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Review

A Systematic Review of Blockchain Literature in Logistics and Supply Chain Management: Identifying Research Questions and Future Directions

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Abstract: Potential blockchain applications in logistics and transport (LSCM) have gained increasing attention within both academia and industry. However, as a field in its infancy, blockchain research often lacks theoretical foundations, and it is not clear which and to what extent organizational theories are used to investigate blockchain technology in the field of LSCM. In response, based upon a systematic literature review, this paper: (a) identifies the most relevant organizational theories used in blockchain literature in the context of LSCM; and (b) examines the content of the identified organizational theories to formulate relevant research questions for investigating blockchain technology in LSCM. Our results show that blockchain literature in LSCM is based around six organizational theories, namely: agency theory, information theory, institutional theory, network theory, the resource-based view and transaction cost analysis. We also present how these theories can be used to examine specific blockchain problems by identifying blockchain-specific research questions that are worthy of investigation.

Keywords: blockchain; supply chain; logistics management; agency theory; information theory; institutional theory; network theory; resource-based view; transaction cost analysis; organizational theories

1. Introduction

The interest in blockchain applications for organizational and business purposes has been growing exponentially in recent years, both in academia and industry. This also holds for the field of logistics and supply chain management (LSCM), where not only are the practitioners devoted to this topic, but also leading operations and supply chain management journals attest to this trend by issuing special calls for papers [1,2]. However, in the light of the disruptive potential attributed to blockchain technologies and its associated studies in this field [3,4], existing academic research shows a lack of theoretical foundations to investigate blockchain technology and its applications [5]. Given its very recent emergence, academic research in this blockchain technology can still be regarded as in its infancy, as most of its research is in the early phases, and still exploratory with highly conceptual models, thus lacking (directly applicable) theories [5].

Similarly, to blockchain research, organizational theories in the field of LSCM, while existing, are rarely used [6–8], because the field of LSCM is boundary-spanning by nature, and therefore has to take into account that the nature of industries, organizational structures or cultures can vary significantly across businesses [9–14]. These highly diverse contexts make it often hard for scholars to

determine the right underlying theory to investigate a problem in LSCM. In fact, LSCM management scholars often diagnose an 'identity crisis' [15] of the field, and stipulate that it suffers from 'conceptual slack' [12], due to the lack of commonality and cohesion in theories, concepts and methods. As a consequence, blockchain research in LSCM is often relying upon assumptions, rather than on established theoretical foundations.

We propose that new knowledge and insights generated for blockchain in LSCM should be based on and explained by extant as well as emergent organizational theories. In particular, we argue that the use of organizational theories provides a bridge for academic research to investigate blockchain-related topics in LSCM. Organizational theories represent the "frame of reference which helps us to make sense out of the events which we observe. It facilitates the process of bringing together and linking events which seem to be randomized and without relationship into a meaningful relationship and order" [16]. However, so far, it is not clear which organizational theories are used to investigate the diverse contexts of blockchain in LSCM, nor to what extent these theories are applied in current literature.

In response, this paper aims to identify specific organizational theories that can be used to examine blockchain literature in LSCM. By systematically reviewing current blockchain literature in LSCM, this paper not only identifies which specific organizational theories are used to examine blockchain in LSCM, but also investigates the respective organizational theories to formulate relevant research questions for blockchain in LSCM. This is the first study systematically linking organizational theories to current blockchain literature in LSCM, thereby introducing academics and managers to the core concepts of the relevant organizational theories, and how these theories can be utilized to investigate specific blockchain problems. It needs to be emphasized that this paper focuses upon the application of relevant organizational theories, i.e., what theories are relevant when investigating blockchain, using LSCM as a context. Overall, the main contribution of this study is to serve as a reference for blockchain in LSCM fields, in order to advance organizational theory building and application.

