Demystifying Blockchain Business Value: Insights from Food Supply Chain Use Cases

Research-in-progress

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Abstract

This study aims to demystify blockchain business value for the food supply chain by analysing various blockchain use cases. Despite the growing interest, there is limited understanding of blockchain's business value, which hinders its wide adoption and investments. The existing literature on technological business value is arguably generic and ambiguous in the context of blockchain. Given blockchain's unique attributes and potential multifaceted impact, a comprehensive evaluation of its business value is necessary. By investigating seven existing blockchain use cases in Study 1, this study identifies four interrelated values- technology, process, network, and service- collectively contributing to blockchain business value. An explanatory model is developed based on the preliminary analysis of Study 1, which will be validated by interviews with eleven experts in Study 2. This research offers profound insights into blockchain business value generation within multi-tier supply chains, encouraging broader industry adoption.

Keywords Blockchain, Business Value, Case Studies, Explanatory model, Food Supply Chain.

1 Introduction

Recent shocks to the food supply chain resulting from war, COVID-19, and climate change have put 49 million people at risk of famine or famine-like conditions (WorldEconomicForum 2022). Concerns about food production, processing, distribution, demand, safety, and affordability (WHO 2020) have been increasingly urgent. To overcome these challenges, about 140 companies have explored, and pilot-tested blockchain (Kumar et al. 2020) due to its high revolutionary potential (Nofer et al. 2017). This is because blockchain is believed to be capable of addressing supply chain challenges, opening new avenues for creating value for all stakeholders (Iansiti and Lakhani 2017), and making a significant impact <removed for refereeing>.However, only a few use cases are still fully operational (Kumar et al. 2020). This is often attributed to a failure to thoroughly evaluate the necessity of blockchain technology (Furlonger and Valdes 2017), its impact and value (Min 2019).

Amid the real-world impact of blockchain remains to be seen, there is a growing need to evaluate and understand the business value of blockchain (Min 2019). Recent academic discourse has echoed this call for blockchain business value evaluation <removed for refereeing>. Motivated by this identified gap, this research aims to clarify the business value of blockchain by understanding the diverse value generated by blockchain that contributes to the overall business value. The research question that this study aims to address is- *How does blockchain generate business value within the supply chain?*

To address this research question and better understand the potential business value of blockchain within the supply chain community, this study has taken a multiple-study approach. In Study 1, this research explores seven blockchain use cases from existing studies to identify different values through within and cross-case analysis. Based on the analysis it develops an explanatory model to demonstrate how values build on each other. Study 2 is designed to validate the explanatory model by gathering insights from key stakeholders, including blockchain experts, service providers, and participants in the food supply chain. This approach helps illuminate the value of blockchain in addressing critical issues within the food supply chain and facilitates the broader adoption of this technology.

The rest of the paper is organised as follows: the following sections present the literature review and outline the research design. It also offers preliminary findings based on the initial analysis and outlines the future steps of this research.

2 Literature Review

Information technology (IT) business value has been an ongoing focus for IS scholars (Melville et al. 2004; Palas and Bunduchi 2020; Schryen 2013). This interest reflects the importance of understanding the business value of IT as it is the cornerstone of IT success (Watts 2018). However, determining the business value remained ambiguous and challenging (Schryen 2011; Schweikl and Obermaier 2022).

Existing research on business value varies significantly in concept, scope, levels of analysis, evaluation periods, and theoretical frameworks, presenting several challenges (Melville et al. 2004; Schryen 2013). **Firstly,** much research on IT business value focuses on economic impacts, like productivity and performance, which may not fully capture the comprehensive value IT generates (Melville et al., 2004; Schryen, 2011). **Secondly**, the proponent of value depends on how we capture and quantify value from IT investment, with challenges from multiple stakeholders' involvement and varying perceptions (Kohli and Grover 2008). **Thirdly**, ambiguous terminology in the literature, such as the interchangeable use of 'IS', 'IT', and 'Technology', and varied terms like 'value', 'performance', 'outcome', and 'benefit', complicates understanding technological impacts (Melville et al. 2004; Schryen 2013). **Fourthly**, the perceived value of technology is dynamic and often depends on its time, usage and adoption (Palas and Bunduchi 2020). **Lastly,** technological value extends beyond organisational boundaries, involving multiple stakeholders and necessitating multi-level evaluation to understand the relationship between IT investment and outcomes (Melville et al. 2004; Schryen 2011).

