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Jakia Sultana
RMIT University, Australia, s3814812@student.rmit.edu.au

Stan Karanasios
University of Queensland, Australia, s.karanasios@uq.edu.au

Say Yen Teoh
RMIT University, Australia, sayyen.teoh@rmit.edu.au

Theorising Blockchain in Supply Chain Activities with Activity Theory

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Jakia Sultana
PhD Student
School of Accounting, Information Systems and Supply Chain
RMIT University
Melbourne, Australia
Email- jakia.sultana@student.rmit.edu.au

Stan Karanasios
Associate Professor
University of Queensland Business School
The University of Queensland
Brisbane, Australia
Email: s.karanasios@uq.edu.au

Say Yen Teoh
Senior Lecturer
School of Accounting, Information Systems and Supply Chain
RMIT University
Melbourne, Australia
Email- sayyen.teoh@rmit.edu.au

Abstract

This paper addresses the lack of theoretical underpinning in the study of blockchain and supply chain by employing an activity theory lens to offer fresh and novel perspectives. Existing blockchain-based supply chain studies are typically atheoretical. While those that are theoretical often rely on predictive theories. Unlike existing studies, we advocate explanatory theory for studying emerging technology and thereby adopt activity theory to theorise and explain blockchain-mediated supply chain activities. Based on case vignettes, we illustrate how activity theory can drive novel insights. This approach highlights how activity theory can privilege extended or new insights in the study of blockchain and supply chains. This endeavour lays the foundation for rigorous theory-based research in the realm of blockchain and supply chain, contributing to the development of activity theory and blockchain research in information systems. It also provides valuable guidance for future researchers, particularly those exploring technology-related studies with an activity theory lens.

Keywords: Activity theory, Blockchain, Framework, Supply chain, Theory-based, Vignette

1 Introduction

In recent years, blockchain received much attention for its revolutionary potential in the supply chain (Bai & Sarkis, 2020; Kshetri, 2018; Treiblmaier, 2018). Many argue that blockchain is critical in transforming supply chain activities (Kshetri 2018), because of its decentralised, immutable distributed and peer-to-peer-enabled system where the trustworthiness is confirmed by data blocks linked with a cryptographic hash of the previous block (Drescher, 2017). Blockchain primarily offers decentralisation, immutability, consensus, transparency, and programmability (Treiblmaier, 2019). Blockchain offerings and design principles (Zheng et al., 2018) can potentially address the limitations of the current technologies used in the supply chain (Ronaghi, 2021). Given that novelty, blockchain is seen as more efficient, sustainable (Friedman & Ormiston, 2022), and emancipatory technology (George & Whitten, 2020) for addressing various supply chain issues.

Despite the technical novelty, blockchain implementations stutter as organisations remain sceptical about the impact and consequences of the blockchain (Lustenberger et al., 2021). This is because existing literature is broadly centred on exploring blockchain applications and trends (Zhu et al., 2022) which is mostly atheoretical. In other words, theory-based studies on blockchain-based supply chains are nascent (Dubey et al., 2022; Treiblmaier, 2018), especially in analysing blockchain uses in supply chain activities.

Theorisation is crucial for facilitating the in-depth investigation of the research phenomenon and research advancement (Gligor et al., 2021). With a good theory, it is possible to explain, predict and examine research phenomena beyond description to advance knowledge development (Zhu et al., 2022). In particular, developing a theoretical framework allows the derivation of research questions based on the theory that enables methodologically rigorous research design (Treiblmaier, 2018).

The lack of theorisation is problematic because it (i) stunts the ability of research to produce knowledge and (ii) limits the use of diverse methodological approaches incorporating manifold theoretical perspectives (Gligor et al., 2021). In the context of blockchain, the lack of theorisation limits the ability to explain blockchain's impact, outcome, reasons to adopt and associated pitfalls. It is also problematic to understand the underlying reasons for blockchain uptake in practice (Zhu et al., 2022).

Reviews of blockchain-based supply chain research show a fraction of research is theoretical (Dubey et al., 2022; Zhu et al., 2022). Most theory-based research is often inclined toward well-established theories (Zhu et al., 2022, p. 20) including Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM), Diffusion of Innovation (DOI), and Unified Theory of Acceptance and Use of Technology (UTAUT), primarily to predict adoption behaviour (Chen et al., 2020; Wong et al., 2020). This limits the lack of novel theoretical insight because it misses the potential insights that may be garnered from multidisciplinary theories (Zhu et al., 2022). As an emerging, yet-to-mature technology, explanatory theories, unconventional theories or new theories developed through an inductive process can be helpful to explain diverse aspects of blockchain and advance the research growth (Zhu et al., 2022). Considering Zhu et al.'s (2022) suggestion for the uses and focus on multidisciplinary explanatory theory, we adopted activity theory to analyse blockchain-mediated supply chain activities.

