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Examples from Blockchain Implementations in Logistics and Supply Chain Management: Exploring the Mindful Use of a New Technology

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Abstract: In the context of logistics, blockchain can help to increase end-to-end visibility along global supply chains. Thus, it can lead to improved tracking of goods and offer tamper-proof data to build trust among parties. Although a variety of blockchain use cases already exists, not all of them seem to rely on blockchain-specific features, but could rather be solved with traditional technologies. The purpose of this paper is, therefore, to identify characteristic use cases described for blockchain in the field of LSCM and to analyze them regarding their mindful technology use based on five mindful technology adoption principles: engagement with the technology; Technological novelty seeking; awareness of local context; cognizance of alternative technologies; and anticipation of technology alteration. The authors identified five blockchain case clusters and chose one case for each category to be analyzed in detail. Most cases demonstrate high engagement with the technology, but there are significant differences when it comes to the other mindful use principles. This paper highlights the need to understand the problem and to apply the right technology in order to solve it. When solving a problem, care should be taken to address a technology's unique features to ensure effectiveness and cost-efficiency.

Keywords: blockchain; mindfulness; supply chain management; logistics

1. Introduction

In January 2018 the stock market value of Kodak skyrocketed 200 percent (and has since plummeted to its original value) after it announced plans to invest in blockchain technology [1]. At the time of writing, blockchain is at the peak of the Gartner Hype Cycle and, thus, at the peak of exaggerated expectations, credited benefits, and capabilities [2]. The rumored potential to transform business is comparable to some vaguely invented treatment that is already praised for curing cancer in medicine. It is passed around as the business "silver bullet", but can this technology actually fulfill these promises?

The publicity-pressured adoption of technology resulting in ill-fitting implementations that do not provide the promised and expected results has previously occurred in logistics and supply chain management (LSCM). A prime example from the recent past is RFID technology, the adoption of which, it has been suggested, was encouraged by overly positive publicity and institutional pressure [3].

When considered in terms of the concept of mindfulness (and its reverse, mindlessness), the adoption of RFID technology is indicated as a technology that is in conflict with organizations' LSCM strategies, resulting in the absence of benefits [4]. As considered in the mindfulness literature, issues with technologies that become public as bad examples discredit the technologies' reputations. This can be caused by badly designed use cases or a lack of knowledge about a technology and the requirements for its successful application—that is, by mindless use of the technology [5,6].

In addition to the well-known examples in the field of cryptocurrency, there already exist a variety of blockchain use cases in many other fields [7]. Examples include logistics and supply chain management, manufacturing, public transport, resource sharing, cyber security, and energy [8]. In order to examine whether a certain use case in the field of LSCM is suitable for a possible blockchain implementation, it should be properly evaluated. The focus of this research is to evaluate whether the proposed benefit of the blockchain is achievable and, therefore, whether the technology is going to be the solution for the problem—or whether it is, rather, a management or process gap. This would lead to the conclusion that blockchain is not needed in this case and is only being applied because of its hyped position in technology-driven markets. At a time when blockchain is widely hyped across all industries, this paper will help practitioners in the field of LSCM to analyze use cases regarding their fit with blockchain technology and its potential benefits.

The remainder of the article is structured as follows: Section 2 summarizes technological aspects of the blockchain, as well as the mindful technology adoption principles that are used to evaluate the fit of blockchain technology with LSCM tasks in the intended use cases. Section 3 explains the research approach to enable the case discussion presented in Section 4; and the paper concludes in Section 5 with a discussion.

2. Theory

This section describes the features of blockchain technology and highlights the unique implications that arise from the technology. To eventually evaluate whether documented use cases utilize the technology to exploit unique features of the blockchain, or whether use cases are driven by a bandwagon effect in which they adopt or propose the adoption of the technology for reasons of adopting a novel technology, this paper considers the concept of mindfulness. In addition, this section presents a framework to evaluate whether the proposed use of blockchain technologies in the identified use cases is mindful or mindless.

2.1. Attributes of the Blockchain Technology

The blockchain is, in essence, a technology to store and access data. As such, each "block" stores a finite set of data and transactions, while the "chain" connects all the blocks in a fixed order. The present dataset is determined by following the chain from the first to the (current) last block and resolving the transactions in each block. As a result, the blockchain not only holds the present dataset, but also the complete transaction history. The way the blockchain is built and operated offers a number of advantages when compared to a classical electronic database or, unsurprisingly, a paper ledger.

Most of blockchain's immediate advantages stem from one of the most basic principles around which blockchain technology is developed: *Decentralization* [9]. In the authors' opinion, decentralization in itself is not an advantage, but enables several others to come into play.

Decentralization of data leads to *increased transparency* regarding the transaction history. Each participant in the blockchain network shares the same dataset, meaning everyone holds the actual documentation of the data. When data are changed, everyone receives the new status quo almost immediately. This does not hold true for local copies of centralized data, especially when it comes to transactions that are performed on paper. However, the increase in transparency does not ignore the demand for *privacy* [10]. Data can be made available only to the holders of permissioned access, e.g., by means of cryptography. As a result, a properly set up blockchain is at the same time more transparent than, and at least as private as, a conventional database.

The shared transaction history can only be updated through consensus [10]. The way this consensus is reached depends on the validation method of a given blockchain. In the case of the Bitcoin blockchain, the most prominent use of blockchain technology, a "proof of work" algorithm is used. Consensus on the present dataset is reached by the majority of calculating power in the network. The size of the network does have an immediate effect on the robustness of the proof of work consensus: To attack the Bitcoin blockchain is nearly impossible because the attacker would have to amass a very large amount of calculating power to outscale the existing network. Private networks that solely rely on proof of work do not, however, have the size required and are more vulnerable to attackers.

Other algorithms include systems like "proof of stake", where the number of relevant holdings of a certain token or coin correlates with the influence on the consensus. Another possibility is "proof of authority", where consensus is agreed between a relatively small number of authorized participants. Each algorithm has its own advantages and disadvantages, and the choice of the consensus used depends greatly on the use case of the blockchain in question. What holds true for all of the algorithms is that changes to the data of the blockchain have to be agreed upon by key subset of the networks participants. This ensures that present data is valid. Past data is protected by the "block" and "chain" parts of the technology. Since blocks are chained together and hold the information of the previous blocks, a change to a transaction in one block of a blockchain also requires changes in each block after that changed. To validate this changed dataset via consensus would require the collusion of the largest part of the network [10]. The combination of the visibility of the complete transaction history, the requirement for consensus on transactions, and the fact that transactions are chained together, makes tampering with the existing dataset virtually impossible and is a reason for blockchain's enhanced security and immutability.