The remainder of this paper is structured as follows: the next chapter provides a brief overview about the lack of theory application in both blockchain and LSCM literature, followed by a presentation of the methodology that is used to identify the relevant organizational theories of blockchain papers in LSCM. The next chapter comprises the core section of this paper, where we introduce the identified organizational theories that can be used to examine blockchain in LSCM and highlight potential research questions. We conclude with a summary of the findings and highlight the limitations of the study.

2. Research Design

To identify the relevant organizational theories in blockchain literature, and to formulate relevant research questions, as stated in the research aims, we conducted a systematic literature review that synthesizes the organizational theories used in blockchain literature in the field of LSCM that has been published to date (for a similar approach, see Sarkis et al. [17]). We followed the established six-step process by Durach et al. [18] specifically developed for supply chain literature reviews (see Figure 1).

Step 1: Define Research Aim

As stated in the introduction, the research aim is twofold: First, the systematic literature will help us to identify what specific organizational theories are used to examine blockchain in LSCM. Second, based upon the specific organizational theories that have been identified, relevant research questions are formulated that can be used to investigate blockchain in LSCM.

Step 2: Craft Inclusion and/or Exclusion Criteria

Following the approach of Durach et al. [18], we developed an inclusion criteria list (see Table 1). First, only peer-reviewed articles were included in the search criteria, as peer-reviewed article are regarded to have higher academic norms [19,20]. Second, we restricted the search to articles that have been published between the years 2010—as blockchain can be regarded as a technology in

its infancy—and 2020, the time of data collection. Moreover, we strictly searched for articles using organizational theories in blockchain research in the context of LSCM only; thus, identified articles had to show content related to blockchain and logistics/supply chain management practices. As a consequence, peer-reviewed articles not fulfilling those criteria were removed.

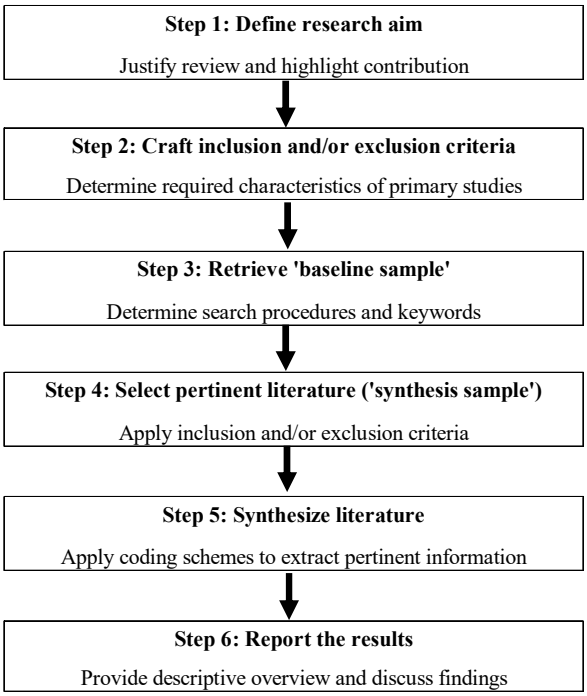

Figure 1. Steps for conducting a systematic literature review (adapted from Durach et al. [18]).

Table 1. Inclusion Criteria.

Inclusion Criteria	Rationale
Peer-reviewed articles	Published peer-reviewed articles increase the quality of the manuscript (Denyer and Tranfield, 2009) and enhance the quality control (Light and Pillemer, 1984)
Selection of papers published 2010–2020	Given its very recent emergence, academic research in blockchain can still be regarded as in its infancy (Treibmaier, 2018).
The summary must include an organization theory in a blockchain article in the context of LSCM	The aim of the review is to analyze and synthesize the organizational theories that are used to investigate blockchain technology in LSCM
Different type of article considered (e.g., empirical, conceptual)	The focus of the study is to evaluate and to synthesize the various theories and methods in blockchain in LSCM
Article must be written in English	English is the dominant research language in the field of blockchain in LSCM

Step 3: Retrieve 'Baseline Sample'

The third step includes the retrieval of a 'baseline sample' to identify relevant articles. Following Herold et al. [21], the selection for the search comprised two databases: The Elton Bryson Stephens Company (EBSCO) (Business Source complete) and the Intercollegiate Studies Institute (ISI) Web of Knowledge (Social Sciences Citation Index (SSCI)-Database). EBSCO, as well as SCCI-databases, comprise extensive and comprehensive repositories in business and management research [22,23]. A team of four senior validated the initial search terms based on the research aim and the inclusion criteria.

