modelling (PLS-SEM) to test the relationship between BTC and supply chain performance. This study develops a feasible route of how to improve firm performance by allocating technology, management, and talent resources to leverage BTC.

Keywords: Blockchain, supply chain management, resource-based view, PLS-SEM

Track: Operation, logistics and supply chain management

Word count: 1496

1. Introduction

Emergent technologies, mainly associated with industry 4.0 and digital service, are expected to have a disruptive impact on the supply chain and force firms to develop new business strategy models. One of the most promising of these technologies is blockchain (Queiroz et al., 2019, Maull et al., 2017). Blockchain is a decentralised, distributive and advanced technology, which we can describe as a digital shared ledger and distributed over the network (Dutta et al., 2020). Every node in this peer-to-peer network maintains an upgraded copy of a database with all transaction history (Bahga and Madiseti, 2016, Scott et al., 2017). Once the records are added, they cannot be edited by a single actor but are verified and managed using automated and shared governance protocols (Christidis and Devetsikiotis, 2016). Blockchain technology has raised the significant interest of supply chain managers because of its unique nature of disintermediation, transparency, confidentiality, security and automation (Wang et al., 2021). Many organisations have started to explore the application of Blockchain technology in the supply chain, ranging from product provenance and traceability (Jabbar et al., 2021), smart contracts (Chang and Chen, 2020), supplier trust (Brookbanks and Parry, 2022), cross-border trade (Chang et al., 2020) and supply chain sustainability (Saberli et al., 2019). Utilising blockchain in the supply chain can improve supply chain transparency and traceability, improving supply chain efficiency as well as reducing risks and administrative costs (Rashid et al., 2022, Gökalp et al., 2022). Based on the recent survey conducted by Deloitte with the data collected from more than 1000 participants around the world, their results show that blockchain will become one of the top five strategic priorities for the next two years (Pawczuk et al., 2019).

To date, blockchain is still in the early stage of development, and the studies in the literature that unify blockchain with Supply chain are in their infancy (Queiroz et al., 2019, Wang et al., 2021, Schmidt and Wagner, 2019). Thus, many scholars call for empirical research to investigate the full implications of blockchain technology in the supply chain (Pournader et al., 2020, Sheel and Nath, 2019, Rejeb et al., 2021). Besides, although several studies investigate the impact of blockchain on the supply chain, most researchers focus on conceptualising and examining blockchain possibilities and challenges for supply chains and providing a solution for particular use cases. This is reinforced by several literature reviews of blockchain technology in the supply chain (Rejeb et al., 2021, Queiroz et al., 2019, Dutta et al., 2020, Moosavi et al., 2021). Furthermore, only 8% of the 26,000 blockchain projects started in 2016 were still actively developed in 2017 (Browne, 2017). Technological uncertainty, scalability issues, and development costs create significant challenges (Schmidt and Wagner, 2019). To deploy blockchain technology and gain competitive advantage, supply chain managers need to integrate various organisational resources to develop blockchain technology capability. Thus, this study aims to fill this gap by exploring the impact of blockchain technology capability (BTC) on supply chain performance improvement. To accomplish the research aim, two research questions are proposed:

RQ1: What resources are critical for firms to build BTC?

RQ2: What performance of supply chain can be shaped and strengthened by BTC?

This study investigates these research questions from the lens of the resource-based view (RBV). In this background, this study builds upon Supply chain management (SCM) literature that uses the Blockchain technology, to examine the resources that are needed to build a BTC. Then we provide a discussion on how a BCT affects supply chain performance.

2. The RBV of blockchain technology

Following Barney (1991) seminal work, RBT has served as a crucial theoretical base for elucidating the significance of resources to sustained competitive advantage (Jeble et al., 2018). Barney et al. (2011) argued that firms could exploit a bundle of valuable, rare, inimitable and non-substitutable resources to achieve profitability in a highly competitive market. RBT emphasised two core components: resources and capabilities. Resources refer to tangible and intangible assets such as technology, human and organisational. Capabilities refer to a firms' strategy for resource utilisation; specifically how resources and organisational procedures are combined to create the intended result (Wang and Sengupta, 2016). After years of study and improvement, RBT has emerged as one of the most effective and well-known theories for analysing, describing, and forecasting organisational relationships and competitive advantages in many business disciplines (Gupta and George, 2016, Barney et al., 2011, Nandi et al., 2020). RBV appropriately explains theoretically how firms can gain competitive advantage by systematically building, integrating and reconfiguring their resources into their organizational processes and routines to transform their unique resources into capabilities (Fawcett et al., 2011). Given that the main objective of this study is to identify several resources that will allow organizations to create BCT, which in turn may lead to superior firm performance, the choice of RBV as a theoretical framework for this study seems appropriate. Hence, according to RBV, when a firm possesses blockchain technology as a unique resource, it must also apply systematic reconfigurations and/or upgrades of the related resources to develop unique BCT to gain leverage over its present and future competition (Nandi et al., 2020, Li et al., 2021).