This immutability is particularly useful when answering questions of ownership and identity, e.g., for a transfer of land, the question: Who actually owns the land in question? With immutable data, actors do not need to rely on trusted partners or intermediaries. The inability to change data on the blockchain enables trustless partnerships because individual actors can verify every transaction and the relevant data by themselves [**9**]. With regard to data storage, decentralization of data storage and computing power makes the system hard to attack and shut down, and offers redundancy of the stored data [10].

Improved traceability is gained by the transaction history, which is always available when dealing with the blockchain. It can be used to trace an item back to its origin to verify its authenticity or, in the case of multi-party transactions, to verify that a transfer of goods (e.g., money) has taken place. The transparent and trustworthy historical transaction data help prevent fraud [10].

If the blockchain is used to replace paper-heavy processes, it can offer vast increases in efficiency and speed. The existence of only one ledger (in the form of the blockchain) and no out-of-date local copies can, by itself, streamline many processes to be more efficient. Without the need to reconcile numerous local ledgers, confirmation times can be shortened. Since every participant can validate the data, third-party intermediaries are superfluous. Immediate validation also reduces the potential for human error. In general, using the blockchain to replace traditional (paper) transactions can streamline the process and make transactions not only safer, but also quicker, while maintaining the quality of the documentation of the transactions [10].

The benefits discussed above can lead to one of the most important advantages for businesses, possibly the key aspect that may lead a business to decide to implement blockchain technology: Reduced costs. The blockchain can offer a reduction in administrative work, such as matching data among different ledgers and validating transactions and the need for third party involvement, and can lead to reduced data errors and outages while at the same time increasing process speed and quality.

2.2. A Suitable Technology and Using Technology Suitably

Technologies have features and tools that are designed to support and fulfill an intended use. The nature of this use can certainly be altered by applying the technology differently than originally intended [11,12], but the use cannot go significantly beyond what the technology features support. However, organizations sometimes adapt technologies without regard to their features. One phenomenon that has received a great deal of research attention is "bandwagon behavior" [5]. This behavior stimulates technology adoption based on momentum generated by prior adopters and success stories leading to adoption based on account of justifications such as, "others are adopting it" and "we need to catch up", instead of objectively considering whether the technology is suitable for any particular use in the organization (e.g., a problem, or a user requiring a technology feature for efficiency). To extend this, this paper considers research that can provide a theoretical basis to evaluate whether a technology is suitable for what an organization is trying to achieve with the technology.

The concept of *mindfulness* considers factors that describe whether the decision to adopt is objectively reasonable and therefore well-thought-out [13]. For that purpose, considerations include actively gathering information about the technology and comparing the technology to alternatives.

The concept of mindfulness originates in psychology and describes an individual's cognitive qualities of being alert and having a lively awareness [14]. It is a state that is characterized by, among other characteristics, an individual's abilities to process information and awareness of multiple perspectives. Concerning the individual, Dane [15] suggested that mindfulness influences an individual's performance on a task but is dependent on the task's environment and the individual's expertise with the task.

Researchers have extended the concept from individuals to organizations. Swanson and Ramiller [5] review the application of the mindfulness concept to organizations which have high cost or impact of errors and, thus, for which being mindful in process creation is an absolute necessity to avoid errors. The research aspires to an improved understanding of what mindful behavior is in a practical environment. However, mindfulness has increasingly been applied to the adoption of technology, especially information technology, in which mindfulness is assumed to contribute to the avoidance of economic costs [5,6,13,16].

The contrasting behavior to mindfulness is *mindlessness*. Preempting that their readers might suggest organizations always make rational—or, rather, mindful—decisions regarding technology adoption, Swanson and Ramiller [5] present several examples of the absence of mindfulness and argue for mindlessness being commonplace. They summarize mindless behavior to be observable in organizations that are not actively paying attention to developments in information technology, because of not valuing IT as a distinctive competence or expecting others to call attention to innovations for them when needed. Mindlessness can further be observed in organizations adopting technologies based on momentum from mindful innovators while being blinded by success stories and uncritical of the technology. It can further be seen in organizations implementing "vanilla" versions of technologies without regard to individual requirements or context. Finally, mindlessness is observable in organizations unaware of technology assimilation issues, leaving users in frustration and confusion as they do not pay attention to users' concerns or blame them for inappropriate use. Thus, mindlessness is the state of reliance on past categories, acting automatically, and fixating on single perspectives without being aware of things possibly being different [17]. The behavior is rigid and lacks variance, although with an appearance of being relatively effortless—and, thus, tempting—while limiting potential [14]. The difference thereby is not just the quantity of information considered, but also the quality.

A number of scholars have investigated the evaluation of mindful technology adoption. Sun [13] extracted four dimensions of mindful technology adoption based on the prior research of Langer [18], which this paper now considers in detail:

1. **Engagement with the technology** concerns the active gathering of information about the technology and exploration of details. As a result, functionality and features are known more thoroughly, and the understanding of the technology is comprehensive.
2. **Technological novelty seeking** describes concisely comparing a technology with existing technologies to identify the uniqueness—or, rather, the novelty—of the technology, enabling the creation of new categories relating the technology to existing technologies.
3. **Awareness of local context** considers the alignment—or fit—of the tasks, the technical environment, and the work domain a technology is designed for with the local specifics, including needs, learning abilities, technical support, compatibility with implemented technologies, and possible reactions of different stakeholder to the novel technology. The consideration of local context assures awareness of how the novel technology may help the organization, how it might change the way of work, and which inconveniences may result from adoption.
4. **Cognizance of alternative technologies** characterizes the comparison to existing technologies, especially by establishing the awareness of alternative views of the novel technology, including advantages and disadvantages. Further, as the name suggests, the characterization is made by comparison to alternative technologies. As a result, realistic expectations about the novel technology emerge and critical conclusions about it are reached.

Considering the prior research of Langer [14,18], the model developed above is missing the aspect of "orientation in the present." Elaborated by subsequent scholars [19], this aspect describes the behavior of paying attention to the present surroundings and consequently acting in a more appropriate fashion, described by analogy to a pedestrian in a dangerous city paying more attention and consequently being more aware of risks as compared to mindless pedestrians. Taking the notion of awareness of an implied change in the previous example and abstracting from that description, the dimension of "anticipation of technology alteration" is developed:

5. **Anticipation of technology alteration** describes the awareness of possible changes of the task the technology is chosen for and how the technology can be adapted to such changes, and how it cannot.