Similar to other systematic literature reviews, we searched for organizational theories in blockchain articles in the field of LSCM by using the keyword "blockchain", combined with "logistics" or "supply chain" (see Table 2). Furthermore, we changed the search string and replaced "logistics" with words possessing a similar meaning, including "transport", "infrastructure", or we added another category named "theory" or "theories" to consolidate the findings. These searches took place in September 2019, and were carried out again in January 2020.

Table 2. Keywords and search string.

Construct	Search String	Databases
Blockchain in Logistics and Supply Chain Management	(AB ("blockchain")) AND (AB ("logistics") OR AB ("SCM") OR AB ("supply chain") OR AB ("transport"))	Business Source Complete SSCI
Note: AB = Abstract		

Step 4: Select Pertinent Literature

In the fourth step, we further examined the articles according to their relevance. The search process identified 58 articles from EBSCO and 160 articles from SSCI, with a significant overlap between the databases, thus reducing the articles for further manual examination to 46.

Two authors read those articles to validate the relevance of the articles [18]. All abstracts were read independently in a blind procedure by the two authors to enhance validity. To ensure inter-coder reliability and added transparency, a third researcher became involved in case of disagreement; however, only 4 per cent of the abstracts resulted in any disagreement between the researchers. This led to another removal of 31 articles, however, another seven articles were added through cross-referencing. The final sample this comprised 22 relevant articles, all of them published between 2018 and 2020. The article selection process is shown in Figure 2 below.

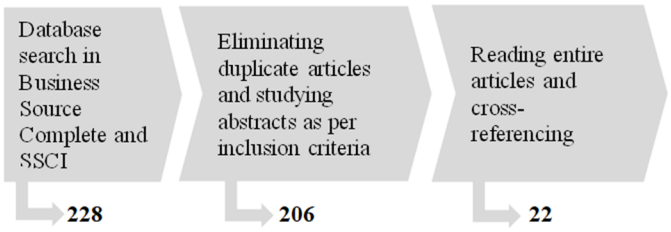

Figure 2. Article selection process.

Step 5: Synthesize Literature

These 22 articles were analyzed to identify relevant organizational theories in order to provide an overview about the blockchain articles in the context of LSCM. In the 22 articles, six relevant organizational theories were identified (see Table 3). As such, the allocation of the papers according to relevant organizational theories also provides a solid foundation to identify and highlight relevant research questions.

Step 6: Report the Results

This step analyzes and synthesizes the results from the 22 identified articles in their respective field [19]. Through this step, the results are interpreted according to the research aim stated in this paper [24]. The next section presents and discusses the use of organizational theories in blockchain research in the context of LSCM.

Table 3. Topics by author.

Theory	Author
Agency Theory	Treiblmaier (2018), Cole et al. (2019), Chang et al. (2019), Beck, Müller-Bloch and King (2018), Murray et al. (2019), Derbali, Jamel, Mani and Al Harbi (2019)
Information Theory	Montecchi, Plangger and Etter (2019), Martinez et al. (2019), Saberi, Kouhizadeh, Sarkis and Shen (2019)
Institutional Theory	Torres de Oliveira (2017), Ahl, Yarime, Tanaka and Sagawa (2019)
Network Theory	Treiblmaier (2018), Buth, Wieczorek and Verbong (2019), Swan (2019), Queiroz and Wamba (2019), Zalan (2018), Treiblmaier (2019), McCallig, Robb and Rohde (2019)
Resource-Based View	Morabito (2017), Treiblmaier (2018), Treiblmaier (2019), Martinez et al. (2019)
Transaction Cost Analysis	Ahluwalia, Mahto and Guerrero (2020), Schmidt and Wagner (2019), Roeck, Sternberg and Hofmann (2019), Treiblmaier (2018), Cole, Stevenson and Aitken (2019), Chang, Chen and Wu (2019), Murray, Kuban, Josefy and Anderson (2019)

