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A Framework for the Profitable Integration of Distributed Ledger Technologies in Enterprise Networks

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Abstract. Distributed ledger technologies (DLT) have been piloted in enterprises to improve transparency and trust relationships among multiple partners but have not managed to mature as planned. Even though most implementation projects demonstrate various opportunities for the involved partners, enterprises experience difficulties in assessing the technology's impact on profitability in order to make valid investment decisions and improve productivity. This paper employs the dynamic capabilities theory to explore how enterprises can adapt and leverage DLT for improved profitability. It presents an applicable profitability assessment model and a collection of quantitative profitability factors of DLT in enterprise networks. The framework and its associated models are developed through an inductive Grounded Theory-based approach, composed of literature reviews and qualitative empirical studies from 40 participating mixed-industry blockchain, tangle, and hashgraph experts. To retrieve profitability factors in a structured manner, the framework features an integration model covering necessary assessment steps; a taxonomy and heat map characterizing the maturity and assessment situation of the DLT; as well as an assessment model to identify and monetize profitability factors.

1. Introduction

In supply chains, the levels of both cooperation and competition are increasing, mainly due to globalization. This development demands new co-opetition approaches to achieve the next level of innovation.[1, 2] Emerging technologies, such as distributed ledger technologies (DLT), address this need and are piloted or already implemented in various industries to establish transparency as well as trustful and traceable relations between potentially untrusted parties.[3, 4] Even though already developed concepts demonstrate feasibility and offer diverse opportunities for the involved parties in practice, few projects successfully introduced productive systems. While 87% of the 447 blockchain projects investigated in 2018 remained in their Proof of Concept (PoC) stages,[5] 80% of PoC's investigated in 2022 have matured further but have yet to reach productivity.[6]

One of the main obstacles is determining the technology's impact on profitability,[7, 8] which is demanded as compensation for the high risks and uncertainties associated with DLT experimentation.[9, 10, 11] Another connected obstacle is seen in the fact that most enterprises still

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pilot their solutions within the boundaries of a rather small number of participants and face difficulties in choosing profitable application areas across their supply chains.[12, 13] While research has been carried out on the systematization of blockchain business models in finance or smart city environments, the supply chain and logistics domain requires further consideration.[14] Therefore, in this paper, three research questions are utilized to address the described problem statements:

(RQ1): Which benefits and challenges are caused by blockchain solutions in supply chain management and can be utilized to derive profitability factors?
(RQ2): Which dimensions can be utilized to characterize blockchain solutions in supply chain management with respect to their maturity and impact on profitability?
(RQ3): Which profitability factors, i.e., revenues and costs, are perceived for a profitability assessment of blockchain solutions in supply chain management?

To address these research questions, the paper first provides background on blockchain solutions in supply chain management and profitability assessments. Next, it presents related works specifically focusing on the profitability assessment of blockchain solutions. Following this, the research methodology is described, including a systematic literature review, taxonomy development, and an interview study. The first outcome of the paper is a catalog of relevant blockchain benefits, challenges, and risks derived from the literature. The second outcome is a multi-dimensional taxonomy that classifies and highlights characteristics related to the maturity and profitability of blockchain solutions in supply chain management. The third outcome maps concrete profitability factors from the analyzed interviews to categories for technology assessment, which are then presented in factor matrices. The paper concludes with a discussion of the results, the extraction of six design principles necessary for developing blockchain profitability assessment models, and an overview of limitations and future research needs.

2. Scientific Background

2.1. Blockchain Technology in Enterprises and Enterprise Networks—Blockchain technology can be seen as the most prominent subset of different distributed ledger technologies that describe decentralized or rather distributed IT infrastructures.[15] In these infrastructures, accounts are no longer managed centrally by a single instance, but in a distributed peer-to-peer (P2P) network.[16] Blockchain technology uses cryptographic mechanisms to secure data integrity by utilizing “blocks” to store transactions sequentially and cryptographically “chained” together. The blocks are distributed among the network participants, represented by nodes, and are agreed upon through a consensus mechanism, thus providing a shared consistent single point of truth.[4] This foundation makes it possible to utilize tokens that build a digital representation of physical assets using trusted execution of smart contracts and used for decentralized applications. In addition, smart contracts are responsible for automating processes.[17] Blockchain solutions can be categorized into public solutions that grant complete data transparency and are most prominently applied for cryptocurrencies, as well as private and consortium solutions that possess access, read, and write authorizations for either single network members or a consortium of members.[18]

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In enterprises—and particularly within enterprise networks—private and consortium blockchain variants are used more frequently.[19] In most enterprises, the supply chain management function is responsible for coordinating, optimizing, and ensuring error- and failure-free cross-enterprise operations by utilizing appropriate technologies for data exchange.[20] Following the renowned Supply Chain Operations Reference (SCOR) model, six main processes are involved in supply chain operations: *planning* processes describe activities required to operate the supply chain by gathering requirements, information, and available resources; *sourcing* processes comprise the ordering and receipt of goods and services; *making* processes refer to the transformation of materials or the creation of service content and lead to *delivery* processes, which involve the creation, maintenance, and fulfillment of customer orders; *return* processes are associated with the reverse flow of goods, while *enable* processes support the overarching management and coordination of the supply chain.[21] Mentzer *et al*. state that implementing supply chain management enhances these processes, improves customer value and satisfaction, and positively affects the profitability of the supply chain and its members.[20]

2.2. Profitability and Profitability Assessment of Blockchain Technology—Profitability is one of the most prominent measures of business performance.[22] In fact, profit maximization is a behavioral goal of enterprises with respect to pure economics and can be achieved by influencing the total revenues or total costs, whose difference results in profit.[23] The described accounting profit can be distinguished from an economic profit that also includes opportunity costs for taking one action versus another.[24] In any case, enterprises generally seek to achieve higher revenues while reducing costs in order to bear market risks.[22, 25] The exploration of new technologies constitutes a risk itself but likewise allows for new opportunities.[26] For new technologies to become a sustainable business reality, profitability considerations are key for their integration processes.[12] Generally, these profitability considerations can be divided between (a) blockchain-caused costs—costs along the lifecycle of a technology, from start-up costs to operations—and (b) blockchain-enabled revenues—potential revenue increases as well as cost reductions through process-, resources-, or effort optimization (see Figure 1).[27, 28, 29] Independent of a particular technology, the profitability assessment of information technologies (IT) has already proven to be challenging in research for decades as complex dynamics influence them,[30] and a lot of benefits are strategic or intangible and therefore non-quantifiable.[31]

While Huber already made technical capabilities responsible for profitability effects,[32] Barney adds different assets such as management skills, organizational processes, and routines, as well as available information and knowledge to be a source of competitive advantage leading to profitability.[33, 34] The capabilities perspective emerged from the resource-based view that conceptualizes a firm as an administrative unit with a goal to allocate resources efficiently.[35] By analyzing capabilities in dynamic environments it is argued that IT might not be a source of value on its own,[36] and value might be realized through organizational adaptation that utilizes IT for creating superior capabilities beyond the boundaries of a focal firm.[37, 38] Therefore, firms often deploy their IT in combination with other resources and organizational processes, to co-create valuable capabilities in their network of partners (see Figure 1).[30] This paper focuses on the valuable capabilities of blockchain solutions in supply chain management and considers the combination of other resources (other technological, information-related, and human resources) as well as organizational processes to derive tangible profitability factors.