The concept of mindfulness has been linked to task/technology-fit theory [13], which considers the fit of a technology with certain features of a task that is proposed to be supported by the technology [11]. This can be applied on an aggregated level, considering fit profiles [11], or on a granular level, considering details, especially about information requirements and information supply and characteristics [20]. The theory considers tasks as actions carried out by individuals or groups in turning inputs into outputs. These are anticipated to be supported by technologies, which are tools used by individuals, but referring in particular to computer systems, as well as user support services that assist users in their tasks [11,21]. The general idea behind the task/technology-fit theory implies a positive effect on task performance if technology functionalities align with the requirements of the task [21]. In detail, the fit is the degree of correspondence between the task requirements, individual abilities, and functionalities provided by the technology. In addition to performance, task/technology-fit has been investigated for its ability to predict utilization, perceived usefulness, perceived ease of use, and satisfaction [22]. However, as Ziguris [11] emphasizes, the theory is embedded in a larger context concerning the fit of task and technology in an institution and, thus, in a social context, which influence the actual effect of the fit. In somewhat provocative words, a perfect fit of task to technology might not compensate for the performance effects of bad management.

Several authors have proposed the measurement of fit according to distinct levels; for example, for information systems, researchers have suggested that fit should be measured on a very granular level, taking account of aspects such as data quality, accessibility of data, and systems reliability [20,21]. However, these components require an existing adoption and user experience with the system, therefore evaluation of task to technology can only be executed post-adoption. Other authors have proposed evaluation of the fit on an aggregated level for group support systems [11,23]. Thereby, the task and technology are categorized; fit profiles of the categories to each other are developed; and these are used to categorize the fit. These profiles allow an evaluation of the fit in a pre-adoption phase based on comparison of intended technology use to task characteristics. However, these profiles ignore whether the task is meaningful and its execution relevant to a problem, and do not consider whether the technology's intended application is a fit with the capabilities of the technology. Thus, while this approach to taking the task/technology-fit into account is theoretically suitable for this research, the researchers assessed it as not applicable to this study.

2.3. Evaluating the Mindful Use of Blockchain Technology Use Cases

Based on the theoretical background presented in the previous sections, the authors developed a framework to evaluate planned use cases of blockchain technology. For a use case in which the use of blockchain technology is the proposed option, this framework is proposed to give guidance to allow practitioners to reflect on whether the preference for the technology results from it being the best option, or whether its consideration as the preferred choice is driven by some kind of wish to find a suitable case to use the novel technology. Thus, the investigation is carried out by considering a technology that is currently at the peak of the hype-cycle, has been publicized with over-exaggerated expectations, and therefore is prone to bandwagon behavior by organizations, resulting in mindless technology adoption. For this purpose, the authors considered the following factors for inclusion in the framework presented in Figure 1: (1) engagement with the technology; (2) technological novelty seeking; (3) awareness of local context; (4) cognizance of alternative technologies; and (5) anticipation of technology alteration.

In this paper, this framework is used to evaluate use cases in LSCM which intend to adopt blockchain technology in terms of the mindfulness presented by the case organizations. The mindfulness demonstrated in the presentation of the use case can suggest either a mindless use of the technology or an over-exaggerated role of the technology under consideration, creating increased interest in the use case. Consequently, the results of this research are intended to provide managers who are planning to adopt a blockchain use with cases or solutions from other case-study organizations to allow them to identify weak-spots or misleading representations.

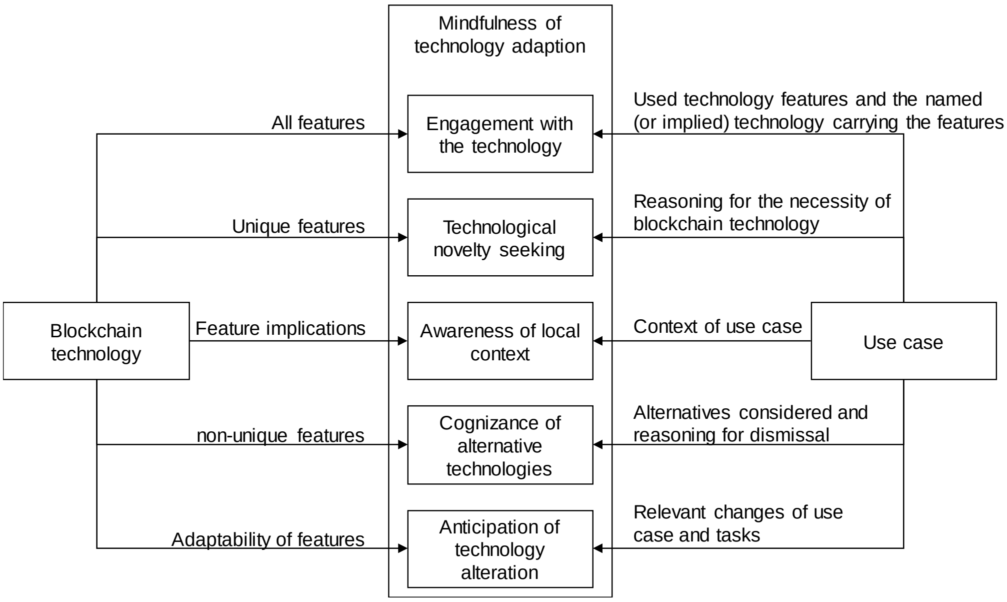

Figure 1. Framework to evaluate the mindful use of blockchain technology in LSCM.

Applying the theory from the previous section to this study, the task of evaluating the mindfulness of a technology adoption for itself corresponds to a judgment task [11,24] and is characterized by uncertainty, especially concerning the information about potential use cases. In addition, this evaluation concerns fuzzy tasks for the design of blockchain applications, with associated uncertainty of the solution scheme and the anticipated outcome from the solution scheme, especially while the technology is in an early stage. Consequently, resulting evaluations of mindfulness are conjectures, which are, however, made in a systematic and informed way to ensure objectivity. In this sense, the technology will be considered based on its features. As discussed in the previous research, the purpose of a technology intended by the designer can be diverted by the user [11,12]. However, the features of a technology limit this diversion, at least to a certain degree technically, if not in creative use.

3. Method

The purpose of this research is to develop a further understanding of the mindful use of blockchain technology in LSCM. Given this exploratory purpose, a qualitative research approach has been chosen, making use of case studies. As this research employs the theoretical mindfulness concept to develop understanding about the meaningful use of blockchain technology in LSCM, the use of case studies is particularly fitting [25].

3.1. Research Design

The case study approach is widely used in LSCM. Due to the very few blockchain initiatives currently existing, this research study considers use cases from secondary data. This approach is similar to previous LSCM research with comparable constraints. For example, scholars have used a case study approach based on secondary data to identify strategies adopted by counterfeiters exploiting legitimate supply chains [26]. The researchers relied on secondary data since the investigated phenomena represent criminal activities, which are difficult to observe at first-hand. The research resulted in the identification and explanation of strategies employed by counterfeiters as well as counter-measures against these strategies.