Activity theory was initially used in Information Systems (IS) research to understand the growing role of digital technology and associated challenges (Bødker, 1989), which later inspired activity theory's uses to understand technology mediation in organisational settings (Allen et al., 2013; Kaptelinin & Nardi, 2018; Kelly, 2018). This growing interest in activity theory to study emerging digital technology illustrates activity theory's potential to provide insight into technology uses, mediation and intervention in different settings. So far, activity theory has been applied to study human-computer interaction (Kuutti, 1996a), the activity of technology integration (Anthony, 2011), study the use of digital technologies and their mediation (Blayone, 2019), to investigate contradiction and congruencies of mobile technology (Karanasios & Allen, 2014), and to study the challenges of digital technology mediation (Rückriem, 2009). Such diverse and useful application shows that IS discipline is a fertile ground for the growth of activity theory's future generation evolution (Karanasios, 2018). Thus, scholars call for studies on activity theory focusing on digital technology to cultivate the development of activity theory (Karanasios, 2018; Karanasios et al., 2021).

This paper responds to these calls by applying activity theory as a theoretical lens to investigate blockchain-integrated supply chain activities. Mainly the purpose is to demonstrate an activity theoretic facilitated understanding of multi-aspects of blockchain uses in supply chain activities, thus leading to the advancement of theoretical avenues of blockchain research. With this in mind, our research question is: *How can activity theory provide novel insights into blockchain-integrated supply chain activities?* In this short paper, we address this question through two case vignettes, one secondary and one primary. Both vignettes represent blockchain implementation scenarios in the food supply chain which are

structured focusing on blockchain systems, benefits, and the associated problems. We looked through an activity theoretic lens to examine the vignettes.

Our analysis shows activity theory is relevant in several ways. Firstly, activity theory helps in conceptualising blockchain impact and use as a multidimensional tool by explaining the creation and evolution of activities. Particularly, pointing to the change from initial intended blockchain uses vs actual uses post-implementation. Secondly, activity theory offers crucial insight into the involved interactions in the inter-organisational setting, like how organisations collaborate and form networks, the poly-motivation for forming networks, and the type of network formed etc. Thirdly, activity theory enables the study of activities from a socio-technical context ensuring a balanced perspective that does not prioritise social aspects over technology or overlook the role of technology in action (Allen et al., 2013). This helps in understanding technology-driven congruence and contradiction in context.

In the following sections, activity theory and its key concepts will be discussed. Afterwards, theoretical framing with activity theory is illustrated and exemplified briefly with two vignettes. This short paper ends by outlining the implications, future steps, limitations and future research directions.

2 Activity Theory and its Concepts

Activity theory is a contemporary multidisciplinary framework that centres around mediated activities, incorporating socially constructed elements such as community, rules, and division of labour, along with technology (Karanasios, 2018). It is grounded on the work of Vygotsky (1980) which was later improved and expanded through three generations by the contribution of Leont'ev and Engeström (Engeström, 1987; Leont'ev, 1978; Vygotsky, 1980).

The initial structure of activity theory is established in Vygotsky's effort to explain how individuals act on the object using the tool (Kelly, 2018). This also set the notion of mediation in activities. Later in 1987, Engeström included rules, community, division of labour and outcome to the activity system model, which was widely adopted to frame individual and collective activities (Karanasios & Allen, 2013). This is also one of the core offerings of activity theory, as it allows to zoom into one central activity and zoom out to other related activities accordingly to research needs.

In activity theory, the actors or *subjects* engage in activities toward an or shared object, it can be the individual, group of individuals or organisations involved in an activity (Karanasios, 2018). In this study organisations in the supply chain network are the subjects. Organisations in the supply chain network might have different motivations and objects. Still, they interact and collaborate toward a commonly shared inter-organisational object or central activity, like achieving traceability and authenticity.