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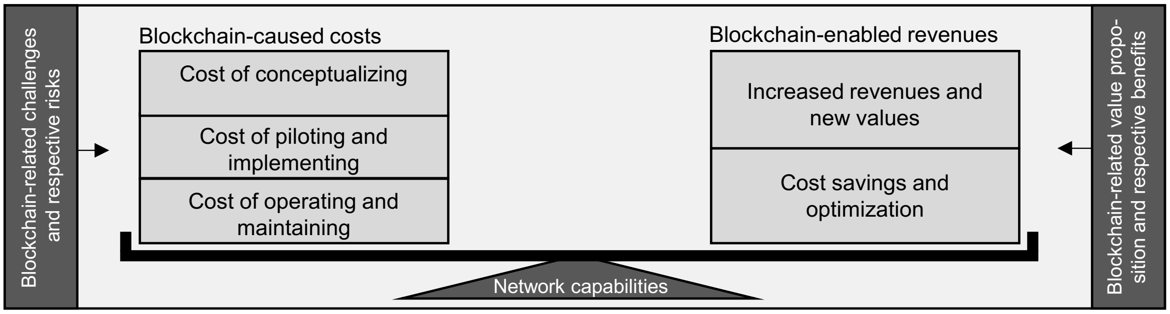

Fig. 1. Blockchain profitability, own figure based on Larsen *et al.* (2022) and Setia *et al*. (2015).[27, 30]

3. Related Work

Scholars have already undertaken initial research on blockchain profitability in specific application areas. Downey *et al*. provide insights into how blockchains add value in supporting the workflow management of engineering contracts and highlight system architectural aspects.[12] Nevertheless, concrete factors influencing profitability are not addressed. Hu examines a blockchain-based e-commerce platform with a focus on profit maximization, [23] but the connection between blockchain functionalities and the resulting profits is not explored. With a stronger focus on the supply chain domain, the not-for-profit organization GS1, [39, 40] Nickelowski *et al*.,[41] and Jensen *et al*., [9] present case studies that touch on blockchain profitability among other topics. While GS1 elaborates on the cost side of a cross-company project for blockchain-based pallet exchange, Jensen *et al*. focus primarily on the revenues generated by TradeLens—a blockchain-supported platform for tracking shipping containers and related documentation across supply chains. These related works demonstrate that only a few productive enterprise solutions provide profitability data that is accessible for scientific research.[9] They also highlight the need for further research to transfer available findings to broader or alternative use cases. [40]

Apart from work dealing with specific application areas, scholars have begun to systematize knowledge on blockchain profitability. Tönnissen and Teuteberg, for example, analyze ten blockchain case studies to identify added values evoked by the technology.[42] They successfully link these added values to blockchain functionalities but remain at a higher-level definition of profitability, focusing on factors like disintermediation and transparency rather than concrete revenues and costs. Weking *et al*. examine the impact and benefits of blockchains through the lens of trust relationships by quantitatively analyzing 99 blockchain ventures. [8] As a result, they introduce five archetypal business model patterns. As a limitation and future research direction, the authors emphasize that a significant gap remains between the promised and actual business value of blockchain applications. Furthermore, Tönnissen *et al*. present a taxonomy of blockchain start-ups by quantitatively analyzing 195 of them via startup databases. [43] The authors identify three business model archetypes and demonstrate ways to create blockchain-based value in an ecosystem. In their discussion section, it is said that further research is needed on blockchain success factors with respect to ecosystems. The study by Kumar and Yash investigates the critical success factors of blockchain technology for enhancing supply chain resilience and sustainability.[44] The authors identify 21 critical success factors such as trust building and enhanced flexibility suggesting that these factors should be considered by

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implementation projects as significant influences. However, while the study provides strong insights into the relationships among these qualitative factors, it falls short in offering concrete, quantifiable metrics that practitioners can use to assess the monetary implications of these factors. The related works demonstrate a clear necessity for more granular analysis of blockchain profitability, particularly with respect to both revenues and costs. They further indicate that deeper insights from practice are needed, as tangible profitability factors remain largely inaccessible from startup databases or existing case studies.

This paper, therefore, contributes to the ongoing debate around whether blockchain implementations in supply chains are expected to, or even capable of, delivering profitability.[45,46] Rather than presuming profitability as a given, this study responds to the lack of operational evidence by developing a structured framework that helps practitioners and researchers critically assess where, how, and under what conditions blockchain solutions may create economic value within enterprise networks.

4. Research Design

In the research design of this paper, both theoretical and practical implications are considered through an engaged research approach. This approach aims to bridge the gap between theory and practice by developing research that not only addresses real-world problems but also advances theoretical understanding.[47] As theoretical insights on blockchain profitability are rare and remain at a high level, an explorative research design is required and conducted by means of the Grounded Theory.[48] Grounded Theory characterizes qualitative research designs that are composed of a collection of systematic but flexible guidelines, and practices applied for largely unknown or complex subjects.[49] Holstein emphasizes the receptiveness towards observations through expert interviews as a research method leading to data being the starting point of research. However, Grounded Theory does not aim to provide complete individual statements as evidence. Instead, the aim is to take a theoretical analysis of observable practices to a higher level while maintaining a clear link to literature findings.[50] Commencing research without considering prior knowledge was found unsatisfactory, particularly for the research subject of supply chain management, where Grounded Theory is frequently used.[51] Therefore, the intention for this paper is to build upon the introduced related works, reflect the stated problem statements, and conduct empirically enriched research addressing clear research gaps. For the outcomes, Grounded Theory allows for an identification of context-specific profitability factors derived from actual industry practices while facilitating a more grounded understanding of how to realize economic value.

Starting from these insights, a research process is developed to answer the research questions raised in section one. Under the application of Grounded Theory, the following research process (see Figure 2) is deployed in this paper and described in detail in this section. The foundation of the paper is developed through a systematic literature review by searching and clustering the first findings on blockchain profitability in catalogs. On that basis, a taxonomy is developed to systematize the findings and characterize the maturity and profitability of blockchain solutions. Finally, the interview study is conducted to retrieve findings presented as a heat map and deliver profitability factors to be presented in factor matrices.

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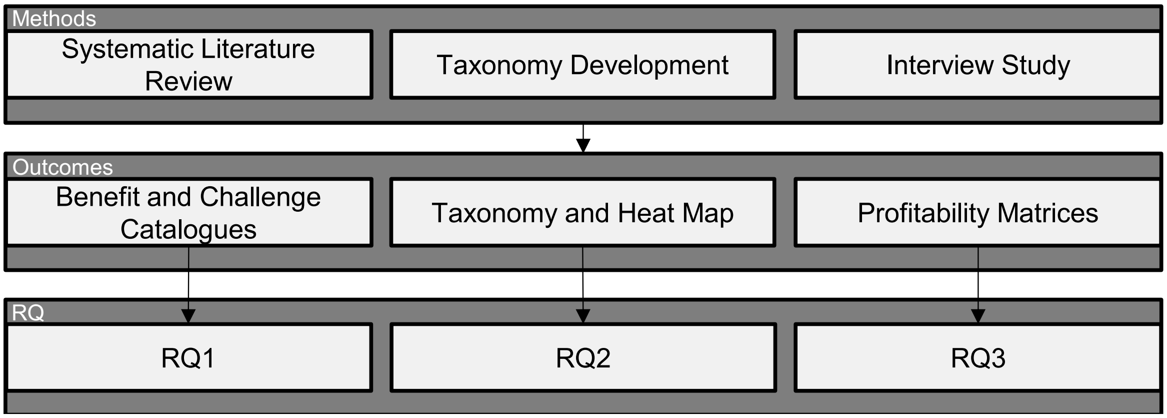

RQ=Research Question

Fig. 2. Research Design and Outcomes.

4.1. Literature Review—To systematically identify existing knowledge on profitability considerations in enterprise blockchain implementations for supply chains, we conducted a systematic literature review of works published between 2023 and 2025.[52] The review follows the established guidelines of Vom Brocke *et al*. and Webster and Watson.[53, 54] Vom Brocke *et al*. propose to (1) define the review scope, (2) conceptualize the topic, (3) search the literature, (4) analyze it, and (5) define the research agenda. Therefore, the review scope is defined as "articles about blockchain in supply chain management focusing on profitability." The resulting Boolean search term (see Figure 3) was iteratively developed and applied to titles, abstracts and keywords in Scopus (as one of the most established scientific databases) before additional screening was conducted in the ACM Digital, Science Direct, and JSTOR databases to make sure to locate a comprehensive number of articles that are representative of the topic.