3. The Role of Organizational Theories in Blockchain Literature in the Context of LSCM

In presenting our study results, we present the identified organizational theories, and discuss their application in current blockchain literature in LSCM. Our analysis of the 22 articles revealed that blockchain literature in LSCM is linked to six organizational theories, namely: agency theory (with six articles), information theory (three articles), institutional theory (two articles), network theory (six articles), resource-based view (four articles) and transaction cost analysis (eight articles). Notably absent theories include game theory, as well as path dependency theory, which usually are also linked to blockchain technology [25,26]. A summary of the results from this review is provided in Table 4, where the theories are identified, basic concepts are presented, recent literature displayed and relevant blockchain-specific research questions are formulated. The next subsections will present and discuss the organizational theories: the basic outline of each section begins with the theory definition and their core constructs. Subsequently, the use of organizational theories in blockchain literature in LSCM are presented, followed by possible future theory applications for blockchain.

Table 4. Organizational theories in blockchain literature in the context of logistics and supply chain management (LSCM).

Theory	Conceptualization	Current Blockchain-Related Study and Theory Application	Future Blockchain Research Questions
Agency Theory	Agency theory posits that the interests of owners and managerial agents routinely diverge, and that managers can use the inherent information asymmetry to inflict agency costs to a firm [27,28]	(1) Blockchain can help enhance trade contract efficiency and harmonize conflicting goals [29] (2) Agency theory was used to examine opportunistic behavior and asymmetry in the distribution of information between the agent and the principal entail agency costs in a blockchain system [30] (3) Agency mechanisms as useful to complement or substitute transactional and relational approaches in blockchain scenarios [31]	What incentives drive blockchain applications? How does blockchain affect the relation between principal and agent? How does blockchain affect trust within business relationships?

Table 4. *Cont.*

Theory	Conceptualization	Current Blockchain-Related Study and Theory Application	Future Blockchain Research Questions
Information theory	Information theory studies the transmission, processing, extraction and utilization of information; thus information can be thought of as the resolution of uncertainty [32]	(1) Information processing technology can be used to evaluate the competitiveness of private versus public supply chains in a blockchain setting [7] (2) Blockchain technology provides more access to the customer, i.e., provenance knowledge [33] (3) Information theory highlights the need for an evaluation of information processing capabilities [34]	To what extent can blockchain reduce uncertainty? How can blockchain increase information-processing capabilities? How can blockchain reduce supply chain risks and increase transparency?
Institutional theory	Institutional theory can be used to examine how companies respond to external pressures. The main argument of institutional theory is that all companies eventually adopt the same or similar strategies through isomorphic pressures (coercive, normative, mimetic) [35]	(1) Blockchain transaction need not only consider the institutional environment, but blockchains can be considered semi-formal institutions themselves, thus the need for public legitimacy [36] (2) Institutional theory was used to develop an analytical framework for P2P systems in a blockchain environment [37]	What isomorphic pressures are dominant with regard to the adoption of blockchain? Why do heterogeneous responses to blockchain implementation from institutional pressures exist? How do the external and internal factors promote blockchain practices?
Network Theory	Network theory examines the interplay and management in interorganizational relations [38].	(1) Network effects seem also to contribute to the rapid internationalization of blockchain start-ups [39] (2) Blockchain can influence the actor configuration of the electricity system using social network analysis Buth et al. [40] (3) Network theory was used to develop a design for a blockchain-based accounting information system [41]	To what extent does blockchain replace personal trust? What are the implications through blockchain with regard to business relationships? How do business relationships change due to an increased transparency of information and trust?
Resource-Based View (RBV)	The resource-based view (RBV) assumes that competitive advantage is sustained by harnessing resources that are valuable, rare, inimitable and non-substitutable [42]	(1) Smart contracts lead to an increase in competencies, and have the potential to automate processes by running rules encoded in computer programs [43] (2) Blockchain can help to make the customer order management process more efficient, but the evaluation of resources and capabilities is necessary [34] (3) The resource-based view can help to answer questions pertaining to the management of organizational structures [44]	What blockchain-related resources generate competitive advantage? How does blockchain change a company's core competencies? How do blockchain applications influence internal resources and competitiveness?