Object refers to the problem or focus for which the subject engages in the activity. An object is a dynamic and driving force in formulating an activity network (Engeström, 1995). The object provides direction to the activities in the network. There is no activity without an object (Leont'ev, 1978). Generally, the object of activity is a problem, focus or project that needs to be achieved (Karanasios, 2018). In IS, the object is the task or work for which technology (tools) is developed or introduced. Identifying an object is considered the first step of the activity. Not necessarily there should be one object, it can be multiple objects. The motivation behind the activity and the object might also change. However, the notion of activity remains focused on the object, being 'object-oriented' (ibid).

All activities are governed by the *rules and norms* of the activity system (organisation) (Karanasios, 2018). Organisational established rules and norms govern the relationship between community and organisation and related activities. The activities are also influenced by the community with whom the subject interacts. Community consideration will help understand how people work on the same object from different views (Karanasios, 2018). All the activities are performed by labour; hence the division of labour in the supply chain is considered in the analysis of activities.

Another crucial component in activity theory is *tools*. All the activities performed by the subject towards an object are mediated by tools (Karanasios, 2018). In this study, organisations' blockchain technology is the tool. Like the spectrum of tools used in human activity, activity theory accommodates tools ranging from tangible or physical tools (a wrench or mobile phone) to ideas and semiotics, to schemas and the environment (Crawford & Hasan, 2006). Since blockchain is a complex technology and comprises a unique combination of technical artefacts (Beck & Müller-Bloch, 2017), the activity theoretic approach allows looking at the blockchain spectrum as a multidimensional tool in the supply chain network, such as shared ledger, smart contract, authenticator etc.

Additionally, activity theory employs contradictions as a crucial analytical tool to comprehend the problem, challenges, tensions, and clashes in context (Kelly, 2018). Contradiction analysis helps in

understanding how changes unfold in the activity system and network (Allen et al., 2013). Generally, contradictions are understood as anything that hinders achieving objectives or impedes the shared objective of the network or central activities (Allen et al., 2013). Contradictions manifest in various forms as tensions, misfits, clashes, disputes or opposition within activities related to the shared object (Allen et al., 2013; Engeström & Sannino, 2011). For instance, organisations' information-controlling attitude in the effort to achieve traceability explains the underlying contradictions and manifestation of tensions with information sharing. Analysing contradictions is also beneficial to understanding how technology implementation (like- blockchain) creates issues and how changes motorise in the activity system and network through handling those tensions (Allen et al., 2013).

3 Theoretical Framing and Brief Exemplifying

In activity theory, activity is considered a part of a woven and interlinked network of activity systems (Karanasios & Allen, 2013; Spinuzzi, 2008). Activities are generated when the subject act on an object, use tools, follow rules, and produce labour within the community (Kelly, 2018). Framing activities with activity theory can follow mainly two core perspectives, i.e., system and network perspectives (Kelly, 2018). From a system perspective, activity theory is used to study a single activity system. This is particularly useful in studying a single organisation or activity (Kelly, 2018) object. Whereas in the network perspective, activity theory is used either to frame interacting activity systems through a shared object or to study a group of interconnected activities focusing on central activity (Kelly, 2018). In IS framing from a network perspective of interacting activity systems and interconnected activities used for studying innovation (Miettinen, 1999), IS solution development (Korpela et al., 2000) or understanding collaborative work (Spinuzzi, 2012) as well as investigating contradictions (Kelly, 2018).

For theoretical framing, this study focuses on the network perspective to frame and study interconnected activities around the central activity of traceability and authenticity. This approach allows one to navigate neighbouring and concurrent activities, their interconnection, and the underlying tension or contradictions (Karanasios & Allen, 2013). Therefore, considering the privileges that activity theory can offer, we developed a theoretical framework to theorise blockchain-mediated supply chain activities (refer to Figure 1). Figure 1 illustrates traceability and authenticity as central activity and the emergence of inter-connected neighbouring activities.