Another study used the intended approach of this research to identify and develop a theoretical understanding of pooling strategies in LSCM [27]. This research aspired to consider an extensive number of case studies to extract a typology and, therefore, used secondary data case studies to achieve a reasonable depth of research effort. The study resulted in a typology of pooling strategies that described four ideal types of pooling with the associated dimensions that underlie the pooling process, thus developing theory relevant to pooling in LSCM. Further, the newly-observed phenomenon of crowd logistics was studied using the secondary data case study approach [28]. This study used secondary data as a reaction to the novelty and ongoing emergence of the phenomenon during the investigation, with crowd logistics initiatives emerging and perishing day-by-day. The researchers assessed the use of secondary data as more relevant to gather useful information compared to interviews. The investigation resulted in a typology of crowd logistics and characterization of crowd logistics, thus building a new theory related to LSCM practice. Finally, the approach in focus has been used to study mindlessness in RFID adoption in LSCM [4]. While the scholars did not present a particular justification for their use of secondary data case studies, it is reasonable to speculate that a reason for choosing the approach is the devaluing nature observed in the RFID initiatives investigated. The scholars' results suggest disappointing outcomes for RFID technology in LSCM due to incorrect implementation in relation to LSCM strategy.

As can be seen, the approach of secondary data case studies has been used for new phenomena, which allow only limited access to primary data, and for investigations that involve a possible critique of executed actions, such as the use of technology. Thus, this approach has an outstanding fit with the purpose of this research.

To implement the intended approach, the authors reviewed literature on the technological background of blockchain technology. This review resulted in understanding the properties of blockchain technology and subsequent appreciation of its unique features [13,15]. Scholars suggest selecting an extensive number of cases to achieve generalization [29]. The case selection, including the number of cases, should also reflect the potential differences among the cases. As investigated by Voss [25], in operations management and LSCM research, a range from one to thirty cases is typically studied with the intention of achieving a reasonable degree of generalization. It is further argued that the number of cases needs to be appropriate to the complexity of the research context [30]. Following the distinction of Gerring and Cojocaru [31], who argue for purpose dependency of the case number, this research study intends to identify sufficient cases for a descriptive goal, which requires the extraction of descriptive features from the cases. As this research is interested in disparities among cases, it is recommended to consider multiple cases (two or more) that represent diverse types of cases. For this research, the number of cases is limited by the few reported cases of intended blockchain applications for LSCM that present relevant differences to provide additional insights.

Thus, following the guidelines for case selection discussed above, the authors set out to identify a set of diverse types of cases. Accordingly, a list of 14 cases was identified that fulfill the requirements of an intention to use the blockchain technology in LSCM. Subsequently, five were chosen that portray reasonable differences, as explained in the next section.

3.2. Data Collection

The authors decided to collect secondary cases only. The use of secondary data in LSCM research has been recommended in recent literature [32]. However, the use of secondary data also has a high degree of fit to this research, as discussed in the previous section. In accordance with the objective of investigating whether exaggerated expectations and an overrated range of features are indicated for blockchain technology, the authors sought evidence describing the publicly communicated features and expectations in use cases. In a systemized way, this investigation of case studies proposed to examine the use of blockchain as a marketing tool while having a minor technological impact on the use case, as opposed to the technology being the backbone of the case.

For this purpose, cases were collected from the professional press and specialized media for blockchain and LSCM. Once cases had been identified, the websites of the solution offering/case executing organizations were further investigated for more detailed information. This data collection yielded 14 cases in total. The initial examination of the identified cases revealed differences in the objectives that the organizations intended to develop through blockchain. As a result, the identified cases were clustered into five categories: Smart contracts; business-to-business traceability; business-to-customer traceability; data transfer; and payment. As explained above, following the guidelines of Gerring and Cojocaru [31], the intention was to select multiple cases that show reasonable differences. As the authors considered all five identified case categories to be important, one case was chosen per category, as presented in Table 1. The intention is that the selected cases universally represent their assigned case category. While the choice of cases for this research is potentially vulnerable to selection bias, the data collection process was directed to reduce this bias. For this purpose, the case identification was executed by only one researcher, who categorized the cases and created a summary of the cases describing the solution, without details of how the blockchain is used and marketed in that case. All researchers together chose one case per category in a discussion based on the summaries presented to them. The main selection criteria for the final cases were representativeness for the case categories, as well as a profound foundation of literature and information being publicly available.

In creating the sample of cases, few limitations were set beyond the use of blockchain technology in the context of LSCM. The case search was limited to the English language, however, this still resulted in international cases beyond the range of English speaking countries. The search was not limited to cases with a finished solution. This search would have yielded tremendously fewer cases to consider, since the technology is still in an early stage, and the existence of exaggerated expectations and an overrated range of features was particularly expected in the early investment phase of cases. Additionally, since reports from the professional press and specialized media are vulnerable to journalistic bias, which could result in presenting the blockchain technology role in the case with more exaggerated expectations and overrated range of features compared to what was intended by the case organization itself, the websites from the case organizations were used as a source. Cases in which no information from the case organization was found were dismissed.

Table 1. Final case selection of blockchain use cases in LSCM.

Organizations	Category	Country	LSCM Activity	URL Link
300Cubits	Smart Contract	China	Booking and forwarding in Ocean Transport	[33]
BanQu	Payment	United States	Raw material production of farming goods	[34]
Bext360	Traceability B2C	United States	Procurement of coffee beans	[35]
Kouvola Innovation	Data transfer	Finland	International Transport	[36]
Walmart (& IBM)	Traceability B2B	United States	Product recall in food supply chains	[37]

3.3. Data Analysis

The analysis of the case documents was executed following guidelines from grounded theory [38]. Due to the intention to explore how organizations are planning to use blockchain technology in LSCM based on publicized articles from the professional press and specialized media, as well as descriptions from the case organizations, the exploratory research approach for qualitative data was assessed as appropriate to the research.

Consequently, each researcher coded the available documents for each individual case. The intention was to identify phenomena that describe the actual intended use of any technology in the case, as suggested by documentary descriptions. The researchers used the codes to develop understanding about the categories of: (1) engagement with the technology; (2) technological novelty seeking; (3) awareness of local context; (4) cognizance of alternative technologies; and (5) anticipation of technology alteration for each case. In addition, improved understanding about the LSCM problem as well as LSCM solutions was developed. For the purpose of reliability, each researcher individually coded the cases and developed his own understanding of the categories. In a series of group discussion, each case was then discussed category by category to develop a mutual understanding among the group by resolving differences in understanding. No mediating rule to create consensus for unsolvable differences in understanding was needed.

Once the discussion was completed, case summaries were written down by individual researchers, and subsequently each was compared by every other researcher to his notes. The analysis resulted in the identification of how the novelty of features of the blockchain technology does play a central role in enabling the use case. The immutability and traceability provided by the blockchain technology are the features that are essentially needed in the case and legitimize its use. However, they may not invariably be needed. This reflects that individuals will alter the intended use of a technology and apply it differently [11]. In the cases considered, the need for certain features provided solely or most efficiently by the blockchain technology effectuated the use of the technology, while other features, which may also be unique or more efficiently provided by the technology, were dismissed. The analysis further revealed feature gaps in the described cases which cannot be closed by the blockchain technology, but require partial solutions from other, undescribed technologies.