Most researchers working in the area of blockchain technology lists various barriers hindering blockchain technology adoption in SCM (Saber et al., 2019, Kopyto et al., 2020, Kouhizadeh et al., 2021) ; however, it does not yield insights into how firms can create a BCT. Based on RBV, Grant (2016) classifies these resources into tangible (e.g., financial and physical resources), human skills (e.g., employees' knowledge and skills), and intangible (e.g., organisational culture and organisational learning) types. The classification of resources into tangibles, human skills, and intangibles has been actively used in the big data analytics capability literature (Gupta and George, 2016, Akter et al., 2016, Mikalef et al., 2020, Ashaari et al., 2021). Consistent with this, we follow the same classification to categorize different resources.

3. Research methodology

A mixed-method approach was adopted in this study to investigate the impact of BTC on supply chain performance improvement (see Figure 1). In order to develop a research model to measure BCT, this study began by conducting a literature review on BTC and firm performance management to identify resources for constructing BTC and key performance indicators (KPIs) to evaluate supply chain performance. Then, a Delphi study is conducted to explore the subdimensions of BTC under each primary dimension (blockchain technology resources, blockchain management resources and blockchain talent resources) identified in the literature review (Akter et al., 2016). To facilitate understanding, the research model was shown (see Figure 2.). The expert panel includes academics and expert practitioners who are active members of three independent research groups located at three UK universities. The academics were senior lecturers or professors in business management disciplines and expert practitioners were department or function managers in a supply chain company. The research program invites 20 experts to participate (12 academics and 8 expert practitioners) Based on the results of the Delphi study, we develop the questionnaire. Thereafter, questionnaires are used to collect data from supply chain managers. Finally, Partial Least Squares Structural Equation Modelling (PLS-SEM) is used to build relationships between BTC and supply chain performance and

evaluate the hypotheses of this study. PLS-SEM can assess multiple levels of hierarchically structured data and achieve valid and reliable results with a complex model (Henseler and Sarstedt, 2013). Moreover, Hair et al. (2011) indicate that PLS-SEM can efficiently analyse small sample sizes without normally distributed data. Given the advantages of PLS-SEM, in recently published articles, it has been applied in blockchain technology and SCM research to assess data (Queiroz et al., 2021, Khan et al., 2021). Thus, given the identified study constructs and the need to assess the interrelationships between several dependent and independent variables simultaneously, PLS-SEM is justified as an appropriate method.