Amid these challenges, reflecting blockchain business value from existing IT/IS business value research is challenging. The reason being (i) the blockchain business value varies on its unique technical artefacts (Beck and Müller-Bloch 2017), (ii) its applications and types are diverse and multifaceted, as it can serve as a platform or infrastructure (Zavolokina et al. 2020). iii) assessing blockchain's value necessitates evaluating various types of value at different stages, and time as the dynamicity of value perception changes over time (Zavolokina et al. 2020) and (iv) its impact is complex and multi-tiered (Sultana et al. 2022).

Table 1: Identified values from blockchain literature and the blockchain-driven value categories

Identified values from blockchain literature	Brief value prescribes	Justifications behind value Categorisation	Blockchain-driven value category
Data integrity	Blockchain immutability through cryptographic hash functions ensures no modification of recorded transactions ensures data integrity (Schmidt and Wagner 2019).	Blockchain's core technical features enhance tamper-evident and decentralised digital transactions and records that generate these values (Xu et al. 2021).	**Technology value**
Authenticity	The permanent and tamper-proof record of transactions enables the tracking of goods, ensuring authenticity (Bumblauskas et al. 2020; Martinez et al. 2019; Schmidt and Wagner 2019)		
Security	In blockchain, no single entity controls the system, which facilitates decentralisation and enhances security (Treiblmaier 2019).		
Process automation	Blockchain programmability enables automated and self-executing transactions through smart contracts which enhance process automation (Chang et al. 2019).	Blockchain contributes to the managing and improving various processes within the supply chain (Beck and Müller-Bloch 2017; Chang et al. 2019) which drives these value creations.	**Process value**
Operational efficiency	Blockchain, through smart contracts, simplifies supply chain transactions and workflows (Chang et al. 2019) and removes the cost and delay in the supply chain (Awwad et al. 2018) helping to speed up financial transactions (Beck and Müller-Bloch 2017).		
Provenance	With blockchain, customers can verify product information digitally which facilitates provenance (Vazquez Melendez et al. 2024).		
Traceability	The information recorded in the blockchain ledger allows future tracing and enhances Traceability within the supply chain (Costa et al. 2013; Food-safety 2012).		
Process optimisation	Process optimisation through blockchain involves reducing intermediaries' fees, operational and processing time, and interference by automating manual processes, centralising peer-to-peer authentication, and disintermediating unnecessary intermediaries (Chang et al. 2019; Lai et al. 2021; Martinez et al. 2019).		
Accuracy	Blockchain enhances accuracy by helping to prevent overproduction and underutilisation while reducing manual errors during planning and execution in the supply chain, thereby ensuring precise resource allocation and bolstering trust in supply sources (Lai et al. 2021; Rao et al. 2021)		
Synchronisation	Blockchain contributes to synchronisation by facilitating seamless coordination and alignment across various stages of the supply chain, minimising discrepancies and delays, which ultimately enhances efficiency and responsiveness in meeting customer demands (Lai et al. 2021)		