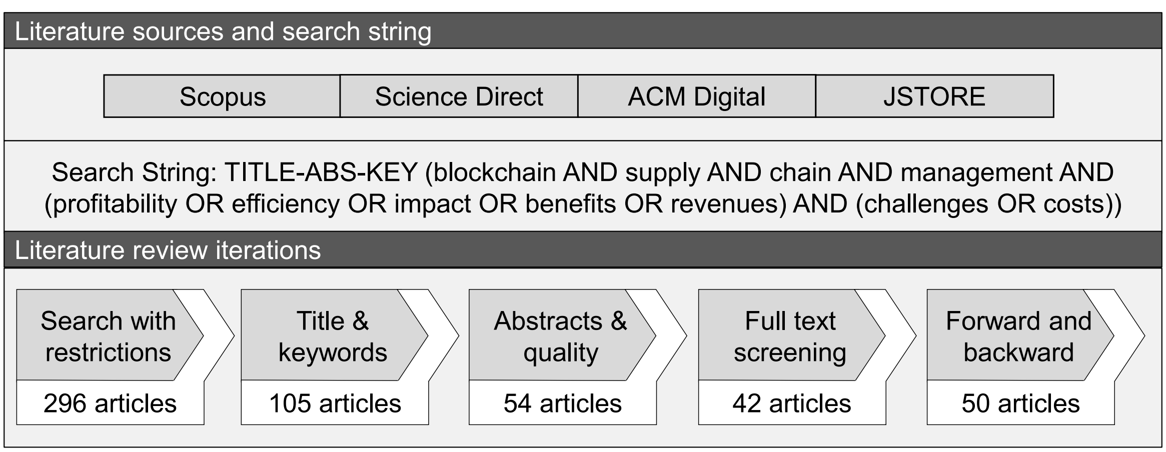

Fig. 3. Systematic Literature Review Procedure, own figure, based on Holstein (2013) and Mills *et al*. (2006).[49, 50]

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Exclusion criteria were applied during the systematic literature review process (languages other than English or German; publishing dates prior to 2015; so-called "grey literature"; non-accessible or not published literature) before scanning through titles and keywords. When reading the article's abstracts in the next step, quality control questions (considering articles' consistency and comprehensibility) were utilized as proposed by Cooper (1988) and Vom Brocke *et al*. (2009) before retrieving those articles selected for a full reading. After full text reading of 54 articles, 12 were discarded while another eight were added through a forward and backward search.

4.2. Taxonomy Development—In order to characterize blockchain solutions described in the literature as well as in practice, a taxonomy is developed to describe their maturity and profitability in a structured and comparable way. Therefore, the widely used methodology for taxonomy development from Nickerson *et al*. is applied. [55] The method consists of seven steps (see Figure 4): the determination of a meta-characteristic; the specification of ending conditions; and the choice to follow a conceptual-to-empirical or empirical-to-conceptual approach, which then leads to an additional three steps either way. The conceptual-to-empirical approach focuses on the development of characteristics and dimensions before examining the objects. The empirical-to-conceptual approach focuses on extracting characteristics and dimensions from the prior examined objects. Both approaches must be conducted repetitively until the prior specified ending conditions are met. Nickerson *et al*. already defined 13 ending conditions that were utilized for this research work during three iterations of the empirical-to-conceptual approach.[55] By means of this approach, dimensions and characteristics were developed, discussed, and deleted in each iteration.

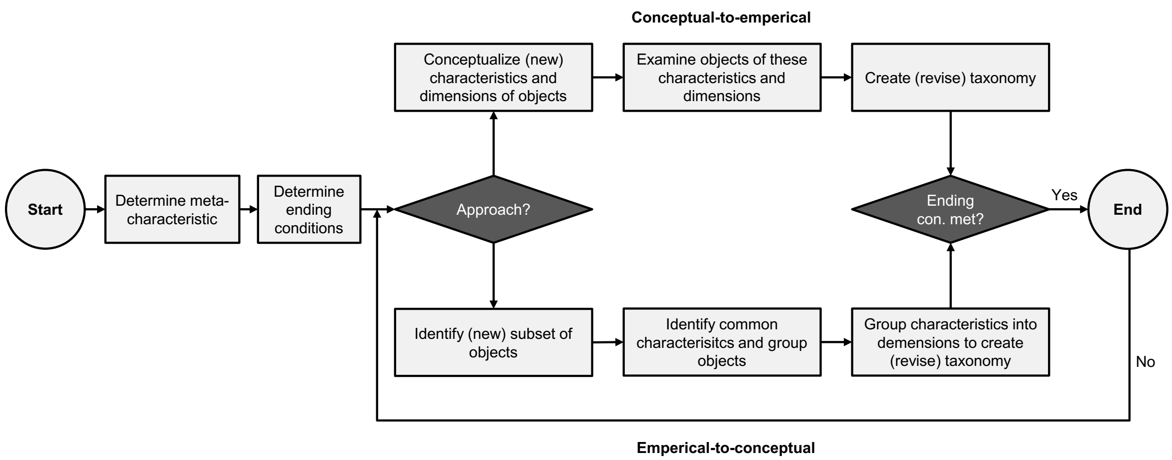

Fig. 4. Taxonomy Development following Nickerson.[55]

The development of the taxonomy required three main iterations until all 13 ending conditions were met. The first iteration was developed with support of 77 articles from a literature review centered around blockchain-focused typologies. This iteration consisted of five meta-dimensions and 17 dimensions. As some of them were not meaningful, it was decided to eliminate them in the second iteration, based on another 12 articles that focused on already published taxonomies in adjacent fields. Four meta-dimensions and 15 dimensions were retrieved in this iteration. After that, the taxonomy was able to meet nine ending conditions.

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Finally, another 14 case-specific articles were selected that explain certain blockchain solutions in detail and offer the possibility of characterizing them by applying the taxonomy.[56] During this iteration, no further dimensions were erased, but wordings were adapted to improve the comprehensibility, prevent repetitive terms, and finally meet all 13 ending conditions. As proposed by Kundisch *et al*., an evaluation of the taxonomy is conducted during the course of the interview study and, as explained below, also presents two windows per model to elucidate their objectives and demonstrate their utility as tools in practice. Lastly, the models are integrated into the overall process and arranged in a sequential order.

4.3. Interview Study—To retrieve more practical insights on blockchain-generated revenues and costs, it was decided to conduct an interview study with blockchain experts involved in current proof-of-concepts, pilot, or implementation projects of blockchain solutions in supply chain management. Therefore, interview partners were selected that possess profound knowledge of unique experiences arising from their actions, responsibilities, and obligations as members of blockchain project teams.[57] As the study is based on Grounded Theory principles, theoretical sampling is applied to further optimize the selection of relevant interview partners.[48] Hence, out of the project members, only practitioners were chosen who are actively involved in current projects and possess medium to high blockchain and supply chain knowledge. The authors estimated the level of knowledge based, in the first place, on the interviewee's position and work experience, and secondarily asked them to assess their own knowledge level at the beginning of the interview.[58] Again, to ensure accuracy, the industries in the selected sample match with relevant industries identified by literature reviews and prior works.[59] The study was conducted over a time horizon ranging from 2020 to 2022 and included single interviews with 40 experts (an overview of the sample can be obtained from Appendix 1, Overview of Interview Partners).