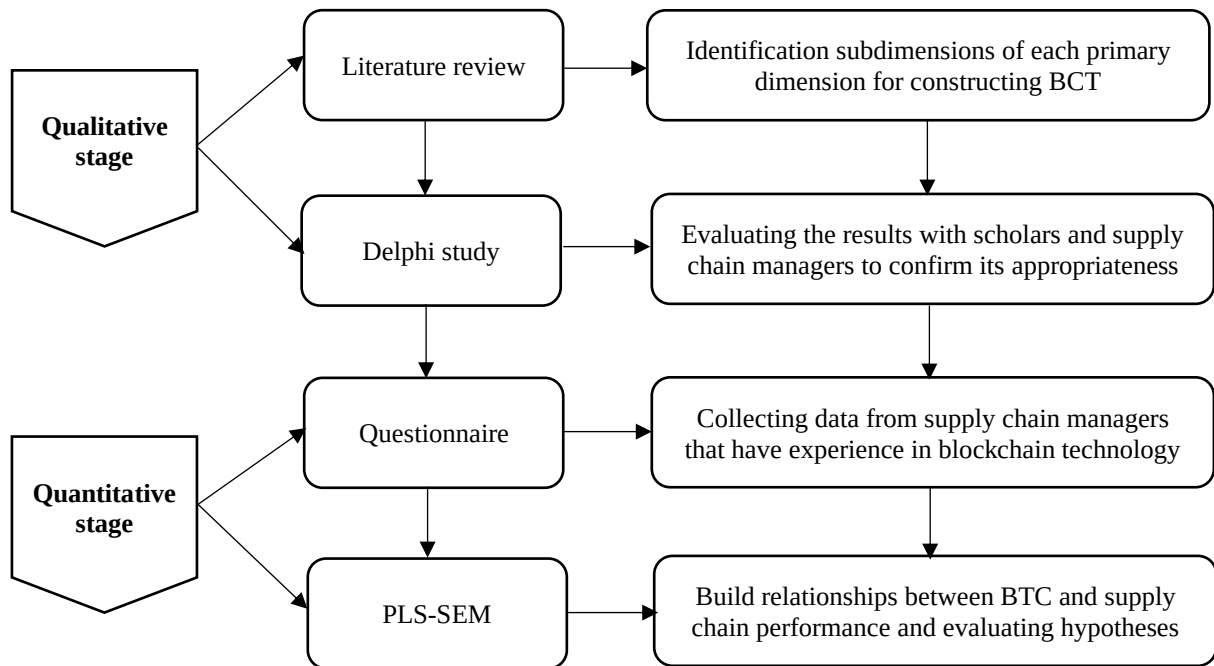


Figure 1 Research methodology framework

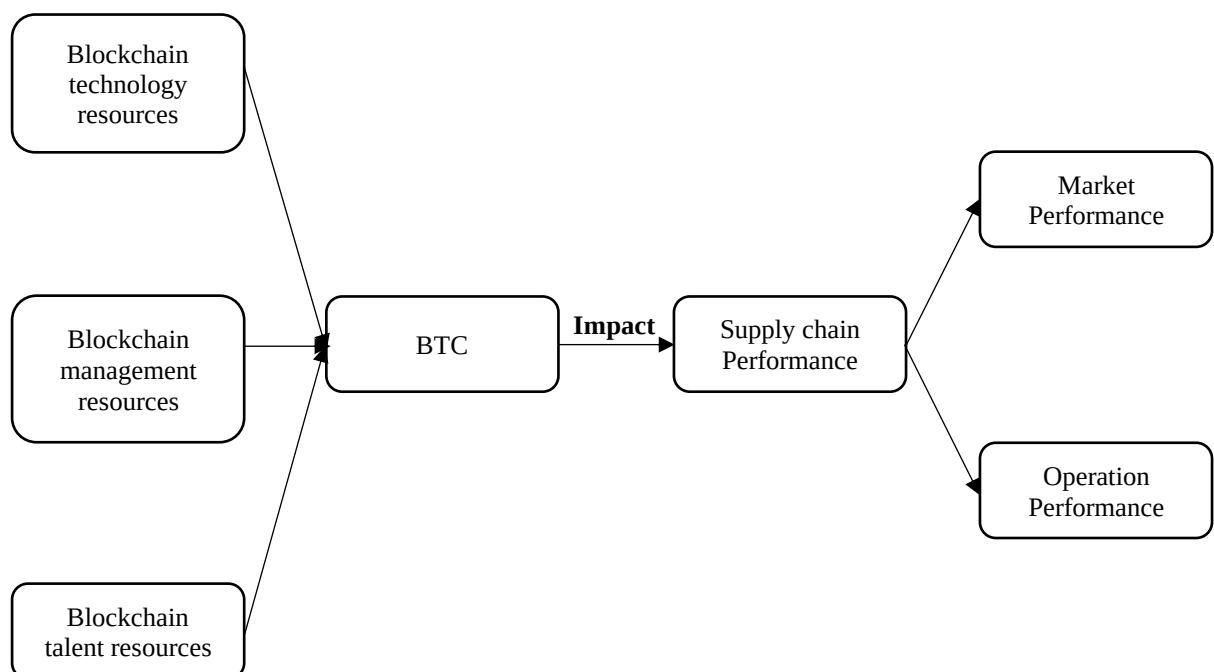


Figure 2. Research model

3.1 Empirical data collection plan

Purposive sampling and snowball sampling are used in this study to identify potential respondents who have an interest in participating in this research. First, purposive sampling was implemented to identify the respondents who have the knowledge and experience to answer the questionnaire. Thus, we developed two criteria to select suitable respondents, including (1) the selected respondents should have more than one year of working experience related to blockchain technology and supply chain management to ensure a high level of expertise; and (2) the selected respondents should be the middle or senior-level management team to ensure a comprehensive understanding of supply chain management. The participation members of Digital Catapult and the partner companies are surveyed for this research. Moreover, the questionnaires were distributed in relevant conferences, forums of supply chain management and LinkedIn, focusing on topic related to supply chain management, digital transformation of supply chain and blockchain. We eligible experts, senior managers, directors, and chief executive officers in the conferences, LinkedIn and forum as our key participants. Then, snowball sampling was used to identify other participants based on the participant's recommendation. The research plan collected about 200 valid questionnaires.