Collaboration	Blockchain contributes to collaboration within supply chains by providing a secure and transparent platform for diverse stakeholders to share data and insights leading to more effective coordination and decision-making (Treiblmaier et al. 2021)	Blockchain enables synergy between joint efforts, thereby enhancing network connectivity and mutual gains among all parties involved, facilitating these values (Demuth 2020; Mačiulienė and Skaržauskienė 2021; Pawczuk 2019).	→ **Network value**
Corporation	Blockchain enhances cooperation among supply chain stakeholders by facilitating the alignment of standards and practices, enabling stakeholders to establish common ground and streamline communication by addressing information asymmetry and coordination difficulties (Nakasumi 2017)		
Co-creation	Blockchain contributes to co-creation by addressing associated challenges with co-creation (Narayan and Tidström 2020) and providing a decentralised and transparent environment for stakeholders to collaborate, share resources, and jointly innovate, fostering trust and mutual recognition among contributors (Mačiulienė and Skaržauskienė 2021).		
Co-opetition	Blockchain facilitates co-opetition by eliminating information gaps and power imbalances through decentralised and informed information sharing and enabling organisations to harness network effects and complementary strengths to achieve shared goals (Demuth 2020; Pawczuk 2019).		
Sustainable practices	Blockchain contributes to sustainable practices within networks by enabling distributed and transparent information sharing, which enhances accountability and traceability throughout the supply chain, thereby promoting ethical sourcing and reducing environmental impact (Chandan et al. 2019; Friedman and Ormiston 2022).		
Transparency	Blockchain also facilitates participant transparency by allowing every node to access the same information and inspect smart contracts' content (Kshetri 2018).	Blockchain enhances the value of services through innovations that align with the needs of various stakeholders, including customers, organisations, and the broader industry contributing to these values (Narayan and Tidström 2020; Nisar et al. 2024)	→ **Service Value**
Trust	Blockchain enhances trust among stakeholders in multi-tier supply chains by providing a transparent and immutable record of transactions, fostering confidence in the integrity of data and interactions (Howson 2020).		
Accountability	Blockchain promotes accountability by enabling traceability and verification of actions and responsibilities throughout the supply chain, ensuring that stakeholders are held accountable for their contributions and decisions (Hastig and Sodhi 2020)		
Quality	Blockchain improves quality by ensuring data accuracy, traceability, and facilitating rapid issue identification and resolution (Yadlapalli et al. 2022).		
Alignment	Blockchain enhances alignment within multitiered supply chains by seamlessly integrating with organisational goals, strategies, business processes, and core values (Nisar et al. 2024).		
Visibility	Blockchain provides unparalleled visibility into the supply chain by allowing organisations to accurately plan and forecast, effectively aligning product supply with demand (Bumblauskas et al. 2020; Martinez et al. 2019).		
Resilience	Blockchain enhances supply chain resilience by facilitating transparency, ensuring that every node has access to the same information and addressing trust-related issues within the decentralised system ((Howson 2020; UNCTAD 2020).		

Hence, evaluating blockchain business value requires a holistic perspective because there can be various forms of business value (Schryen 2011) and comprehensive understanding at organisational, inter-organisational, and industry levels, accommodating a multi-stakeholder view.

In this study, we argue business value is multifaced which includes diverse values that businesses care about, not limited to financial values only (Killick 2016). IT business value can manifest in multiple ways at multiple levels (Kohli and Grover 2008). Unlike existing research which leans towards financial/economic values for investigating business value (Melville et al., 2004; Schryen, 2011), this study focuses on the functional values that blockchain brings contributing to the overarching blockchain business value. To do that, this study investigated different value attributes of blockchain to get insight into the overall business value and to understand how diverse values manifest.

Therefore, this study reviewed blockchain literature related to value discussion to comprehensively understand the value generated by blockchain given the need to explore diverse blockchain business value. Existing literature on blockchain directly or indirectly explored and discussed different blockchain impact and value attributes (Kamble et al. 2020; Pournader et al. 2020; Xu et al. 2021). Based on our review, we identified different blockchain value attributes, which we then categorised into four blockchain-driven value categories- technology, process, network and service; summarised in Table 1.

3 Research Design

This research is designed based on a multiple-study approach, to ensure academic rigour and to align with top IS outlets as identified in recent publications (Toorajipour et al. 2024; Zhang et al. 2024).We begin with a literature review to identify research gaps and to frame the studies. Our literature search covered key databases like AISe-L, Web of Science, and Scopus, focusing on peer-reviewed academic journal articles. Additionally, we reviewed white papers from HBR, McKinsey & Company, Concensys, Medium, Investopedia, and Deloitte for blockchain value-in-practice discussions. The literature review was designed to provide an in-depth outlook to find different value attributes of blockchain. These value attributes are the prerequisites for analysing the case studies in Study 1.

In Study 1, we conducted case study research to understand the complex phenomenon of blockchain, as it is an effective method for investigating and translating industry experience into theory development and research design (Kouhizadeh et al. 2021). We selected blockchain use cases within the food supply chain. Based on Google searches, 21 use cases from grey literature (Daley 2022) and academic research were identified (Akhtaruzzaman Khan et al. 2022; Howson 2020; Rogerson and Parry 2020). We refined the selection based on two criteria: operational use cases and those explored in existing research. After excluding conceptual and pilot cases (Tönnissen and Teuteberg 2020), we selected seven cases that meet both criteria. Refer to Table 2 for the details of the seven case studies. Based on the analysis of the seven cases, we developed an exploratory model of blockchain business value (ref to Figure 1).