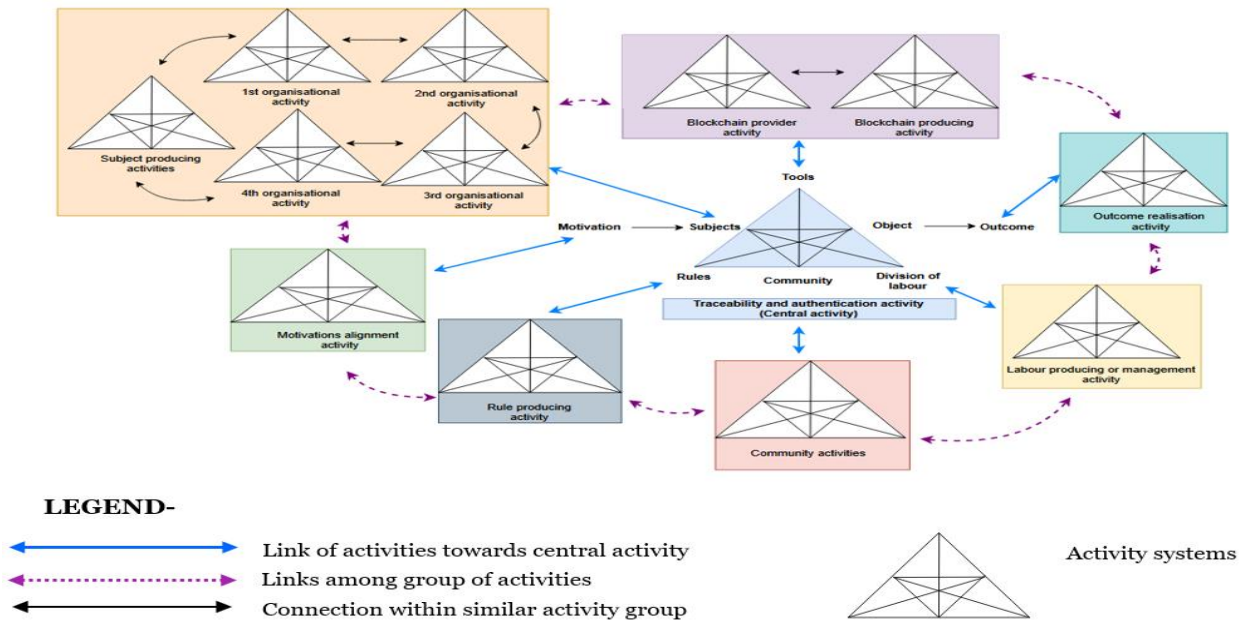

Figure 1: Framework for analysing blockchain integrated supply chain activities (adapted and modified from Karanasios and Allen (2013))

In the supply chain network, different organisations perform different value-added activities from manufacturing the product to serving the end customer, focusing on enabling traceability and authentication (Rana et al., 2021). Framing organisations as subject and their activities, activity theory enables a comprehensive examination of the supply chain network dynamics. Consideration of activities' interconnection allows an understanding of how activities interact and contradict. This aspect is particularly useful in IS research as it facilitates a deeper understanding of technology's influence in shaping activities and overall system dynamics (Karanasios, 2018).

Considering traceability and authenticity as central activity, we develop a framework that helps to trace all the inter-connected activities required to perform (Karanasios & Allen, 2013). For instance, organisations need to bring other actors into the blockchain project to achieve traceability and authenticity in the supply chain network, so there is subject-producing activity. Different supply chain actors have their own part of the activity for achieving traceability and authenticity, so there are organisations' activities. To use blockchain, organisations and blockchain providers need to produce blockchain, so there is blockchain-producing activity. In addition, to use blockchain for traceability and authenticity, some activities create rules, and use labour along with the community (Kelly, 2018). Thus, activity theoretical framing of interconnected activities allows bringing all the related activities into the analysis (as shown in Figure 1).

Framework 1 will be useful in investigating several aspects of blockchain-based supply chain research. This framework can be employed for facilitating theory-based research on topics like- blockchain-enabled changes in supply chain activities, tensions in supply chain activities, the impact of blockchain in supply chain activities and others by facilitating theory-based research.

Case vignettes are used to build our arguments and demonstrate the use of the activity theoretical framework. Six case-based vignettes are used to illustrate how activity theory helps to understand the use of blockchain in the supply chain. Vignettes help to connect with arguments from practice (Berland et al., 2017) and such demonstration of arguments is common in IS (Günther et al., 2017). More importantly, it enhances the credibility and trustworthiness of the knowledge-generation process (Marques Nascimento Macêdo & Bispo, 2022; Sampson & Johannessen, 2020).

Among the six case vignettes (refer to Table 1) four vignettes are collected from Rogerson and Parry (2020) and two are based on primary sources. We searched and screened relevant empirical papers that examined blockchain in the supply chain. We looked if the paper (i) investigated real blockchain projects (ii) discussed both benefits and problems with blockchain implementation and (iii) provided adequate details of the cases. Following a reasonable evaluation, we found the structure and cases of Rogerson and Parry (2020) are suitable for this study's exemplification purpose. The primary vignettes are based on the data collected from a research project on 'Tensions with blockchain implementation and use', which authors are parallelly involved in. The project investigates blockchain implementation in the food supply chain to understand the benefits and ongoing tensions that align with the focus of selected secondary vignettes.