Table 4. *Cont.*

Theory	Conceptualization	Current Blockchain-Related Study and Theory Application	Future Blockchain Research Questions
Transaction cost analysis	Transaction cost analysis (TCA) considers how much effort and cost is required for two entities (i.e., buyer and seller) to complete an economic exchange or transaction. Transaction costs include the ex-ante costs of initiation and agreement, as well as those ex-post costs of control and adjustment [45].	(1) Blockchain alters transaction costs and affects firm boundaries by using smart contracts [46] (2) Blockchain potentially involves a reduction in transactions costs, as well as a more market-oriented governance structure for buyer–supplier transactions by the limitation of opportunistic behavior, as well as the uncertainty of environment and behavior [47] (3) Blockchain technology has the potential to reduce or even avoid cost, and thereby define nine effects of blockchains on supply chain transactions under the three enablers: transparency, trust and disintermediation [48]	How does the blockchain change transaction costs? How can the transaction costs of organizational structure be reduced through blockchain applications? How may blockchain be used to reduce the transaction costs between horizontal and vertical suppliers?

3.1. Agency Theory or Principal-Agency Theory

Agency theory posits that the interests of owners and managerial agents routinely diverge, and that managers can use the inherent information asymmetry that arises from their positioning within a firm [27,28]. These conflicts of interest represent the basis for the so-called principal–agent relationships [49]. The main concept of agency theory is that these conflicts and mitigation tactics incur agency costs to a firm, and thus, such agency costs encompass both losses from self-serving agent behavior, and the costs incurred by the firm in trying to prevent such behavior [27].

From a blockchain perspective, we found six articles that linked blockchain in LSCM to agency theory. For example, Kaal [50] used the principal–agency theory to highlight information flows in a blockchain-based scenario, in order have a higher transparency and accessibility to either the principal or the agent, or both. Cole, Stevenson and Aitken [31] argue that agency mechanisms are useful to complement or substitute transactional and relational approaches in blockchain scenarios. Chang, Chen and Wu [29] used agency theory to investigate how blockchain can help enhance trade contract efficiency, and harmonize conflicting goals. Principal–agency theory was used by Beck et al. [51] to examine governance dimensions through a blockchain setup, with coordinated incentives enabling agents to select their own behavior, but prompt to select actions that correspond with the system design goals. Murray, Kuban, Josefy and Anderson [46] examined the impact of blockchain on monitoring agent motivations and firm operations, and then discuss the lack of impact on excess expenses and interest alignment compensation.

Derbali, Jamel, Mani and Al Harbi [30] used agency theory to examine opportunistic behavior and asymmetry in the distribution of information between the agent and the principal entailed agency costs in a blockchain system.

As such, agency theory can be used to investigate how parties deal with uncertainty and asymmetry under a blockchain scenario, where the need for trust disappears, and blockchain technology can help to solve agency problems.

3.2. Information Theory

Information theory studies the transmission, processing, extraction and utilization of information, thus information with information theory can be thought of as the resolution of uncertainty [32]. The basic rationale behind information theory is that the more knowledge about a topic is available, the

less new information can be collected. In other words, if an event is expected, only little information can be gained. On the other hand, if an event is unlikely to happen, relatively new information can be collected when the event happens.

Information theory in logistics and supply chain, in the context of blockchain applications, often deals with information technology acceptance or information processing (theory) within information systems. Information processing theory, in alignment with information theory, characterizes companies as systems that possess both a need and ability to process information as a means to reduce uncertainty [52].