4. Results and Discussion

In this section, the results from the case analysis are presented and subsequently discussed. The cases are evaluated based on the criteria introduced in the previous sections. In addition, the problem to be addressed and the intended solution are described.

4.1. Case Discussion: 300Cubits

300Cubits aims at revolutionizing the shipping business by tokenizing the contract between customer and container liner. Their aim is based on the vulnerability of the booking process and adherence to closed agreements.

When booking a reservation for a container, customers do not need to pay in advance, which means there are no consequences in the case that they do not deliver their goods to the port terminal in time. As a reaction, this results in overbooking activities by the container operators, as they can expect 25–30 percent of no shows. These overbookings further lead to the conclusion that a booking made by a costumer might not be able to be shipped. Previous initiatives such as deposits or bank guarantees were not accepted by the involved parties.

As a solution to this supply chain issue, 300Cubits proposes a token deposit system, which is organized as a tamper-proof Blockchain intermediary and utilizes a smart contract. Customer and container liner both pay a token into an escrow account, which results in an immutable agreement. In case one of the parties cannot fulfill its part of the contract, the other party will get both tokens. Due to this contract, no-show and overbooking become consequential.

The case organization shows engagement with the technology. General functions of the Blockchain technology are exploited within the case and the use of that technology seems to be realistic. The case organization is aware of possible entry barriers and offers a risk-free and free of charge testing phase to attract future clients on board. The case stands or falls with the transaction speed of the technology used, the Ethereum blockchain. The case literature mentions the plan to develop an in-house blockchain solution in case Ethereum is not adequate, which seems to be realistic at this time. The case organization presents awareness about the writing into the blockchain requiring some form of accessibility, which, however, is addressed with a parallel booking system, which needs integration into 300Cubits' solution.

This solution exploits the novelty of the blockchain technology by using the unique trust feature. Due to the solution, an immutable agreement is created and automatically enforced on failure to comply. Thus, neither party has to trust the other or an intermediary any more, and a trustless partnership can be executed.

300Cubits presents awareness of local inhibition and is planning a well-considered rollout program. The solution offers more security but takes away the often-needed flexibility for shippers who may have to change their shipping arrangements after initial booking. Although the case literature mentions costumer complaints about deposits and is marketing 300Cubits' solution as solving that problem, the token is still a kind of upfront payment. The case, therefore, has to be seen as an attempt to make this payment method acceptable, while it could also drive shippers to other liners that do not have deposits and additional booking processes.

There is proficient knowledge on certain risks for the blockchain solution, as the secondary case literature mentions the transaction speed of Ethereum and the probability of a slow adoption rate for the technology in this specific industry. For 300Cubits to enforce this solution in the shipping industry, they need to build trust into their technology as conventional booking systems might be preferred by the majorities of users. However, to execute the smart contract correctly, a reliable signal proving each party's compliance is necessary—a serious requirement of this blockchain implementation. The case literature indicates great optimism about the port taking on the role of signal provider. This level of altruistic participation of a multitude of ports in that process might be unrealistic.

In the long run, the solution shows some risk of unintended use of the tokens that could result in alteration to the solution that could affect shippers' and liners' attitude towards the solution. When dealing with third-party tokens there is always a currency risk that needs to be taken into account, although this would also apply for a deposit made in dollars, and the case organization has paid attention to this risk.

4.2. Case Discussion: BanQu

BanQu offers a blockchain case for social sustainability by giving unbanked people, who are currently restricted from participating in global supply chains, the opportunity to participate in the global economy.

The case organization addresses the issue of 2.7 billion unbanked people living worldwide, meaning these adults are without a financial bank account to access the corresponding financial operations and benefits. The reason for being unbanked is not always poverty, but may be due to a variety of reasons. Without a bank account, it is hard for these people to connect to the economy, which makes it harder to participate in global supply chains, e.g., receiving payment from abroad or investing in more efficient processes to increase output.

BanQu's blockchain solution aims at connecting the unbanked community to the global economy by utilizing a distributed ledger as a secure and immutable database. The case organization states that 60 percent of unbanked people do own smartphones, which could be used as a platform to connect them to the economy. The blockchain platform will help the unbanked to record their financial transactions in a credit history, to give them a baseline, provide them the opportunity to leverage financial services on BanQu's platform, and to own their own data. For LSCM purposes, they create financially viable farmers with traceable farming products and payments to farmers. These farmers are provided with a digital identity and consequently with a financial history presenting trustworthy (financial) behavior. Thus, the solution strengthens the weakest suppliers in today's supply chains.

Considering the case organization's publicized engagement with the technology, the analysis of the secondary case literature revealed a number of deficits, which should be examined. Writing into the blockchain requires approval of these transactions by other parties, resulting in costs for the energy used. It remains unclear who will pay for the blockchain transaction considering the case addresses the poorest of the poor. Furthermore, based on the available information, the system is vulnerable to fraud. In order to have trustworthy records in the blockchain, the records have to be provided by a trustworthy source. The literature, however, indicates that any member of the system can write transactions into the blockchain without any oversight, so that members could write a multitude of fake transactions in order to build up a credible financial history. There is no crypto-currency involved that is traded and the transactions are not explained to be coupled to cell phone transactions. In addition, it remains unclear where the decentralized ledger would be stored.

Trust in the financial history of a person, which is usually provided by a third-party organization—a bank—is the novelty of the blockchain technology that is exploited in this solution case. The trust is provided due to the traceability and immutability of financial transactions, which is usually a given due to the transactions being administered by the bank without any option of the bank's customer to change or manipulate them. However, the trust in these transactions is dependent on trust in the interface between real-world transactions and the writing process in the blockchain, which is not well defined.

Concerning the awareness of local context, the case data display some inconsistency. As discussed in the case literature, not all unbanked people own cellphones. Consequently, not everybody in the target group can be reached with the blockchain-based solution. It is questionable, whether the main target group within the unbanked community, being the poorest in the supply chains, belong to the group owning a cellphone. In addition to the rollout of a novel technology in rather underdeveloped regions, Internet access will definitely be necessary for the concept. Further, unbanked people might be unfamiliar with the investment or insurance concepts presented by the case organization and would have to be educated on the principles of loans and interest, as well as insurance and insurance contributions. In addition, the success of the model is based on how potential partners for the proposed financial services (e.g., bank loan, crop insurance) will value the BanQu-score.