4. Intended contributions

The potential contributions of this study are summarised as follows. As for the contributions to theory, this study first proposed various organisational-level resources that in combination build a BTC. Second, the result obtained through validation of the proposed model brings new empirical insights showing how BTC can influence supply chain performance; that is, market performance and operation performance may be influenced by BTC. This is important because as BTC is continuing to be adopted by organisations. Managers will need to better understand and knowledge about BTC development for supply chain management to systematically reflect on the capabilities and limitations of the technology, which will help them to gain competitiveness advantage in the uncertain supply chain ecosystem. Third, this study contributed to progressive literature on blockchain-based supply chain technology through the theoretical lens of RBV and empirical evidence from multi-industrial supply chains in UK.

As for the potential contributions to the managerial practices, first, this study proposed a survey instrument to measure a BCT of the firms. As such, it is easier for firms to determine key factors to focus on to gain insight into the challenges of developing BTC in the supply chain. Second, this study develops a feasible route of how to improve firm performance by allocating technology, management, and talent resources to leverage BTC. This finding can help supply chain managers to formulate strategies for assisting supply chain companies in developing BTC to provide better service to their customers.

5. Acknowledgements

The authors gratefully acknowledge the funding contribution of the Engineering and Physical Sciences Research Council (UK) to the Next Stage Digital Economy Centre in the Decentralized Digital Economy (DECaDE) [Grant Reference EP/T022485/1].

Reference:

- AKTER, S., WAMBA, S. F., GUNASEKARAN, A., DUBEY, R. & CHILDE, S. J. 2016. How to improve firm performance using big data analytics capability and business strategy alignment? *International Journal of Production Economics*, 182, 113-131.
- ASHAARI, M. A., SINGH, K. S. D., ABBASI, G. A., AMRAN, A. & LIEBANA-CABANILLAS, F. J. 2021. Big data analytics capability for improved performance of higher education institutions in the Era of IR 4.0: A multi-analytical SEM & ANN perspective. *Technological Forecasting and Social Change*, 173, 121119.
- BAHGA, A. & MADISETTI, V. K. 2016. Blockchain platform for industrial internet of things. *Journal of Software Engineering and Applications*, 9, 533-546.
- BARNEY, J. 1991. Firm resources and sustained competitive advantage. *Journal of management*, 17, 99-120.
- BARNEY, J. B., KETCHEN JR, D. J. & WRIGHT, M. 2011. The future of resource-based theory: revitalization or decline? *Journal of management*, 37, 1299-1315.
- BROOKBANKS, M. & PARRY, G. 2022. The impact of a blockchain platform on trust in established relationships: a case study of wine supply chains. *Supply Chain Management: An International Journal*.
- BROWNE, R. 2017. There were more than 26,000 new blockchain projects last year-only 8% are still active. *November*, 9, 2017.
- CHANG, S. E. & CHEN, Y. 2020. When blockchain meets supply chain: A systematic literature review on current development and potential applications. *IEEE Access*, 8, 62478-62494.
- CHANG, Y., IAKOVOU, E. & SHI, W. 2020. Blockchain in global supply chains and cross border trade: a critical synthesis of the state-of-the-art, challenges and opportunities. *International Journal of Production Research*, 58, 2082-2099.
- CHRISTIDIS, K. & DEVETSIKIOTIS, M. 2016. Blockchains and smart contracts for the internet of things. *Ieee Access*, 4, 2292-2303.
- DUTTA, P., CHOI, T.-M., SOMANI, S. & BUTALA, R. 2020. Blockchain technology in supply chain operations: Applications, challenges and research opportunities. *Transportation research part e: Logistics and transportation review*, 142.
- FAWCETT, S. E., WALLIN, C., ALLRED, C., FAWCETT, A. M. & MAGNAN, G. M. 2011. Information technology as an enabler of supply chain collaboration: a dynamic-capabilities perspective. *Journal of supply chain management*, 47, 38-59.
- GÖKALP, E., GÖKALP, M. O. & ÇOBAN, S. 2022. Blockchain-based supply chain management: understanding the determinants of adoption in the context of organizations. *Information systems management*, 39, 100-121.
- GRANT, R. M. 2016. *Contemporary strategy analysis: Text and cases edition*, John Wiley & Sons.
- GUPTA, M. & GEORGE, J. F. 2016. Toward the development of a big data analytics capability. *Information & Management*, 53, 1049-1064.
- JABBAR, S., LLOYD, H., HAMMOUDEH, M., ADEBISI, B. & RAZA, U. 2021. Blockchain-enabled supply chain: analysis, challenges, and future directions. *Multimedia systems*, 27, 787-806.
- JEBLE, S., DUBEY, R., CHILDE, S. J., PAPADOPOULOS, T., ROUBAUD, D. & PRAKASH, A. 2018. Impact of big data and predictive analytics capability on supply chain sustainability. *The International Journal of Logistics Management*, 29, 513-538.