From a blockchain perspective, only three articles used information theory to investigate blockchain in LSCM. For blockchain, information theory could be used to analyze the complexity of a supply chain; i.e. information theory can be used to quantify the complexity within a supply chain system by providing information describing the system. For example, Montecchi, Plangger and Etter [33] investigated the applicability of blockchain technology in supply chains, in order to assist customers by giving access to more information; i.e. provenance knowledge. This study emphasizes the positive effects of the blockchain for the customer aiming to reduce their fear of this technology. Martinez, Zhao, Blujdea, Han, Neely and Albores [34] also looked at blockchain from an information theory perspective, and highlighted the need for an evaluation of information processing capabilities. In the same vein, Saberi, Kouhizadeh, Sarkis and Shen [7] suggest that information processing technology can be used to evaluate the competitiveness of private versus public supply chains in a blockchain setting.

Overall, information theory can be used to link any uncertainty and complexity within the supply chain, and by providing more information, the uncertainty and risks could be reduced. Moreover, information theory provides a foundation for the analysis of how blockchain can increase information-processing capabilities, as well as increase transparency along the supply chain [53,54].

3.3. Institutional Theory

Institutional theory facilitates the examination of how companies react to external pressures. The basic assumption of institutional theory is that a company is embedded and influenced by institutions, and their norms and practices to which companies eventually conform [55]. This so-called isomorphism within institutional theory can be distinguished into three pressures: coercive, normative and mimetic pressures [35]. Another main construct within institutional theory are institutional logics [56,57], which represent the values and beliefs of a company, and are often used to examine institutional and organizational change within companies (e.g., a shift to more innovation).

From a blockchain perspective, institutional theory could be used to examine how logistics and supply chain managers seek to manage space, resources and legitimacy to overcome institutional pressures, in particular how innovative approaches (such as blockchain) from competitors lead to mimetic processes. For example, Torres de Oliveira [36] argues that any blockchain transaction needs to be introduced to accommodate the grounds in which its transactions occur, namely the institutions.

He further argues that formal institutions will remain critical regarding blockchain, and will need to undergo a dramatic transformation in relation to their scope and actions. Moreover, blockchains can be considered as semi-formal institutions that are dependent on public legitimacy. In contrast, Ahl, Yarime, Tanaka and Sagawa [37] used institutional theory to develop an analytical framework for P2P systems.

Overall, institutional theory can be used to examine why companies adopt logistics innovations and blockchain technologies. Using the isomorphic pressures, scholars might be able to distinguish between the different pressures, and determine specific attributes related to their adoption and implementation. Institutional theory can help to classify if blockchain adoption or strategy is more internally or externally driven, as well as to identify the logics behind the adoption.

3.4. Network Theory

Network theory examines the interplay and the management of interorganizational relationships. Similarly, to transaction costs analysis, network theory examines links between organizations, but concentrates rather on relationships than on transactions [38].

From a blockchain perspective, six articles used network theory to examine blockchain technology in LSCM. For example, Queiroz and Wamba [58] drew on the emerging literature on blockchain and network theory to develop a technology acceptance model (TAM). Buth, Wieczorek and Verbong [40] used social network analysis to examine how blockchain can influence the actor configuration of the electricity system in the Netherlands. McCallig, Robb and Rohde [41] developed a design for a blockchain-based accounting information system using network analysis. Network effects seem also to contribute to the rapid internationalization of blockchain start-ups, as found by Zalan [39].

Overall, from a blockchain perspective, network theory can help to analyze the interplay within firms' interorganizational networks. Assessing the role between relationships and information transparency may help managers to understand if personal relationships can be replaced with the increased information exchange offered by blockchain technology. Additionally, network theory can also help to assess how business relationships change with the use 'trustless systems', which may not only automate contract compliance, but also replace personal relationships [59].