The alternative to the solution provided by the case organization is obviously a financial institution like a bank. Current guidelines of financial institutions do not allow people without identities, credible financial history, or sponsors to create an economic identity. Thus, the BanQu solution, or rather the blockchain solution, seems to be a profound way to create those identities by giving pseudo-banked histories as a gateway. While banks would take on BanQu's customers in that case, the solution is set up to abolish itself with the charitable goal of lifting people out of an unbanked situation.

Concerning the alteration of these issues, a conceivable alteration might be a government-controlled digital identity for the unbanked and a related government bank. This would make the BanQu solution redundant but, as mentioned above, would fulfill BanQu's goal. Furthermore, regulation might limit some risk-taking behavior for financial institutions as a result of previous or anticipated financial crises. Accepting the financial history created by BanQu could eventually be rated as a risk-taking behavior and interfere with the business model.

4.3. Case Discussion: Bext360

Bext360 is an organization focused on developing technologies to improve social sustainability in a supply chain. For that purpose, they developed a blockchain to track and trace coffee beans on the complete route from farmer to consumer.

The supply chain relevant problems Bext360 tries to address within the supply chain for coffee beans can be put under the title fairness. On the one hand, farmers of coffee beans are treated badly on a regular basis. They receive either low wages, delayed payments or even no payments at all for their beans. In addition, intermediaries and resellers often take more than their fair share of the product. On the other hand, consumers must rely on the little information they get when buying coffee. The chain of information regarding authenticity of the proclaimed coffee quality or if farmers were paid and treated fairly is incomplete and vulnerable to falsification.

The supply chain relevant solution Bext360 is proposing is supposed to solve the unfair treatment by developing a complete chain of information. They propose that a robot automates the quality evaluation of coffee beans and assigns a fair price. Bext360 plans to use a blockchain implementation to bind the data from this transaction to a token per bag of coffee and, therefore, offers traceability from source to consumer down to the bag of coffee beans. With access to the information on the token they would be able to track the actual transaction of beans and payment, proving a price, which is supposed to be fair to ensure an actual living wage for the farmers, as well as the origin of the beans.

The case suggests a high level of engagement with blockchain technology. With the use of a crypto token to track the product and all the relevant information across its life span, Bext360 has built a meaningful blockchain case while acknowledging that the data written into the blockchain needs a trustworthy source as well. By making sure the data input is automated and, therefore, genuine, the quality of the saved data can be assured. It is, however, unclear how data manipulation at later steps of the supply chain is handled. Although manipulation or simple lack of data at this stage only influences the tracking quality and not the proof of the farmer's pay, the consumer might not have full insight into the supply chain.

The choice for blockchain and against other database systems seems logical. To be able to prove the fair treatment of farmers and a clean supply chain, Bext360 must prove the immutability of its data to the external world (consumer of coffee). The ability to manipulate the data, which, in the case of using a centralized database offering this kind of visibility, at least one party would have, is not available to any party in this blockchain implementation.

The mentioned immutability to gain the transparency of data, which represents a novel feature of blockchain technology that this case is exploiting, does, however, rely on a decentralized network of parties storing copies of the ledger. Documents on this case do not explain why a decentralized network is necessary and if the actual network is really decentralized (and, therefore, a proper implementation of the blockchain ideology).

The data of the suggested case shows a lack of local awareness regarding the region of implementation. The possibility of a working and sustainable implementation of automated coffee bean analysis and pricing combined with the need for constant internet connections is questionable considering that most coffee bean farmers are situated in developing countries. It depends on Bext360's ability to keep the infrastructure working and the robots safe from theft, vandalism, and other damaging exposure (e.g., rain, erosion) as well as confirming rightful usage. To identify the farmers, they have to be part of the process and identify themselves with a unique ID. To fight fraud, e.g., by using a farmer's ID as a reseller, farmers must understand the process and have the possibility to contact some sort of authority that is able to punish misusage of the process. The idea only offers true benefits if the "real life" application works as planned. In detail, farmers must actually receive the pay that is documented in the blockchain and the tokenized bags of coffee beans have to contain beans of the stated quality. It is not explained how Bext360 is going to make sure of those issues.

The case presents cognizance of alternate approaches to the problem. The "classic" approach of tracking and tracing is expensive, imprecise, and does not address the consumers' demand for visible transactions on the supply chain. Bext360 has seemingly put fundamental thought into the development of a proper use of the blockchain to approach a problem that has barely been addressed directly with other technologies. No specific considerations of alteration to the task or problem by the case organization was identified. No relevant alteration could be identified by the researchers.

4.4. Case Discussion: Kouvola Innovation

Kouvola Innovation wants to implement blockchain technology to enhance the information flow around supply chains, remove inefficiency and, as a result, reduce cargo transport times, especially in cross-organizational supply chains.

The LSCM problem Kouvola strives to tackle is of cargo units moving inefficiently through cross-organizational supply chains as well as transportation and distribution infrastructure. The cargo units move as efficiently as the surrounding infrastructure allows them to. A bottleneck in cross-country and cross-organizational transportation is the communications infrastructure along the supply chain.

Kouvola Innovation claims a communication structure that cannot facilitate data transfers along the supply chain due to a missing data standard, missing connectivity, and missing interpretability results in suboptimal behavior. The transfer of data in the supply chains on which the case organization is focusing is often delayed, the transferred data is inaccurate, or the receiver is simply not able to read or receive the necessary information.

The proposed solution seems relevant to the supply chain. Kouvola Innovation wants to develop and implement a standard for communication in the cargo business based on blockchain technology. In addition, they want to develop a standard for blockchain projects in general. Their goal is to create a trustful and open communication network. However, without standards regarding, e.g., data quality and formats, an open network would not generate any benefits. Their goal is to have a data hub for participants of the supply chain, regardless of data source and base technologies. In essence, Kouvola Innovation wants to change the present peer-to-peer communication to a hub-and-spoke-like system with a central data hub.

In the data, the team of Kouvola Innovation shows engagement into the blockchain technology as the organization seems to have a deep understanding of the blockchain technology as well as other different communications technologies and the different challenges that arise with data gathering or data storage. The case organization emphasizes the blockchain's inability to gather data and addresses this shortcoming with other technology, such as sensors. Regarding the costs of the system, some questions remain unanswered. It remains unclear at what frequency data will be written to the data hub and what kind of information shall be available to the participants. An awareness of the huge data volume does exist within the case, which might not be handled by the blockchain, but shear data volume does not necessarily result in higher degrees of usable information for participants. A technical standard does not solve the problem of agreeing about the content to be shared. Moreover, this blockchain-based solution does not solve the interface problem, since every participant has yet to create an interface from his system to the data hub.

The case falls short in mentioning proper use or need for the novelty of the technology. The case focusses on traceability of cargo and the availability of information. The possible increase in transfer speed of data and the existence of data history should lead to a more effective use of the actual data. Kouvola Innovation does not address the immutability of data and the case does not suggest a real need for it.