The data collection process started with an invitation email giving the experts an idea of the study's research methodology, goals, and the topic of the conversation, but also asking them to provide supporting material prior to the interview if available. In particular, they were asked to provide any existing procedures for profitability analysis or similar material. After scheduling appointments, the interviews took place via Zoom and were recorded with an additional audio recording tool. The interview duration was scheduled for 60 min and effectively varied from 40 to 90 min. At the beginning of each interview, the partners were asked to introduce themselves and their company briefly. Then, interview questions were asked based on a semi-structured interview guideline and involved three major topics: (1) the description of the particular blockchain solution, its maturity, and involved parties; (2) benefits and challenges as well as concrete revenues and costs that have been identified; and (3) mechanisms for profitability assessment that are already in place or could be brought into place (the interview guideline can be obtained in Appendix 2: Interview Guidelines).[60] The interviews were recorded with the experts' consent, transcribed, and analyzed systematically. Building upon the taxonomy, it was a further goal to identify white spots in the predominant characteristics and display them as a heat map. Therefore, all interviews were coded along with the taxonomy characteristics as binary (1: the blockchain solution offers the feature; 0: the blockchain solution does not offer the feature; see Appendix 3 for an example of the coding process) and selected results were discussed in a group of blockchain scholars in the form of a peer debriefing.[61] Particular results were sent back to the respective interviewees for an additional review and confirmation (see the "confirmation" (CON) column in Appendix 3). Finally, profitability factors were identified

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within the interview transcripts and displayed in profitability matrices. Here, again, workshops were conducted as a peer-debriefing. For the revenue matrix, a group of blockchain scholars was consulted. For the cost matrix, a group of both blockchain scholars and developers was formed to validate the item allocation and ensure a correct and universal description. As only a few blockchain projects have reached an operational stage—reflected in the maturity stage of our taxonomy—most of the identified profitability factors are based on perceived rather than observed data.

5. Findings and Discussion

5.1. Catalogs on Blockchain Benefits and Challenges in Supply Chain Management—The literature review results in catalogs of blockchain benefits and challenges that emerge in supply chain management and builds a basis for profitability considerations. The full list of sources reviewed in the review is available in the supplementary materials (available online at: `https://doi.org/10.5281/zenodo.15200130`). These references are cited as [SX] within the supplementary document. The catalogs are equipped with a selection of items that are clustered to present benefit and challenge categories. While the benefit items build a basis to derive revenues, the challenge selection helps to derive costs accruing through blockchain implementations. More than half (56%) of the reviewed papers deal with the research topic independent of specific industry characteristics. The information coming from the remaining papers (44%) is focused on agriculture and food industry (22%), automotive and mobility (11%), as well as others (11%), and is hence generalized for supply chain management in the clustering process. The reviewed papers are comprised of journal (74%) and conference papers (26%).

The benefit catalog is clustered into six categories (see Table 1) following Cole *et al*. who describe theoretical benefits connected to the key blockchain characteristics utilized in operations and supply chain management: distribution and synchronization across networks, use of smart contracts, peer-to-peer network basis, and immutability of data.[62] The first category, "transparency and visibility," describes the elimination of information gaps across the supply chain and its cross-company processes. It relates to the functionalities of blockchains to distribute data in peer-to-peer networks and enforce consistency via consensus mechanisms bringing all stakeholders to a single knowledge state.[63] The second category, "traceability," describes tracking and tracing processes related to products, activities, or transactions supported or enabled by blockchains' tamper-proof decentralized data storage and connectivity to IoT devices.[64] The third category, "trust and reliability," describes the ability to establish trust-free relationships with different supply chain stakeholders that emerge from blockchains' ability to offer a single point of truth for the stored information, as well as the possibility to clearly assign information to identities.[65] The fourth category, "automated triggers and decisions," describes the automation and autonomization of processes through blockchain-based smart contracts that can be implemented on different maturity levels.[66] The fifth category, "disintermediation," describes the possibility to reduce the dependence of high power stakeholders.[67] The sixth and last category, "data security and accountability," describes the immutability of data and further benefits connected to the inherent cryptographic mechanisms embedded in blockchains.[68]

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Table 1. Blockchain Benefits in Supply Chain Management.

Category	Benefits	Literature reference
Transparency and visibility	Immutable records enable trusted data sharing and auditability across stakeholders	[S1-S6]
	Interoperability across systems facilitates unified data sharing	[S7, S8]
	Integration with IoT and edge devices for real-time environmental and quality monitoring across distributed operations	[S9, S10]
	AI-driven predictive insights based on blockchain-verified data	[S11]
Traceability	Product traceability from source to destination supports origin verification and reduces counterfeiting	[S12-S18]
	Digital twins record key asset events, creating a virtual audit trail of product lifecycle activities	[S19-S22]
	Sustainability data, like carbon emissions or ethical sourcing, can be securely linked to product histories	[S23]
Trust and reliability	Decentralized consensus enhances data verification, reducing fraud	[S24-S27]
	Tokenized documents and digital identities improve data credibility	[S28, S29]
	Self-sovereign identity management gives users control over their credentials and data sharing	[S29]
Automated triggers/decisions	Automated process triggers through blockchain-based smart contracts	[S30-S33]
	AI agents and DAOs make real-time decisions based on verified data	[S34, S35]
Disinter-mediation	Peer-to-peer interactions minimize reliance on traditional intermediaries	[S36-S38]
	Decentralization reduces entry barriers, fostering inclusivity, especially for SMEs	[S39]
Data security, accountability	Ensures data integrity and provides secure, immutable audit trails	[S40-S42]
	Role-based data access for supply chain partners	[S43, S44]
	Confidential computing and zero-knowledge proofs for security	[S45]

DAO=Decentralized Autonomous Organization

The challenge catalog is clustered in four categories (see Table 2) and aligned to the human-technology-organization (HTO) approach, which was extended by Henke *et al*. by the information (I) perspective.[69] The approach was developed to describe management approaches for the fourth industrial revolution and found appropriate to be used in the blockchain context. In the challenge catalog, the human category comprises challenges with respect to human resources, their behavior, and competencies. The technology category comprises challenges related to the technical functionalities of blockchains, connected systems, and hardware components. The organization category comprises management and compliance topics related to the implementation and operation of blockchains. Lastly, the information category comprises challenges related to blockchain-based data management and governance.

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Table 2. Blockchain Challenges in Supply Chain Management.

Category	Challenges	Literature reference
Human challenges	Understanding and communicating long-term DLT benefits when ROI is not immediate	[S46, S47]
	Human error (*e.g.*, mislabeling) when storing data on-chain	[S48, S49]
	Need for new skillsets and user training to interact with blockchain-based systems	[S50]
	Resistance to shifting roles and responsibilities in decentralized ecosystems	[S51]
Technological challenges	Lack of technical maturity, data security, and privacy issues	[S52-S54]
	Storage and transaction latency issues under real-world scale	[S14, S18]
	Interoperability limitations between DLT platforms and enterprise systems	[S52, S54]
	Difficulty linking physical goods to digital representations reliably	[S12, S46]
	Challenges in balancing scalability, decentralization, and energy efficiency	[S55]
Organizational challenges	Supplier and partner reluctance to adopt due to unclear incentives	[S50, S54]
	Ensuring legal compliance across multiple stakeholders and jurisdictions	[S53, S56]
	Lack of global standards and evolving regulatory environments	[S54, S57]
	Dependence on external blockchain infrastructure or consortia governance	[S12]
Information-related challenges	Ensuring trustworthy data entry on-chain, especially in decentralized or self-reporting settings	[S53, S56]
	Visibility control and governance over shared information	[S58]
	Absence of standardized dispute resolution over blockchain-verified data	[S59, S60]

From the catalogs it can be seen that both blockchain benefits and challenges are well understood in current supply chain literature as multiple items could be identified building a starting point for profitability considerations. Nevertheless, few items are already equipped with tangible revenues or costs that can be quantified. A lack was found in determining concrete application areas of blockchain solutions and, therefore, in specific business processes that are affected by the implementation. In our related work section, few papers with single-case analyses immerse themselves in the subject. Other papers offer starting points in business process analysis for blockchain solutions, but do not support their findings with empirical evidence and lack profitability focus.[70] Therefore, the taxonomy development took place to build an artifact that supports analyzing the application area and business processes of blockchain solutions in supply chain management while building a basis for the results of the conducted interview study through maturity and profitability dimensions.