3.5. Resource-Based View (RBV)

The resourced-based view (RBV) of competitive advantage is often applied to evaluate the development of logistics and supply chain management practices and their impact on the company's competitiveness. The basic assumption of RBV is that superior company performance can be attributed to a company's ability to accumulate resources and capabilities that are 'rare, valuable and difficult to imitate' [42]. In other words, companies are considered as a combination of distinctive resources which allows them to build and develop a competitive advantage [58]. These resources can be tangible or intangible [60,61], and they may have been developed inside the company, or have been acquired in the market.

From a blockchain perspective, four articles use RBV to investigate blockchain-related issues in LSCM. For example, Morabito [43] argues that smart contracts may potentially automate intra- and interorganizational processes, in particular for specialized tasks. Such a scenario may reduce the unique competencies in those companies offering services potentially substituted by blockchain technology, but may also lead to increasing competencies in these companies using novel technologies to complement the services. Treiblmaier [1] and Treiblmaier [44] within both works argues that RBV can help to answer questions pertaining to the management of organizational structures, while Martinez et al. (2019) have tested how blockchain affects the customer order management process. In the light of the resource-based view, they emphasize that not only is the evaluation of resources and capabilities necessary, but also the reflection upon capabilities that still have to be acquired.

As such, RBV can be used to examine the company's capabilities of existing organizational resources, as well as how blockchain can help to shape the company's competitiveness. RBV can help to assess whether strategic resources should be reorganized in order to deal with the changes stemming from blockchain applications, be it positive changes, such as an increase in competitiveness through new payment channels, or negative changes, such as a new competitor who offers a simplified processing of shipment documents [62].

3.6. Transaction Cost Analysis

The theory of transaction costs analysis, or transaction costs economics, is based on the assumption that a company's decision is determined, not only by the price, but also its transaction costs [63]. The most economically efficient transaction, i.e. that minimizes the cost of the transaction, and maximizes the value for the parties, is then the adequate mode for a transaction. The adoption of

blockchain may affect companies inside and outside transaction costs simultaneously, and reduce or expand the company's transaction cost boundaries [1]. For example, a company may discontinue business with companies whose services can be substituted by blockchain technology (e.g., clearing, trade settlement or even mandatory reporting) [64], or new market players offering services needed for blockchain to emerge.

From a blockchain perspective, eight articles specifically use transaction costs analysis as a foundation to investigate blockchain technology in LSCM. For example, Schmidt and Wagner [47] investigate the potential of blockchain to reduce transaction costs. Having generated six theses, they conclude that blockchain potentially involves a reduction in transactions costs, as well as a more market-oriented governance structure for buyer–supplier transactions by the limitation of opportunistic behavior as well as uncertainty of environment and behavior. Similarly, Roeck, Sternberg and Hofmann [48] examined the potential of blockchain technology to reduce or even avoid cost, and thereby define nine effects of blockchains on supply chain transactions under the three enablers: transparency, trust and disintermediation.

Ahluwalia et al. [65] discuss how blockchain can help startups to deal with their financing issues from a transaction cost perspective, and thereby build a model to prove the effectiveness of blockchain technology for this application. Using smart contracts, Murray, Kuban, Josefy and Anderson [46] investigated how blockchain alters transaction costs and affects firm boundaries, while Chang, Chen and Wu [29] showed that blockchain-based systems can also reduce opportunistic behavior from both trading parties, since verifiable smart contracts are immutably recorded on the blockchain.

Overall, transaction costs analysis can help to determine the effect of transaction costs changes through blockchain technology, which subsequently affects organizational structures and practices. Thus, transaction costs economics can be used to explain how certain elements of blockchain technology change the design of contract agreements, and how automated smart contracts may reduce transaction costs significantly.

4. Conclusions

This paper reviewed the literature on blockchain in LSCM, with a focus on extant and emerging organizational theories that can be used to expand understanding and knowledge for blockchain literature in the LSCM field. We found that researchers in their studies of blockchain in LSCM have addressed a range of topics, but the majority of the papers have no theoretical foundations, which limits not only opportunities to strengthen and further develop theories in LSCM, but also neglects evidence-based theories for the investigation of blockchain technology and its potential applications.