The case displays some inconsistencies regarding awareness of context. The depicted case tries to fit a regional solution to a worldwide system. Much of the use of the central data hub relies on the implementation of sensors per cargo unit. This comes with substantial costs and effort, especially since the project focuses on the Scandinavian area but shipping containers leave and enter this area constantly. To acquire a useful amount of real-time data, a high percentage of cargo units must be equipped with IoT sensors. The transparency of the data has to be restricted to the relevant participants to maintain the safety of crucial information and is dependent on willingness to share data. The project relies on stakeholders' participation. However, there is no information on how to enable that participation. Not everyone will be interested in a pooled data hub. Powerful players will most likely not want to give up their power of data and information, but rather use this for their personal (monetary) interests. Kouvola Innovation has to find ways to incentivize the participants of the supply chain to offer their information in a more open way, rather than the present peer-to-peer method. Finally, yet importantly, the simple existence of a huge database regarding supply chains in the Scandinavian area does not increase the efficiency of said supply chains. The data has to be analyzed, and appropriate actions have to be taken, to generate benefits.

The case does not discuss the use of alternative technologies. The case does not display the necessity for the decentralization of the database. Most of the data sources in the form of IoT sensors would not have the storage capacity for a local copy anyway. The participating logistics providers most likely do not care for a local copy, as long as they can rely on the integrity of the data. The reason to implement the idea on a blockchain and not in the form of a classical database is not clear and remains unaddressed by the case organization in the documents publicly available.

The EU funds the project, which means that the promised funding is secure. An extension of the research goal or timeframe depends on additional funding. The use of a different standard for the transfer of data should not be a problem. The implementation of Kouvola Innovation offers flexibility and adjustability to changing data sources anyway.

4.5. Case Discussion: Walmart

In cooperation with IBM, Walmart is working on blockchain pilots with the goal of enhancing their supply chain transparency and tracking their goods more efficiently.

Due to lack of transparency in their multi-actor food supply chain and inefficient processes, Walmart struggles to track and identify its products. This issue can become serious in food supply chains if food is contaminated and can causes illness in customers. However, the problem of traceability concerns any product in the supply chain and can be necessary for several reasons apart from contaminated food.

Together with IBM, Walmart developed and started testing a solution for a more efficient data exchange. The solution developed is based on blockchain technology and enables them to identify and track products faster (from six days to 2 s) and to remove recalled goods from their shelves. The solution requires data input for every product into a private blockchain.

The case data suggest a relatively low engagement with blockchain technology. In the available secondary literature, it does not become clear how the data input, especially for small players, is organized with regard to writing information into the blockchain for the individual products. Furthermore, there is a lack of information on how and where the blockchain will be stored. It does not become clear that Walmart is aware of the decentralized nature of the blockchain. Furthermore, the cost of writing data, especially considering the large number of transactions to be written in this case, and the assurance required to create trustworthy data sources—points addressed in the previous cases—are not mentioned in the public material. Overall, it cannot be assured, based on the secondary literature of that case, that the technology and the corresponding problems have been fully addressed.

This solution utilizes the novelty of blockchain technology as it is using its uniqueness concerning traceability as well as increased speed and efficiency. This enables Walmart to reduce its tracking time from six days to 2 s. It is important to note that, in order to accredit this to the blockchain technology, the speed increase should be due to the validation processes no longer being necessary. If the speed increase is solely based on an efficient database, this could also be solved without the blockchain by using a write-only central database. Although the data does not mention it, in Walmart's specific case, the immutability of the blockchain can play an important role, as continuous refrigeration chains require uncompromised data due to the nature of the products.

The secondary case data displays a lack of local awareness, as it simply does not mention possible local and case-specific circumstances, which need to be considered. As local security plays a significant role, it remains questionable how the case will deal with the fact that companies in the retail business do not want their supply information to be shown to competitors within the blockchain.

The available case data fall short in the comparison with alternative technologies. Secondary case literature only mentions the comparison with the current system regarding the transaction speed (from six days to 2 s), without further describing this current solution. Alternative technologies, such as a central database with write-only access, which could be stored at Walmart itself, are not examined, although the case appears to be a prime example that could be solved with a central database in combination with more efficient processes. Immutability of the data for other actors than Walmart could be achieved with a private Walmart database with limited manipulation rights for other actors. Based on the requirements derived from the data, the necessity for a decentralized solution are not depicted. Furthermore, advantages and disadvantages of the different technologies, especially of the blockchain technology, are not considered in the case data.

Available data present no cognizance of possible process alteration. Possible alteration might include changes in the supplier network, which would lead to the task of rolling out the blockchain technology to and with the new partners. This is an advantage of the blockchain as this would be easily possible and cost efficient. Another alteration can be found in the need for new data records. In case new datasets for each product will be stored within the blockchain, an adaption will also be possible.

It remains unclear whether blockchain is the right solution for Walmart's case, as the case literature available shows large gaps in the evaluation of the criteria for mindful use of the technology. This conclusion might be explained by the limitations of the research method itself, as this information may exist, but was not made available to the public.

4.6. Overall Discussion

The systematic evaluation of the five cases shows a good understanding of case organization towards problems relevant to logistics and supply chain management. Our results are aggregated in Table 2. The problems resulting from no-shows by customers, on one hand, and overbooking of capacity by logistics providers, on the other (300Cubits), and inefficient communication in the container business as a whole (Kouvola Innovation) are valid challenges to address. However, in the case of Kouvola Innovation, the problem description only touches the very surface of the problem without identifying achievable goals for the proposed solution. Improved tracking and tracing to increase customer trust (Bext300) or reaction times (Walmart) display a high degree of relevance. Credibility of unbanked people (BanQu) is not a problem with direct consequences to supply chains. However, the potential market impact of integrating unbanked people into the economic system and their more reliable and mature participation in supply chains would enhance logistical endeavors as well.

However, very different levels of quality can be found in the proposed solutions for the aforementioned problems. Using immutable agreements and deposits as an incentive for correct behavior in the cargo business is a very straightforward and practical approach (300Cubits). The proposal of a standard for blockchain programs is valid, but does not directly address how they will solve the problem of inefficiency (Kouvola Innovation). The three cases targeting tracking, tracing, and transparency also propose solutions of very different quality. Providing full transparency for customers with the combination of automated data input is a very good approach to create trust with customers (Bext300), while creating a trustful transactional history for unbanked people does not work without validation of the input (BanQu). Creating a fully transparent supply chain that allows for quick reaction is a good idea in theory, but the case does not mention how the data is generated. It seems impractical for high-volume, low-value items (Walmart).