5.2. Taxonomy of the Maturity and Profitability of Blockchain Solutions in Supply Chain Management—The taxonomy development process results in a morphological box presented in Figure 5, which is applied as a heat map illustrating the interview study findings by utilizing three greyscales from dark (frequent hits) to light (few or no hits). At its core, the taxonomy is built upon four meta dimensions (MD): the first MD, which describes the entity applying a blockchain solution; the second, which addresses the particular application area; the third, which describes the maturity of the solution; and the fourth MD, which offers categories related to the

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profitability of the solution. The dimensions are formulated with respect to the prior developed MD by synthesizing literature as described in the research design section and resulting in conceptual characteristics. By this means, the taxonomy aims at characterizing the maturity and profitability of blockchain solutions in supply chain management.

MD	Dimension	Characteristics						E/N
Applying Entity	BC Entity	User	Enabler	Provider				E
	Enterprise Size	Small	Medium	Large				E
	SC Stakeholder	Manufacturer	Supplier	Service Provider	Customer			E
Application Area	Industry	Automotive	Agriculture & Food	Energy	Logistics	Cross Sectoral	Other	E
	SC Process	Plan	Make	Deliver	Source	Return	Enable	N
	Involved Functions	IT, IT security	R & D	Management	Logistics	Legal	Specialized	N
	BC Network	Private	Consortium	Public				E
Project Maturity	Status	PoC	Pilot	Productive				N
	Scope	Record Keeping	Automation	Tokenization	Plattforming			N
	Project Motivation	Technology Exploration	Compliance	Profitability				N
	Assessment Approach	No Assessment	Estimation	Model or Tool				E
Profitability Factors	Benefits	Transparency and Visibility	Traceability	Trust and Reliability	Process Efficiency	Disintermediation	Data Security and Accountability	N
	Revenues	Optimization of Processes	Optimization of Ressources	Optimization of Expenses	Increased Revenues			N
	Challenges	Human	Technology	Organization	Information			N
	Costs	Development Costs	Consulting Costs	Training Costs	Running Costs			N

MD=Meta Dimension; E/N=Exclusive/Non-Exclusive

Fig. 5. Taxonomy on Maturity & Profitability of Blockchain Solutions in Supply Chain Management.

5.3. Applying Entity—Based on the taxonomy's first MD, blockchain projects in supply chain management can be differentiated between three stakeholder groups: (1) users that implement the solutions in their business processes; (2) providers that either develop blockchain solutions or offer premises to host network nodes; and (3) enablers that build concrete use case and bring together network participants.[71] In addition, attention is given to the enterprise size, measured by their number of employees (small=1-10; medium=11-100; large=101 and above), as well as to the position of the enterprise in the supply chain.[67] While in the interview study, there was a broad balance of 10-15 interview partners each representing blockchain users, enablers, and providers, in terms of enterprise sizes mainly small and large-sized enterprises could be approached. While most blockchain providers were represented by small-sized enterprises, both enablers and users were primarily represented by large-sized enterprises. This aligns with broader industry observations, as large enterprises often have at least partly necessary technical expertise, and more financial resources and strategic motivation to explore blockchain through PoC projects. Given the high upfront investment and complexity of implementation, small and medium-sized enterprises frequently lack the capacity to independently initiate blockchain adoption and instead rely on solutions introduced by larger industry players in their network. Regarding the position of the enterprises in the supply chain,

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manufacturers and logistics or financial service providers could be approached as blockchain project initiators. Most of the initiators faced difficulties approaching a significant number of suppliers (see Figure 6, I_04) and building a trusting relationship to get actively involved (see Figure 6, I_28).

SC Stakeholder	I_04	"We did approach suppliers, but there is still this workaround we have in place. Our main suppliers invite further upstream suppliers anonymously, so we are not informed who they are."
SC Stakeholder	I_28	"What the suppliers may not yet fully understand we look at this whole process: Manufacturers are not interested in playing off as many suppliers as possible against each other and creating a bad atmosphere. You just want to ensure that you can produce as efficiently as possible."

Fig. 6. Interview Citations—Applying Entity.

5.4. Application Area—For the taxonomy's second meta dimension (MD), the application area, several industries involved in blockchain projects focusing on supply chain management were identified. The most frequently mentioned industries have been selected to be displayed in the taxonomy. In the interview study, blockchain developers and enablers were found to be engaged in blockchain projects that are not limited to specific industries or industry sectors; thus, the category "cross-sectoral" was added. The blockchain users are distributed across the identified industry sectors, with a few enterprises falling into the "other" category, which includes sectors such as finance, fashion, and machinery construction. To identify the business processes affected by the respective blockchain solutions, we utilized the SCOR model phases, as explained in the background section. The most significantly impacted supply chain processes are in planning and sourcing (see Figure 7, I_36), while delivery and enabling processes were mentioned less frequently (see Figure 7, I_01). Make and return processes were rarely mentioned as being impacted by blockchain solutions.

The enterprise functions involved in implementing blockchain were adapted from Düdder *et al*. and include management (encompassing upper management, project management, and product management), which received the highest number of mentions.[72] IT, IT security, and logistics functions were mentioned less frequently, while research and development, legal, and specialized functions such as corporate social responsibility were mentioned the least. In most cases, enterprises indicated that representatives from multiple enterprise functions are necessary for a successful blockchain project (see Figure 7, I_26). However, many of the projects encountered challenges and were initiated without the involvement of these additional functions (see Figure 7, I_04).

Importantly, most participants of the interview study came to the consensus that blockchain technology is generally not seen as a replacement for existing centralized systems but rather a complementary technology, acting as a trust anchor enhancing transparency, security, and traceability of information shared across other systems. This consensus reflects a core characteristic of blockchain technology, positioning it as a backbone technology that integrates with and complements other systems rather than replacing them. Lastly, regarding the network setup, blockchain solutions in the interview sample primarily involve private blockchains, where a single enterprise interacts with selected contributors. Consortium blockchains, which involve multiple contributors, were utilized less frequently, and truly decentralized public blockchains were not yet a focus for the enterprise solutions in the sample.

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SC Processes	I_36	"[The solution] mainly concerns sourcing processes, so the selection of production sites and products while considering social and environmental standards, human rights, fire protection standards. […] [Then] also procurement processes where we need price information, capacities, and payment terms."
SC Processes	I_01	"In our project we see immense potential for processes in warehousing and disposition, […] but it is always important to communicate the projects internally so that the benefits can be transferred to further departments."
Involved Functions	I_26	"We have to involve up to 15 internal departments, starting with Finance, Legal and Compliance, Audit, IT and Security. When implementing a new product, each department is represented in a committee and all departments have to agree on the implementation."
Involved Functions	I_04	"I have to take responsibility myself here, it had to do with time constraints, but if the IT department and other departments that are affected, so purchasing, sourcing, quality, if they had been involved from the very beginning, it would have been great."

Fig. 7. Interview Citations—Application Area.

5.5. Project Maturity—On that basis, information could be obtained regarding the project maturity in the taxonomy's third MD. The first indicator for maturity can be determined by the technical project status.[73] Here, most of the projects are allocated to a Proof-of-Concept (PoC) status, *i.e.*, enterprises identify a supply chain problem to be solved or optimized with the support of a blockchain solution and prepare first concepts on how to implement the solution. Some projects are allocated to pilot status, *i.e.*, enterprises elaborate on particular applications in more detail, connect first partners, and can demonstrate feasibility. Yet only a few projects enter the status of productive systems that actively integrate a running blockchain solution into established processes. Also, in terms of the project scope described by a higher or lower governance and process sophistication, most projects are allocated to a lower level and therefore described as integrity seekers that use the technology for record-keeping purposes. Some analyzed projects took further steps in automating processes or tokenizing assets, while only a few projects can be labeled as innovators that actively scale their solution with multiple partners (platforming).[74] Another indicator of the maturity of a blockchain project in supply chain management can be determined by the motivation to run the project, whether it is about exploring the technology, complying with regulatory requirements, or improving supply chain profitability.[75] While nearly all interviewees state that profitability is important to be analyzed and achieved in the future, only a few see it as a current motivation and driver for their projects (see Figure 8, I_26). Most interviewees describe ambitions to be at the forefront of technological developments or start building up necessary competencies for the future, which are allocated to "technology exploration" (see Figure 8, I_13). Less often, interviewees describe particular things such as the supply chain acts, or regulations that prescribe traceability.