This paper allows us to draw a number of conclusions regarding the integration of the literature. First, organizational theories provide a valuable source of theoretical foundations and underpinnings for examining and expanding research in blockchain in LSCM. Second, we found significant questions exist that require examination, and thus provide plentiful opportunities for future research, in particular, given the infancy of blockchain technology.

Third, given that there is still only limited blockchain literature in LSCM which is based on the use and applications of theories, the domain of blockchain may offer an opportunity to engage in more interdisciplinary research, thereby strengthening the theoretical basis, and finding new ways to look at innovation and technology beyond organizational boundaries.

This paper contributes to the blockchain discourse by providing a well-structured foundation for those who aim to apply organizational theories and widen research in LSCM. A summary of the blockchain-related research questions and associated investigation opportunities per theory can be found in Appendix A. The authors strongly believe that significant opportunities exist to understand the nexus between LSCM and blockchain by applying theoretical foundations. However, the paper did not elaborate and discuss related tools and methodologies that may help to understand the linkage between LSCM and organizational theories.

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Appendix A

Theory	Blockchain Investigation Opportunities and Future Research Directions	Blockchain-Related Research Questions
Agency Theory	Agency theory can be used to investigate how parties deal with uncertainty and asymmetry under in a blockchain scenario, where the need for trust disappears, and blockchain technology can help to solve agency problems.	What incentives drive blockchain applications? How does blockchain affect the relation between principal and agent? How does blockchain affect trust within business relationships?
Information theory	Information theory can be used to link the uncertainty and complexity within the supply chain, and by providing more information, the uncertainty and risks could be reduced. Moreover, information theory provides a foundation for the analysis of how blockchain can increase information-processing capabilities, as well as increase transparency along the supply chain.	To what extent can blockchain reduce uncertainty? How can blockchain increase information-processing capabilities? How can blockchain reduce supply chain risks and increase transparency?
Institutional theory	Institutional theory can be used to examine why companies adopt logistics innovations and blockchain technologies. Using the isomorphic pressures, scholars might be able to distinguish between the different pressures and determine specific attributes related to their adoption and implementation. Institutional theory can help to classify if blockchain adoption or strategy is more internally or externally driven, as well as to identify the logics behind the adoption.	What isomorphic pressures are dominant with regard to the adoption of blockchain? Why do heterogeneous responses to blockchain implementation from institutional pressures exist? How do external and internal factors promote blockchain practices?
Network Theory	Network theory can help to analyze the interplay within firms' interorganizational networks. Assessing the role between relationships and information transparency may help managers to understand whether personal relationships can be replaced with the increased information exchange offered by blockchain technology. Additionally, network theory can also help to assess how business relationships change with the use 'trustless systems', which may not only automate contract compliance, but also replace personal relationships	To what extent does blockchain replace personal trust? What are the implications through blockchain with regard to business relationships? How do business relationships change due to the increased transparency of information and trust?

Theory	Blockchain Investigation Opportunities and Future Research Directions	Blockchain-Related Research Questions
Resource-Based View (RBV)	RBV can be used to examine the company's capabilities of existing organizational resources, as well as how blockchain can help to shape the company's competitiveness. RBV can help to assess whether strategic resources should be reorganized in order to deal with the changes stemming from blockchain applications, be it positive changes, such an increase in competitiveness through new payment channels, or negative changes, such as a new competitor who offers a simplified processing of shipment documents	Which blockchain-related resources generate competitive advantage? How does blockchain change a company's core competencies? How do blockchain applications influence internal resources and competitiveness?
Transaction cost analysis	Transaction costs analysis can help to determine the effect of transaction costs changes through blockchain technology, which subsequently affects organizational structures and practices. Thus, transaction costs economics can be used to explain how certain elements of blockchain technology change the design of contract agreements, and how automated smart contracts may reduce transaction costs significantly.	How does the blockchain change transaction costs? How can transaction costs of the organizational structure be reduced through blockchain applications? How might blockchain be used to reduce transaction costs between horizontal and vertical suppliers?

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