While most cases suggest a high engagement with the technology with regard to its restrictions, some questions are left unanswered. Two cases suggest that either the customer or a third-party beneficiary pays for the transaction (300Cubit, Bext300), while one case leaves the answer to the question open (Kouvola Innovation). Two cases do not address the question of who pays for transactions at all (BanQu, Walmart). A similar picture evolves when looking at transaction speed and data capacity. Three cases directly address these challenges (300Cubit, Bext300, Kouvola Innovation), while the remainder do not address the question (BanQu, Walmart). Only two cases explicitly address the difference between data storage and data gathering (Bext300, Kouvola Innovation), while the others, at least in part, falsely suggest that the challenge of data gathering is solved by implementing the blockchain. The problem of incorrect data input is only addressed and solved by one case (Bext300).

Table 2. Final case results.

Factor	300Cubits	BanQu	Bext360	Kouvola Innovation	Walmart
Engagement with technology	Awareness of general blockchain features demonstrated Awareness of possible entry barriers proven	Funding of transaction costs unclear Trustworthiness of data source (transactions) unclear Ledger storage unclear	Awareness of general blockchain features demonstrated Trustworthiness of input-data assured	Awareness of general blockchain features demonstratedShortcomings of blockchain addressed	Data input and thus trustworthiness of data source unclear Ledger storage unclear
Technological novelty seeking	Trust	Trust	Immutability	Unclear	Traceability
Awareness of local context	Awareness of local inhibition Previously unsuccessful middleman-solution for problem is automated but might bear further unconsidered unsuccess factors	Inconsistencies regarding technology and technology access of intended customers Infrastructure for technology rollout questionable/at least challenging in intended customer region	Infrastructure requirements for automated analysis and pricing in intended region challenging Risk of theft, vandalism and other damage	Regional solution is supposed to fit to a global system High costs for equipment unaddressed	Local content unaddressed
Cognizance of alternative technologies	Proficient knowledge on certain blockchain risks displayed (possibly mitigated)	Barriers from traditional financial systems inhibit satisfaction of intended customers	Classical tracking and tracing approaches do not satisfy intended customer requirements, yet	Alternative technologies unaddressed Necessity of decentralization not displayed	Implemented approaches do not satisfy intended customer requirements Alternative technologies to current implementation unaddressed (e.g., write-only database)
Anticipation of Technology Alteration	Unintended use of tokens possible and could lead to alteration, is addressed as being a minor issue	(in the long term expectable) governmental controlled identities would make the solution redundant	No alterations have been identified	Solution addresses flexibility to data standards and supply chain structures	Solution displays flexibility to supplier structures

Three cases use the novelty feature of trust in trustless partnerships in combination with the immutability of the data (300Cubit, BanQu, Bext300). While all cases mention a gain in transparency, there is no visible necessity to implement it using the blockchain technology in two cases (Kouvola Innovation, Walmart).

Only one case shows full awareness of the regional implications of their solution (300Cubit). Two cases rely on the use of complex technology in regions with little infrastructure and high risk for theft, damage, or lack of supply (BanQu, Bext300). One case suggests a regional solution to the global container market, which does not seem sustainable (Kouvola Innovation), and one case does not address the issue (Walmart).

When considering alternative technologies to solve the problems, two cases make a proper case for the need of the blockchain technology because of the shortcomings of existing technologies (300Cubit, Bext300), while one proposes a stark improvement to an already existing method (Walmart). One case suggest that the solution would be possible in a different way, but is not accepted by the necessary actors (BanQu) and one case does not address alternative technology at all (Kouvola Innovation), supporting the claim that the technology is not used in a mindful way.

Considering the anticipation of technology alteration, no case explicitly mentioned unsolvable problems. The researchers found several minor alterations that are worth mentioning.

5. Conclusions

The research used an advancement of the theory of mindfulness to assess the use of blockchain technologies in the context of logistics and supply chain management. The five discussed case studies suggested different engagement and understanding of the new technology and the problems it is supposed to solve. Several implications, both on the theoretical and on the managerial levels, can be deduced from the case study discussion.

5.1. Theoretical Implications

This article exploits and enhances the existing theory of mindfulness and applies it to blockchain technology. In doing so, the research offers insights into the novelty of the blockchain technology on a user level with a focus on the relevant abilities of the novel technology as well as requirements for its mindful use.

Concerning the theory of mindfulness, the results hint towards some lack of understanding of the true features of the blockchain technology or intended alteration of the blockchain's actual role in the project to make it more prominent in publicly-available documentation. The data associated with each case showed shortcomings in addressing specific challenges and only vaguely referred to the blockchain's role in solving these problems. However, more than once it looked like the source of the problem was not on a technological level and, therefore, could not be addressed by blockchain technology (e.g., gathering data at a single item level in the case of food supply chains).

The choice of cases that each target a different issue in LSCM is sufficient for the research goal of creating a broad overview of the current situation regarding blockchain implementation in LSCM. However, the information within the data might not address every aspect of a given case study and, therefore, a failure to address a particular aspect in a case study does not automatically mean that the team did not address the matter internally. This can result in an inaccurate assessment of the case study within this research and could, therefore, influence the results in a way that misrepresents the case.

For the future, more in-depth research, it might therefore be rewarding to focus on several case studies within the same sub-field of LSCM instead of a single case study of different fields to generate unbiased results for the chosen sub-field. In any case, a more detailed and focused analysis of questions regarding the mindful use of blockchain technology will require a dataset that is less prone to influence by outliers and subjective interpretation. This quality of data may, however, be very hard to acquire with the current state of blockchain projects. The high number of early stage projects and the low number of finished projects that generate meaningful insights make it challenging to collect unbiased data for future, more detailed research approaches. This results in the immediate necessity for researchers to focus on the collection or generation of high quality data regarding blockchain projects to enable future research approaches. The discussion suggests that a good understanding of the task-technology-fit of blockchain and problems within the LSCM field is necessary to implement blockchain technology in a meaningful way. This offers research opportunities on the levels of identification and classification for both aspects: The different kind of problems in LSCM and the aspects that the blockchain technology can address.

5.2. Managerial Implications

This research emphasizes the need for a proper understanding of the problem and the technology (or the mix of technologies) that is proposed to solve it. The technology should be chosen with respect to the problem and its unique features or its most effective or cost-efficient common features contributing to the solution. In the case of blockchain, it seems that the technology is sometimes picked first, and the problem is applied to a blockchain solution afterwards. This results in a less than optimal task-technology-fit and, subsequently, in poor results for the project. To properly fit the novel technology to a problem, applicants have to first understand the problem and the true capabilities of the technology. Knowledge and consideration of alternative technologies can save organizations the inconvenience of a less-than-ideal fit between problem and technology. The article does not answer the question of how to check the fit of a problem for blockchain or a different technology, but suggests that the first step in finding the proper technology to solve a problem is to fully and truly understand the problem at hand and compare this to the features of the technology and their contribution to a solution.

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