Finally, for the project maturity MD, a final indicator deals with assessment approaches that are in place to derive profitability statements. They can be based on broader estimations, business model conceptualizations, or quantitative business case calculations.[76] In the interview study, most project representatives state to rely on estimations or do not yet have assessment approaches in place (see Figure 8, I_09). One of the examples that already deals with profitability impact is cited below (see Figure 8, I_22).

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Project Motivation	I_26	"We started 3.5 years ago, I only stepped in front of the committee [for financial justification] a few months ago. We had to make a business case, but it is extremely difficult […]. How to predict whether the product is accepted by the market and potential partners, or how many you get convinced and onboarded."
Project Motivation	I_13	"Currently our clients are more interested in exploring the privacy and security preserving functionalities of blockchain technology instead of observing financial effects."
Assessment Approach	I_09	"We don't have profitability analysis in place, we have not been able to quantify that. It is definitely required, [but] you don't have enough data to do a quantitative analysis."
Assessment Approach	I_22	"[We] go with traditional methods […] and have a look at where the specific advantages are, so we speak about utility analysis, investment calculation, or simply looking at current and target process comparisons to see what can be achieved with the blockchain solution."

Fig. 8. Interview Citations—Project Maturity.

5.6. Profitability Factors—With respect to the maturity of the blockchain solution under consideration, the fourth taxonomy MD focuses on the solutions' impact on profitability. The first indicator usually considered in the preliminary evaluation phase of a blockchain integration project is the set of strategic benefits, which are often difficult to quantify and attribute to the blockchain solution.[31] By following the conducted systematic literature review and clustering, the taxonomy presents the categories derived from the benefits catalog. The majority of projects featured in the interview study stated that their supply chain processes would be improved in terms of transparency and visibility, traceability, as well as automation (see Figure 9, I_08). It is important to note that these statements come from projects that have not yet implemented the solutions in a live operational environment. Some projects also refer to the realized or perceived benefits of enhanced trust and reliability, while disintermediation and data security were only mentioned rarely (see Figure 9, I_27).

Benefits	I_08	"In our case, we benefit from blockchain technology under the umbrella of the circular economy […] to monitor transactions in the supply chain as an immutable database, for customers when buying organic products, using tracking and tracing capabilities to trace materials used in the garment or identify the respective farmers upstream. Sometimes also process automation through smart contracts is included."
Benefits	I_27	"We do not yet see the benefit of disintermediation in our project as there are a lot of coordination efforts necessary to set-up governance rules that leave no partner behind."
Challenges	I_29	"We haven't solved the problem of different standardized data formats. We would need a program that collects data sets from our customers and suppliers as they are and brings the mapping intelligence to be able to solve the issue of formats at the front."
Challenges	I_10	"I think [the biggest challenges] it's the legal aspects of cross border trade or even the legal acceptance of the data exchange and the technology itself. It's not something that's been litigated, so it doesn't have a previous. I think that slows people down from acceptance and then I think it's [the challenge] to bring the disparate parties to one table."

Fig. 9. Interview Citations—Benefits and Challenges.

Starting from the strategic benefits for supply chain processes as a starting point, the second dimension is composed of tangible benefit categories, *i.e.*, cost savings as well as revenues. In the interview study, most interviewees had difficulties identifying concrete items but claimed to address process and effort optimization in a second instance. Resource optimization and increased revenues were only mentioned rarely (see revenue matrix in the next section). On the

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other side of profitability measures, the analysis starts with challenge categories, also introduced in the systematic literature outcome, and proceeds to cost categories that are introduced by Barreau and successfully applied for coding in the conducted interview study.[77] In the study, most project representatives refer to technology and information-related challenges (see Figure 9, I_29), while human and organizational aspects are also mentioned (see Figure 9, I_10), including the legal perspective. Regarding costs, most cited consulting expenses, while development and training costs are mentioned secondarily. Running and maintenance costs were largely reported as still outstanding.

5.7. Profitability Factor Matrices for Blockchain Solutions in Supply Chain Management—Finally, in this section, a special focus is given to the particular blockchain-generated revenue and cost items in supply chain management identified during the systematic literature review and interview study. Both the revenue and cost items are presented in profitability factor matrices and mapped to the taxonomy characteristics. In the first revenue matrix category for process optimization, items could be associated with all strategic benefits, covering multiple processes (see Table 3).[78] The interview study focuses on blockchain-based automated triggers that mainly account for speeding up purchase and payment processes (see Figure 10, I_11). With similar emphasis, transparency and traceability benefits were described as substitute coordination, communication, and documentation processes that lead to the second category for resource optimization.[79]

In the interview study, a focus is given on the substitution of transport, customs, contracting, and further product-related documents by blockchain devices used to present and verify necessary information. This way, both paper and printing costs as well as related emissions are reduced (see Figure 10, I_24). The blockchain-supported transport processes also refer to the third revenue matrix category for expense optimization that focuses on a reduction of human errors and associated penalty payments (see Figure 10, I_27). [41] Finally, for the category of increased revenues, improved customer satisfaction is described as an outcome of blockchain-enabled trust that leads to a willingness to pay higher prices.[80] In the interview study, customer satisfaction is addressed as well as productivity increases in the workforce, and both are described as a result of blockchain-based automated triggers and decisions but also disintermediation (see Figure 10, I_03).

For the analysis of cost factors a second matrix (Table 4) summarizes and categorizes the literature and interview findings. In the human-centered category, factors related to staff training range from an initial technology understanding to advanced ones conveying necessary programming skills for pilot developments (see Figure 11, I_03 (first reference)) or governance rules to bring solutions into productivity.[81] Furthermore, human resources are called to set up first business concepts, develop pilots, or engage in the development of blockchain increments. Depending on the enterprise size, participants of the interview study either initiated their projects through the involvement of single employees, departments, or larger committees (see Figure 11, I_26). These internal resources apply particularly when conducting business concepts, while external consultants are considered to work on pilots and advanced project phases. In the technology-centered category, costs arise from server operations that might also be outsourced to blockchain as a service (Baas) providers (see Figure 11, I_03 (second reference)) and connected devices and sensors that interact with the blockchain.[64] In the organization-centered category, first, the initiation of interdisciplinary project teams and respective change management processes are considered.[82] By advancing the project, further

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cost factors emerge by modifying existing processes and IT infrastructures as well as by the integration procedures of further partners (see Figure 11, I_04). In the information-centered category, coordination efforts can be identified that cover on/off-chain decisions as well as considerations of what information to share with which partner. Finally, the integration of further information sources from oracles and convenient governance concepts emerge as efforts associated with blockchain implementation (see Figure 11, I_27).