No	Source type	Case Vignettes
1	Secondary	AgriDigital (Rogerson & Parry, 2020)
2	Secondary	Techrock (Rogerson & Parry, 2020)
3	Secondary	World Wildlife Fund and TraSeable Solutions (Rogerson & Parry, 2020)
4	Secondary	Demeter (Rogerson & Parry, 2020)
5	Primary	Orange juice blockchain solution
6	Primary	Leafy green blockchain solution

Table 1. Case vignettes

All the selected vignettes are based on empirical data on blockchain uses in the food supply chain network. Both secondary and primary source case vignettes are structured by highlighting key points such as background, system and benefits and problems following Rogerson and Parry (2020). In this short paper, we exemplify the use of the activity theory framework with two vignettes: one secondary sourced and one primary sourced.

Vignette 1- AgriDigital (Rogerson & Parry, 2020, p. 606)

This illustration is about AgriDigital, an Australian company founded in 2015 to manage agricultural produce and supply chain finance. The agricultural sector lacks digitisation and traditionally relies on manual and paper-based record-keeping. AgriDigital responded to growing consumer demand for traceability and authenticity by introducing a blockchain-based verification system.

System and benefits: Within the ArgiDigital platform, data from various sources at different stages are collected and recorded, which is particularly crucial for verifying organic status and providing assurance. This data encompasses details such as seed usage, weather conditions, fertilization, milling production, transportation specifics, and adherence to operational practices. These data are batch-verified, hashed, and stored on a private Quorum blockchain. RFID-enabled weighbridges are employed to track shipments, enabling the detection and weighing of tagged vehicles, adding time, weight, and location information to the blockchain. A web application is used to verify organic status during packaging and at

the consumer's end. Thus, ArgiDigital helps to verify marketing claims, offers information assurance about products' organic status and enhances visibility.

Problems: There are three challenges highlighted with AgriDigital uses for verification and visibility, firstly human input can pose a challenge as errors and data corruption during data entry can be amplified in blockchain-enabled systems. The inherent trust mechanism of blockchain may result in data being accepted without sufficient human scrutiny, leading to a potential lack of critical questioning. Secondly, full digitisation of supply chains is necessary for blockchain to reach its potential. Although certain industries, including agriculture, face practical difficulties in achieving full digitisation, a senior manager believes that the simultaneous development of products and technological solutions can facilitate the integration of blockchain and maximise its benefits. Finally, the senior manager emphasises that blockchain implementation within a small network is merely a theoretical exercise. In a fully digitised network, as many nodes as possible need to be added to enhance data volume and security. However, the inclusion of many nodes could result in risking actors' identities and sensitive data (i.e., such as pricing and contractual information) in the blockchain network given the immaturity of privacy solutions at both the chain and transactional levels. Although, this may be resolved in time as the technology matures.

Using activity theory to analyse this case vignette provides the following insights. **Firstly**, an examination of AgriDigital's pre-implementation activity shows undigitised processes and lack of provenance spurred the AgriDigital implementation and facilitated new techno-organisational structures. For instance, AgriDigital implementation activities led to the use of subsequent other technological tools (i.e. RFID), impacting techno-organisational behaviour in the supply chain. **Secondly,** we considered the poly-motivational nature of AgriDigital implementation, outlining the multi-voice from multi-party for working on a common problem. The AgriDigital implementation to meet increasing customer demand for traceability and authentic information shows the motivations are influenced by the broader community. Focusing on the subject, community, and object triangle, helps to analyse and understand the impact of these external factors on channelling organisational actions to act on central activities. It also shows organisational motivation is driven by both internal and external stimuli. **Thirdly,** we considered the wide network of inter-connected activities that build on each other. The object of activity can be absorbed by other activities creating and forming new activities. Understanding the creation and evolution of activities is particularly useful for conceptualising the impact. For example, in the above vignette AgriDigital implementation activities for verification lead to subsequent activities where AgriDigital is used as a different tool. Although AgriDigital was initially developed for verifying claims, it is now used as a tool for learning activities, information assurance and supply chain visibility.

Vignette 5 -Orange Juice Blockchain Solution

This precedent revolves around the implementation of blockchain in the orange juice supply chain involving organisations from both Europe and the USA. The key issues in this supply chain are lack of traceability, limited information sharing, regulations and human rights violations. To ensure traceability and transparency and address sustainability concerns, involved organisations recognised the need for implementing an emerging technology blockchain. Additionally, interrogation by NGOs and research organisations focus on the ethical working conditions and compliance influenced organisations' actions for traceability.