Table 2: Selected cases

No	Blockchain use cases in the food supply chain	Location	References
1	AgriDigital	Australia	(Eyers 2018; Sylvester 2019; Tönnissen and Teuteberg 2020; Xu et al. 2019)
2	IBM Food Trust	New York, United States	(Daley 2022; Howson 2020; IBM 2020)
3	OpenSC	Australia	(Akhtaruzzaman Khan et al. 2022; Howson 2020)
4	Provenance	Indonesia	(Akhtaruzzaman Khan et al. 2022; Howson 2020)
5	Techrock	China	(Rogerson and Parry 2020)
6	TraSeable (WWF)	Fiji	(Howson 2020; Rogerson and Parry 2020)
7	BeefLedger	Australia, China	(BeefLedger 2023; Jerome and Wei 2022; Natanelov et al. 2022)

Study 2 is designed to validate the explanatory framework developed from the cases presented in Study 1. This validation is achieved through semi-structured interviews with experts in blockchain and supply chain

management. These interviews are designed to gather expert perspectives on the emerging theoretical frameworks, thereby enhancing the robustness and credibility of this study. We identified and contacted 25 experts from blockchain-related seminars and conferences, from whom so far, we have interviewed 11 experts. All interviews were conducted via videoconferencing due to the global distribution of the experts.

4 Preliminary Findings and Future Steps

The preliminary findings are drawn from a literature review and seven use cases from Study 1. Four blockchain business values (technology, process, network, and service value) were identified each contributing to the integral components of the blockchain business value in practice.

We reviewed all the value attributes identified in the literature review and found that most of the values were also identified in the seven cases. However, we note an over-optimism in the literature regarding value attributes like anonymity and co-creation. Across the seven case studies, the core technological value identified is authentication. For process value - improving transparency and traceability are prioritised in all cases. In network value, information sharing, and sustainable practices are mostly observed. Trust and safety are identified as core service values from the case analysis. We also observed that the values are building on each other. For example- The technological value attribute authenticity and data integrity provides foundational benefits that facilitate traceability and transparency as process value and facilitate information sharing and collaboration as apparent in AgriDigital and IBM Food Trust. Building on blockchain process and network values, multi-stakeholder service value is observed such as BeefLedger. Based on these findings, we developed an explanatory model of blockchain business value (refer to Figure 1). This model shows that blockchain's core technical features facilitate technological value, which influences the other values like network, process value and service value. A combination of these values ultimately contributes to blockchain business value. However, the interconnection among these values requires further analysis and investigation.

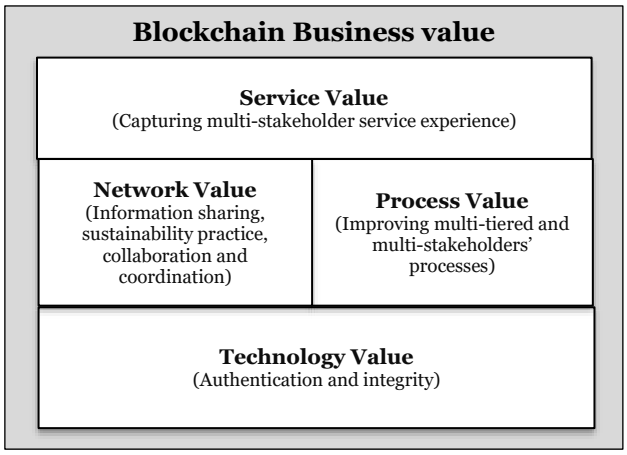

Figure 1: Blockchain business value model

We further plan to analyse and explore inputs from the expert interviews to validate our findings, understand the interconnection among the values and refine our explanatory model, offering rich insights into blockchain value in practice in Study 2. Therefore, the future steps involve a thematic analysis of expert interviews to understand the value practitioners perceive based on their experience with blockchain in various use cases.

Our study contributes to both Information Systems (IS) academics and industry by presenting a comprehensive model that highlights the cumulative nature of blockchain business value across four key dimensions: technological, process, network, and service. For IS scholars, this model offers a theoretical framework that addresses the gaps in the literature by illustrating how blockchain drives business value through interconnected value types, advancing the understanding of its impact beyond financial metrics. For industry practitioners, our model provides practical insights on leveraging blockchain's potential to create sustainable ecosystems, offering a strategic pathway to align blockchain initiatives with organisational goals and overcome adoption challenges.

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, (doi: 10.1016/j.ijinfomgt.2024.102822)