	Optimization of processes	**Optimization of resources**	**Optimization of expenses**	**Increased revenues**
Transparency and Visibility	Reduction of coordination, communication processes, faster dispute resolution	Smarter capacity utilization	**White spots**	Simplified access to new markets
		Reduction of storage space		
	Reduction of document maintenance processes	Substitution of different kinds of documents	Reduction of human errors and prevention of penalty payments	
Traceability	Reduction of tracing, searching, and monitoring processes	Reduction of wastage, emissions, env. footprint	Reduction of corruption-related countermeasures	Development of new business areas, monetization of traceability data
Trust and Reliability	Reduction of testing and reconciliation processes	**White spots**		Increased purchase power, new customers
	Reduction of compliance verification processes			Increased repurchase rate
Automated triggers and decisions	Reduction of manual purchase and payment processes		Reduction of interface costs to other systems, complexity	Increased productivity of the workforce
Disintermediation	Reduction of coordination processes between different parties		Decrease of fees for third-party involvement	Decrease of system failures, higher customer satisfaction
	Reduction of reconciliation efforts		Reduction of errors, reprocessing tasks, fines	Surpassing distribution channels
Data Security, Accountability	Reduction of manual record checks, auditing processes		Simplified connection to hard-ware devices, IoT Integration	Secure data marketplace, offering data-as-a-service

Table 3. Blockchain Revenues in Supply Chain Management.

Revenues	I_11	"Through smart contracts, we are speeding up the process […] and calculate with roughly 50% time savings for processing a purchase order for integrated receivables."
Revenues	I_24	"We can substitute 40-60 pages of transport documents that incur in international transports of dangerous goods […] while having 250.000 transmissions a year."
Revenues	I_27	"…while errors in transport documents or the missing ability to update them properly lead to trucks being mislabeled and therefore again penalty payments."
Revenues	I_03	"By having the blockchain solutions in place, we don't need to worry about system failures or cyber-attacks that approach traditional central parties. By having the information stored on our multi-node system there is just no single point-of-failure anymore."

Fig. 10. Interview Citations—Revenues.

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Table 4. Blockchain Costs in Supply Chain Management.

	Proof-of-Concept	**Pilot / MVP**	**Productive System**
Human	Training on blockchain fundamentals and potential use cases	Training on applications, technical frameworks and integration	Training on operations, compliance, and strategic impact
	Internal resources for business concept development	Internal/external staff for technical concept development	Internal/external staff for implementation
	Initial legal and compliance consultations	Workshops for stakeholder alignment and governance considerations	Continuous upskilling and role adjustments
Technology	Platform setup, initial smart contract development, sandbox infrastructure	Server cluster or BaaS contract for node hosting	Operations & maintenance or BaaS fees
	Basic cloud hosting and wallet access	Device, sensor, and systems integration	Continuous sensor and device connectivity
		Licenses for development tools and test environments	Transaction fees and network usage
			Security testing and audits
Organization	Initiating cross-functional project teams	Change management for decentralized collaboration	Adaptation of traditional processes and infrastructure
			Integration of additional partners
Information	Effort to decide what info to store on-chain	Effort to define what data to share with which partner	Coordination for joint governance model
	Data classification and risk assessment	Data access control and permission design	Onboarding of new data sources (oracles)
			Audit trails, backups, and compliance documentation

MVP=Minimum Viable Product

Costs	I_03	"It's necessary to get trainings on the coding conventions depended on the respective frameworks […] for Corda it will be Java, for Ethereum Solidity and for Tendermint GoLang."
Costs	I_26	"Staff costs can vary a lot and are […] depended on the number of employees and project duration. […] We took 3.5 years from first idea to MVP and involved representatives of up to 15 departments."
Costs	I_03	"Our clients are willing to pay BaaS providers especially to bootstrap the initial pilot. […] If everything works out fine they are more interested in integrating the solution in their own IT infrastructure."
Costs	I_04	"To build the interfaces to the blockchain system when onboarding new partners is not a problem at all. […] We even save costs as the interfaces are cheaper to build than traditional interfaces. […] The efforts are higher in identifying and approaching the partners that should be onboarded."
Costs	I_27	"The information-related governance costs are the most important ones in my understanding at least for the phase of research and pilot set-up. […] I speaking about daily exchanges and coordination efforts, […] that also have to happen between the partners, why I would definitely include travel costs."

Fig. 11. Interview Citations—Costs.

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Before concluding, in this last paragraph, design principles are presented that were collected in the interview study when pointing the interview partners towards a reconciliation of the collected blockchain-enabled revenues and costs, given the goal to develop a profitability model in future research. Throughout the interview study, it was possible to collect six design principles that are listed and described in the following: (1) The model should deliver systematic support (I_03) while giving the possibility to be integrated into a roadmap (I_25). (2) The model should be of low complexity and therefore easy to use when needed (I_01). (3) The model should demonstrate that potential revenues are in fact generated by the blockchain solutions in place and should be able to consider different use cases (I_06). (4) The model should be able to involve qualitative benefits (I_27) that show a great occurrence in blockchain use cases, and (5) deliver mechanisms to generate quantitative outcomes (I_01). (6) Finally, the model should consider concrete business processes to demonstrate results that are not based on vague guesses.

6. Contributions

This paper contributes to the literature on distributed ledger and blockchain technology as well as to general information systems in several important ways. First, while existing literature acknowledges blockchains' potential benefits for supply chain management, it does not empirically establish how profitability emerges, its relationship with project maturity, or which specific profitability factors apply. This study addresses these gaps by systematically examining profitability in blockchain applications, thereby enhancing the understanding of how blockchain technology impacts the financial viability for adopters. The study serves as a foundation for further research by providing a structured overview of blockchain application areas, maturity levels, and profitability, encouraging scholars to build on its findings. Second, this paper advances the broader discourse on the relationship between information technologies and profitability by applying a capabilities approach. The profitability taxonomy and matrices developed in this study provide a structured method for assessing the economic implications of general information system and technology adoption, validated through blockchain case studies. Additionally, the research design demonstrates a systematic approach to taxonomy development in information systems research by involving an interview study, presenting the results as a heat map, and linking findings to profitability matrices. This approach offers a methodological framework for deriving and validating taxonomies, integrating insights from the literature with empirical data. Third, beyond systematizing existing knowledge, our findings highlight critical challenges influencing blockchain profitability. The research suggests that profitability is highly contingent on the maturity of blockchain projects and the network effects from the surrounding ecosystem. Many blockchain initiatives struggle to scale due to limited adoption among suppliers and mid-sized partners, high initial investment costs, and regulatory uncertainty. These insights emphasize that, while blockchain technologies can drive efficiency and transparency, their economic viability depends on overcoming these structural and operational barriers.

This paper provides practitioners with a structured overview to better understand blockchain maturity and profitability in supply chain management, aggregating insights from various sources. The taxonomy serves as a benchmarking tool, enabling enterprises to assess their project status relative to industry peers. The revenue and cost matrices offer concrete examples

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that can inspire businesses to innovate, scale, and refine their blockchain strategies. Additionally, our findings present strategic recommendations for enterprises considering blockchain adoption. The taxonomy and matrices highlight that, while benefits such as transparency and automation are well-recognized, cost structures remain uncertain, particularly due to interoperability and governance challenges. Managers can use these insights to decide whether to develop in-house solutions or partner with external providers, ensuring that profitability considerations align with long-term strategic goals. Our findings also support decision-making related to risk management and help businesses evaluate the scalability and long-term viability of their blockchain initiatives. Furthermore, these insights assist in understanding the potential for integration with existing systems, making blockchain adoption more seamless. Ultimately, these insights support the development of blockchain initiatives that are economically, ecologically, and socially sustainable.