System and benefits: Blockchain is designed to record data at every stage, from the plantation to the end consumers. This includes details such as harvest timing, plantation names and locations, production information, quality checks for sweetness, acidity, vitamin C, sensory attributes, colour, and taste. Furthermore, to ensure ethical labour practices, the Rainforest Alliance certification of the plantations is also documented in the blockchain. The blockchain provider is responsible for verifying the accuracy of the data and ensuring that all participants have correctly uploaded the information. By capturing information at every stage, this blockchain system promotes traceability within the orange juice supply chain, fostering collaboration among growers, processors, bottlers, retailers, and consumers. It also enables consumers to better understand the organisation's commitment to a sustainable juice value chain.

Problems: Firstly, resistance to information sharing was impacting traceability activities. End-to-end traceability requires organisations to share information in the network. The local organisational information policies often contradicted the global information-sharing requirement for achieving traceability, reinforcing the resistance to sharing the data. Organisations collaborated and worked on a global level to push required information sharing on the local level. However, they only shared limited traceability information comparing initial intention. Secondly, blockchain operational requirements in scanning and data-feeding activities with an unautomated scanning and data-capturing system led to

increased organisational workload and costs. Often it led organisations to skip data feeding to blockchain and break the visibility in the supply chain network. Thirdly, the lack of a governance model for blockchain-based traceability created difficulty in enforcing standards and regulations.

The insights that activity theory drives here are- **firstly,** it helped to understand how organisations collaborate and form networks to act toward common network objects for solving common inter-organisational issues. Organisations also demonstrate motivation congruence for sustainability in traceability activity. While there is alignment in terms of motivation, we have also revealed that organisational collaboration is influenced by the broader community, including NGOs and other action research organisations for ethical working conditions and compliance. The notion of the subject, community, and object triangle is useful for analysing and understanding the impact of these external factors on organisational actions to enable traceability. Additionally, we were able to uncover types of connections (i.e., temporary or long-lasting) organisations form to work on addressing inter-organisational issues. **Secondly,** we observed how the activity of achieving traceability drives the implementation and use of inter-organisational tools like blockchain. The use of an inter-organisational tool changed the techno-organisational structure and expanded the supply chain network with a potential actor. In OJSC the blockchain provider's role is to monitor information input and provide information assurance to the actors in the supply chain network. Such the role of blockchain providers can be seen as the interaction between a subject and a community. This dynamic nature of blockchain providers highlights the emergence of possible hybrid actors and demonstrates how blockchain can reshape and evolve concepts of hybridity. **Thirdly**, we uncovered a contradiction between the organisational information-sharing policy and the requirement for information sharing – this impacted traceability data sharing and resulted in tensions. Uncovering this also helps to point to possible solutions, such as the requirement for common rules for sharing, which can lead to new insights around the importance of shared fit among organisations' constituent components. Blockchain could also lead to new ways of coordinating actions by creating new forms of governance and decision-making. Blockchain technology offers a new way to consider concepts of "rules" in the organisation. **Fourthly,** by centring our analysis on central activities, we were able to trace the emergence of tensions in the activities. For example, we identified scanning and data-feeding issues that have emerged in the blockchain-producing activities and division of labour activities. Identification of this suggests that actors need to adjust their existing scanning system to improve scanning and feeding data to the blockchain or increase the labour to perform the required scanning and data-feeding activities. This is suggestive of deeper contradictions within this activity network.

4 Implications, Future Steps and Limitations

Acting on the concern for lack of theorisation (Dubey et al., 2022; Treiblmaier, 2018), this paper aims to theorise the study of blockchain and supply chain to facilitate the in-depth investigation of the research phenomenon. By developing a theoretical framework through activity theory, this paper encourages cross-disciplinary theory in studying this emerging phenomenon. This paper demonstrates the application of activity theory to the analysis of blockchain-integrated supply chain activities and utilises vignettes to exemplify how the activity theory-based framework can yield fresh insights. This paper also provides a useful guide for future researchers, especially to use activity theory in their blockchain and other technology-related studies. The analysis of blockchain applications presented is also useful to other emerging technologies and distributed activities context. Moreover, this endeavour of theorisation will work as a bedrock for future rigorous theory-based research in the phenomenon of blockchain and supply chain, contributing to the development of both activity theory and blockchain research in the field of IS.