- KHAN, S. A. R., GODIL, D. I., JABBOUR, C. J. C., SHUJAAT, S., RAZZAQ, A. & YU, Z. 2021. Green data analytics, blockchain technology for sustainable development, and sustainable supply chain practices: evidence from small and medium enterprises. *Annals of Operations Research*, 1-25.
- KOPYTO, M., LECHLER, S., HEIKO, A. & HARTMANN, E. 2020. Potentials of blockchain technology in supply chain management: Long-term judgments of an international expert panel. *Technological Forecasting and Social Change*, 161, 120330.
- KOUHIZADEH, M., SABERI, S. & SARKIS, J. 2021. Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers. *International Journal of Production Economics*, 231, 107831.
- LI, Z.-P., CEONG, H.-T. & LEE, S.-J. 2021. The effect of blockchain operation capabilities on competitive performance in supply chain management. *Sustainability*, 13, 12078.
- MAULL, R., GODSIF, P., MULLIGAN, C., BROWN, A. & KEWELL, B. 2017. Distributed ledger technology: Applications and implications. *Strategic Change*, 26, 481-489.
- MIKALEF, P., KROGSTIE, J., PAPPAS, I. O. & PAVLOU, P. 2020. Exploring the relationship between big data analytics capability and competitive performance: The mediating roles of dynamic and operational capabilities. *Information & Management*, 57, 103169.
- MOOSAVI, J., NAENI, L. M., FATHOLLAHI-FARD, A. M. & FIORE, U. 2021. Blockchain in supply chain management: a review, bibliometric, and network analysis. *Environmental Science and Pollution Research*, 1-15.
- NANDI, M. L., NANDI, S., MOYA, H. & KAYNAK, H. 2020. Blockchain technology-enabled supply chain systems and supply chain performance: a resource-based view. *Supply Chain Management: An International Journal*, 25, 841-862.
- PAWCZUK, L., MASSEY, R. & HOLDOWSKY, J. 2019. Deloitte's 2019 Global Blockchain Survey-Blockchain gets down to business. *Deloitte Insights*, 6.
- POURNADER, M., SHI, Y., SEURING, S. & KOH, S. L. 2020. Blockchain applications in supply chains, transport and logistics: a systematic review of the literature. *International Journal of Production Research*, 58, 2063-2081.
- QUEIROZ, M. M., FOSSO WAMBA, S., DE BOURMONT, M. & TELLES, R. 2021. Blockchain adoption in operations and supply chain management: empirical evidence from an emerging economy. *International Journal of Production Research*, 59, 6087-6103.
- QUEIROZ, M. M., TELLES, R. & BONILLA, S. H. 2019. Blockchain and supply chain management integration: a systematic review of the literature. *Supply Chain Management: An International Journal*.
- RASHID, A., ALI, S. B., RASHEED, R., AMIRAH, N. A. & NGAH, A. H. 2022. A paradigm of blockchain and supply chain performance: a mediated model using structural equation modeling. *Kybernetes*.
- REJEB, A., REJEB, K., SIMSKE, S. & TREIBLMAIER, H. 2021. Blockchain technologies in logistics and supply chain management: a bibliometric review. *Logistics*, 5, 72.
- SABERI, S., KOUHIZADEH, M., SARKIS, J. & SHEN, L. 2019. Blockchain technology and its relationships to sustainable supply chain management. *International Journal of Production Research*, 57, 2117-2135.
- SCHMIDT, C. G. & WAGNER, S. M. 2019. Blockchain and supply chain relations: A transaction cost theory perspective. *Journal of Purchasing and Supply Management*, 25, 100552.
- SCOTT, B., LOONAM, J. & KUMAR, V. 2017. Exploring the rise of blockchain technology: Towards distributed collaborative organizations. *Strategic Change*, 26, 423-428.

- SHEEL, A. & NATH, V. 2019. Effect of blockchain technology adoption on supply chain adaptability, agility, alignment and performance. *Management Research Review*.
- WANG, H.-M. D. & SENGUPTA, S. 2016. Stakeholder relationships, brand equity, firm performance: A resource-based perspective. *Journal of Business Research*, 69, 5561-5568.
- WANG, Y., CHEN, C. H. & ZGHARI-SALES, A. 2021. Designing a blockchain enabled supply chain. *International Journal of Production Research*, 59, 1450-1475.