7. Limitations and Suggestions for Future Research

This paper is still subject to several limitations. Despite following well-established guidelines for conducting systematic literature reviews, it cannot be guaranteed that all relevant literature has been identified. Additionally, the review reflects a snapshot in time and is shaped by the authors' decisions, such as the selection of keywords, exclusion criteria, and databases. The lack of blockchain cases that have reached high maturity levels made it challenging to identify concrete profitability factors, and quantitative estimations were rare. As a result, this study focuses primarily on perceived revenues and costs, rather than fully realized profitability figures. Identifying profitability factors for emerging technologies is inherently difficult, as they are often context-dependent and challenging to isolate. Consequently, not all fields of the revenue matrix could be populated, highlighting the need for further research. Moreover, as the paper aimed to cover a broad range of cross-industry profitability factors, it was not possible to delve deeply into each individual item. Nonetheless, the paper provides a critical overview of blockchain maturity and profitability in supply chain management and offers valuable insights that can drive further exploration in technology assessment within information systems research. Building on the findings of this paper, future work could involve workshops with blockchain initiative members to quantify revenue and cost factors through tangible case studies. In particular, emerging blockchain trends—such as decentralized and federated learning, decentralized autonomous organizations (DAOs), AI agents operating through smart contracts, as well as tokenization of assets—should be carefully considered alongside other novel applications. Further dimensions of the taxonomy also provide a foundation for developing governance models and decision-making tools for enterprises, especially regarding how to involve external partners and what information to share with them. Notably, blockchain-based joint risk management and forecasting approaches remain underexplored in the current literature. The maturity dimension of the taxonomy could also be expanded to create a comprehensive maturity model. Finally, given the rapid evolution of blockchain technology, all findings presented here are designed as extendable artifacts, with new applications continuously emerging.

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Conflict of Interest

The authors declare that they have no known conflicts of interest as per the journal's Conflict of Interest Policy.

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Appendices

Appendix 1: Overview of Interview Partners

#	Position	Application area	Industry	Enterprise category
01	Project Manager	Interface harmonization and automation of financial transactions	Machine construction	Wholesaler
02	Chief Executive Officer	Data exchange and SSI concepts for private persons and enterprises	Diverse	IT solution provider
03	Lead Developer	Tracking and tracing in harvesting processes and automation of financial transactions	Food and agriculture	IT solution provider
04	Division Manager CSR	Certification processes and tracking and tracing of fashion products	Fashion	Fashion retailer
05	Advisor	Record keeping and data exchange for audit purposes	Finance	Consultancy
06	Chief Operating Officer	Data exchange for the use of construction machinery	Pharma	IT solution provider
07	Project Manager	Data exchange and SSI in health care	Fashion	IT solution provider
08	Senior Consultant	Data exchange and tracking and tracing processes	Diverse	Consultancy
09	Director and Consulting Expert	Data exchange and tracking and tracing processes	Finance	Consultancy
10	Director Corporate Services	Data exchange and tracking and tracing processes	Diverse	Consultancy
11	Director and Consulting Expert	Data exchange and tracking and tracing processes	Finance	Consultancy
12	Senior Consultant	Data exchange and tracking and tracing processes	Diverse	Consultancy
13	Project Manager Digitalization	General blockchain enterprise systems on Ethereum-basis	Energy	Energy provider
14	Project Manager Digitalization	General blockchain enterprise systems on Ethereum-basis	Energy	Energy provider
15	IT Manager Digitalization	Blockchain-based smart contracts for process automation	Energy	Energy provider
16	Project Lead Digitalization	General blockchain enterprise systems	Energy	Energy provider
17	Supply Chain Manager	Blockchain-based smart contracts for process automation	Energy	Energy provider
18	IT Expert	General blockchain enterprise systems	Energy	Energy provider
19	IT Expert	General blockchain enterprise systems	Energy	Energy provider
20	Blockchain Solution Architect	Blockchain-based supply chain data and document exchange	Diverse	Consultancy
21	Software Developer	Blockchain-based machine-to-machine connectivity	Diverse	IT Solution provider
22	Technical Sales Lead	Data exchange and tracking and tracing processes	Diverse	Consultancy
23	Head of Blockchain Lab	Blockchain-based transparency for auditing processes	Diverse	Consultancy
24	Blockchain Project Vice President	Data exchange and tracking and tracing processes of dangerous goods	Automotive	Car manufacturer
25	Consultant	Networked financial transaction and secure data exchanges	Diverse	Consultancy
26	Senior Business Expert	Blockchain-based trade finance	Finance	Bank
27	IT Expert R&D	Data exchange and tracking and tracing processes of dangerous goods	Logistics	Logistics service provider
28	Expert Innovation	Data exchange and tracking and tracing processes	Finance	Bank
29	Management Board	Tracking and tracing of technical products and payment automation	Machine Construction	Wholesaler
30	Business Developer	blockchain-based financial transactions and decentralized auctions	Finance	IT solution provider
31	Head of Quality	Data exchange and tracking and tracing processes	Automotive	Car dealer
32	Expert Digital Economy	Data exchange and tracking and tracing of customer satisfaction	Diverse	Government organization
33	IT Project Manager	Decentralized data markets	Automotive	IT solution provider
34	Project Manager	Decentralized data markets	Automotive	IT solution provider

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35	Finance Manager	Decentralized data markets	Automotive	IT solution provider
36	Manager Digital Risk and SCM	Data exchange and tracking and tracing processes	Logistics	Consultancy
37	Consulting Manager	Data exchange and tracking and tracing processes	Diverse	Consultancy
38	Business Analyst	Data exchange and tracking and tracing processes	Diverse	Consultancy
39	Chief Executive Officer	Data exchange and tracking and tracing processes in health care	Pharma	IT solution provider
40	Chief Executive Officer	Blockchain-based verification of certificates and tracking and tracing processes	Food and Agriculture	IT solution provider

Appendix 2: Interview Guideline

Section	#	Question
General	1	Could you please introduce yourself (position and department) and your company (size, industry, position in the supply chain)?
Blockchain application	2	Could you please elaborate on the blockchain project you are involved in and touch on the application area and type (addressed market segment, involved internal and external parties, affected supply chain processes, blockchain type, framework, consensus mechanism) as well as the project maturity (project status, application aim, project motivation)?
	3	Could you please explain which benefits you encounter in the context of your blockchain project?
	4	Could you please explain which challenges and risks you encounter in the context of your blockchain project?
Profitability factors	5	Could you please explain which concrete costs arise from your blockchain implementation or could be derived from to the prior given challenges?
	6	Could you please explain which concrete revenues arise from your blockchain implementation or could be derived from the prior given benefits?
Profitability assessment	7	Do you think it is meaningful to assess the profitability of the blockchain solutions in your particular project?
	8	Do already have a procedure to assess the profitability of the blockchain solutions, if so can you explain the procedure? If not, how could such a procedure look like and what needs to be considered?

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Appendix 3: Coding Process

MD	Dimension	Characteristics						E/N	CON
Applying Entity	BC Entity	User 1	Enabler 0	Provider 0				E	✓
	Enterprise Size	Small 0	Medium 0	Large 1				E	✓
	SC Stakeholder	Manufacturer 1	Supplier 0	Service Provider 0	Customer 0			E	✓
Application Area	Industry	Automotive 0	Agriculture & Food 0	Energy 0	Logistics 0	Cross Sectoral 0	Other 1	E	✓
	SC Process	Plan 1	Make 0	Deliver 0	Source 0	Return 1	Enable 0	N	✓
	Involved Functions	IT & IT Security 0	R & D 0	Management 0	Logistics 0	Legal 0	Specialized 1	N	✓
	BC Network	Private 1	Consortium 0	Public 0				E	✓
Project Maturity	Technical Status	PoC 1	Pilot 0	Productive 0				N	✓
	Scope	Record Keeping 1	Automation 0	Tokenization 0	Plattforming 0			N	✓
	Project Motivation	Technology Exploration 1	Compliance 1	Profitability 0				N	✓
	Assessment Approach	No Assessment 1	Estimation 0	Model or Tool 0				E	✓
Profitability Factors	Benefits	Transparency and Visibility 1	Traceability 1	Trust and Reliability 0	Automation Triggers and Decisions 0	Disintermediation 0	Data Security and Accountability 0	N	✓
	Revenues	Optimization of Processes 1	Optimization of Ressources 0	Optimization of Expenses 0	Increased Revenues 0			N	✓
	Challenges	Human 0	Technology 1	Organization 0	Information 0			N	✓
	Costs	Development Costs 1	Consulting Costs 1	Training Costs 0	Running Costs 0			N	✓

MD=Meta Dimension; E/N=Exclusive/Non-Exclusive; CON=Confirmation by Interviewee

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