Our future steps will involve a detailed discussion of the insights provided by activity theory across all six vignettes and its applicability in explaining real-world complexities. Building on the insights, we also aim to posit different propositions. Furthermore, we will discuss how blockchain can challenge some activity theory concepts pointing to the future development of activity theory in studying emerging technologies like blockchain.

This study is limited by the scope and theory utilisation. This paper primarily emphasises activity theory and also highlights the challenges posed in studying blockchain with activity theory. Future research could explore these challenges, contributing to the development of activity theory and expanding opportunities to study critical aspects of blockchain uses. Future research also could explore the integration of theories for complementing activity theoretic analysis and facilitating a comprehensive understanding of blockchain's role in supply chains. Based on this study's activity theoretic analysis, additionally, future studies could examine blockchain's long-term business value and its impact on organisational rules and structures empirically.

5 References

Allen, D. K., Brown, A., Karanasios, S., & Norman, A. (2013). How should technology-mediated organizational change be explained? A comparison of the contributions of critical realism and activity theory. *MIS Quarterly*, 835-854. Retrieved from https://www.jstor.org/stable/43826003

Bai, C., & Sarkis, J. (2020). A supply chain transparency and sustainability technology appraisal model for blockchain technology. *International Journal of Production Research, 58*(7), 2142-2162. doi: 10.1080/00207543.2019.1708989

Beck, R., & Müller-Bloch, C. (2017). *Blockchain as radical innovation: a framework for engaging with distributed ledgers as incumbent organization.* Paper presented at the 50th Hawaii International Conference on System Sciences.

Berland, L. K., McNeill, K. L., Pelletier, P., & Krajcik, J. (2017). Engaging in argument from evidence. *Helping students make sense of the world using next generation science and engineering practices*, 229-257.

Bødker, S. (1989). A human activity approach to user interfaces. *Human Computer Interaction, 4*(3), 171-195. doi:10.1207/s15327051hci0403_1

Chen, S., Liu, X., Yan, J., Hu, G., & Shi, Y. (2020). Processes, benefits, and challenges for adoption of blockchain technologies in food supply chains: a thematic analysis. *Information Systems and e-Business Management*. doi:10.1007/s10257-020-00467-3

Crawford, K., & Hasan, H. M. (2006). Demonstrations of the Activity Theory framework for Research in IS. *Australasian Journal of Information Systems, 13*(2), 49-68. doi:10.3127/ajis.v13i2.40

Drescher, D. (2017). *Blockchain basics.*: Springer.

Dubey, R., Gupta, M., Mikalef, P., & Akter, S. (2022). Incorporating blockchain technology in information systems research. *International Journal of Information Management*, 102573. doi:10.1016/j.ijinfomgt.2022.102573

Engeström, Y. (1987). 1987 Learning by Expanding: An Activity-Theoretical Approach to Developmental Research. Helsinki: Orienta-Konsultit.

Engeström, Y. (1995). Objects, contradictions and collaboration in medical cognition: an activity-theoretical perspective. *Artificial intelligence in medicine, 7*(5), 395-412. doi:10.1016/0933-3657(95)00012-U

Engeström, Y., & Sannino, A. (2011). Discursive manifestations of contradictions in organizational change efforts: A methodological framework. *Journal of organizational change management, 24* (3), 368-387. doi:10.1108/09534811111132758

George, J. J., & Whitten, G. D. (2020). Blockchain in the Role of Emancipatory Technology. Retrieved from https://aisel.aisnet.org/amcis2020/global_dev/global_dev/8

Gligor, D. M., Pillai, K. G., & Golgeci, I. (2021). Theorizing the dark side of business-to-business relationships in the era of AI, big data, and blockchain. *Journal of Business Research, 133*, 79-88. doi: 10.1016/j.jbusres.2021.04.043

Günther, W. A., Mehrizi, M. H. R., Huysman, M., & Feldberg, F. (2017). Debating big data: A literature review on realizing value from big data. *The Journal of Strategic Information Systems, 26*(3), 191-209. doi: 10.1016/j.jsis.2017.07.003

Kaptelinin, V., & Nardi, B. (2018). Activity Theory as a Framework for Human-Technology Interaction Research. *Mind, Culture, and Activity, 25*(1), 3-5. doi: 10.1080/10749039.2017.1393089

Karanasios, S. (2018). Toward a unified view of technology and activity. *Information Technology & People, 31*, 134-155. doi:10.1108/ITP-04-2016-0074

Karanasios, S., & Allen, D. (2013). ICT for development in the context of the closure of Chernobyl nuclear power plant: An activity theory perspective. *Information Systems Journal, 23*(4), 287-306. doi: 10.1111/isj.12011

Karanasios, S., Nardi, B., Spinuzzi, C., & Malaurent, J. (2021). Moving forward with activity theory in a digital world. *Mind, Culture, and Activity, 28*(3), 234-253. doi:10.1080/10749039.2021.1914662

Kelly, P. R. (2018). An activity theory study of data, knowledge, and power in the design of an international development NGO impact evaluation. *Information Systems Journal, 28*(3), 465-488. doi: 10.1111/isj.12187

Korpela, M., Soriyan, H. A., & Olufokunbi, K. C. (2000). Activity analysis as a method for information systems development: General introduction and experiments from Nigeria and Finland. *Scandinavian Journal of Information Systems, 12*(1), 8. Retrieved from https://aisel.aisnet.org/sjis/vol12/iss1/8

Kshetri, N. (2018). Blockchain's roles in meeting key supply chain management objectives. *International Journal of Information Management, 39*, 80-89. doi:10.1016/j.ijinfomgt.2017.12.005

Leont'ev, A. N. (1978). *Activity, consciousness and personality*.

Lustenberger, M., Malešević , S., & Spychiger, F. (2021). Ecosystem Readiness: Blockchain Adoption is Driven Externally. *Frontiers in Blockchain, 4*. doi:10.3389/fbloc.2021.720454

Marques Nascimento Macêdo, N. M., & Bispo, M. d. S. (2022). Qualitative Vignettes Drawing on Real Cases as Method in Organizational Research. *Canadian Journal of Administrative Sciences / Revue Canadienne des Sciences de l'Administration, n/a*(n/a). doi:10.1002/cjas.1692

Miettinen, R. (1999). The riddle of things: Activity theory and actor-network theory as approaches to studying innovations. *Mind, Culture, and Activity, 6*(3), 170-195. doi:10.1080/10749039909524725

Rana, R. L., Tricase, C., & De Cesare, L. (2021). Blockchain technology for a sustainable agri-food supply chain. *British Food Journal, 123*(11), 3471-3485. doi: 10.1108/BFJ-09-2020-0832

Rogerson, M., & Parry, G. C. (2020). Blockchain: case studies in food supply chain visibility. *Supply Chain Management, 25*(5), 601-614. doi:10.1108/SCM-08-2019-0300

Ronaghi, M. H. (2021). A blockchain maturity model in agricultural supply chain. *Information Processing in Agriculture, 8*(3), 398-408. doi:10.1016/j.inpa.2020.10.004

Sampson, H., & Johannessen, I. A. (2020). Turning on the tap: the benefits of using 'real-life' vignettes in qualitative research interviews. *Qualitative Research, 20*(1), 56-72. doi:10.1177/1468794118816618

Spinuzzi, C. (2008). *Network: Theorizing knowledge work in telecommunications*: Cambridge University Press. doi:10.1177/1050651912444070

Spinuzzi, C. (2012). Working alone together: Coworking as emergent collaborative activity. *Journal of business and technical communication, 26*(4), 399-441. doi:10.1177/1050651912444070

Treiblmaier, H. (2018). The impact of the blockchain on the supply chain: a theory-based research framework and a call for action. *Supply Chain Management: An International Journal, 23* (6), 545-559. doi:10.1108/SCM-01-2018-0029

Treiblmaier, H. (2019). Toward More Rigorous Blockchain Research: Recommendations for Writing Blockchain Case Studies. *Frontiers in Blockchain, 2*. doi:10.3389/fbloc.2019.00003

Vygotsky, L. S. (1980). *Mind in society: The development of higher psychological processes*: Harvard university press.

Wong, L. W., Leong, L. Y., Hew, J. J., Tan, G. W. H., & Ooi, K. B. (2020). Time to seize the digital evolution: Adoption of blockchain in operations and supply chain management among Malaysian SMEs. *International Journal of Information Management, 52*. doi:10.1016/j.ijinfomgt.2019.08.005

Zhu, Q., Bai, C., & Sarkis, J. (2022). Blockchain technology and supply chains: The paradox of the atheoretical research discourse. *Transportation Research Part E: Logistics and Transportation Review, 164*, 102824. doi:10.1016/j.tre.2022.102824