Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 181 (2021) 495–502

Procedia Computer Science

www.elsevier.com/locate/procedia

CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies 2020

What are the main drivers of Blockchain Adoption within Supply Chain? – an exploratory research

Leonor Jardim*, Samuel Pranto, Pedro Ruivo, Tiago Oliveira

NOVA IMS – Infomation Management School, Universidade Nova de Lisboa, Campus de Campolide, 1070-312 Lisbon, Portugal

Abstract

This paper aims to identify the main drivers for Blockchain adoption within Supply Chains, following the Design Science Research (DSR) methodology and focusing on defining, validating, and reducing a myriad of factors with the aid of experts on both fields. Based on the literature review, and through means of questionnaires, factors were rated and refuted according to the relevance given. Two rounds narrowed the results, and upon consensus nine drivers were identified fitting under two categories: Challenges and Incentives. Considering the results are based on a limited number of factors, and the impact of firm-level influences were disregarded, respondent's perceptions could have slightly varied if the sample of participants differed. Overall, it provides academics with a theoretical framework combining existing literature into a set of drivers. Providing insights to vendors on how their reputation may influence clients' adoption, whilst fulfilling a literature gap in the supply chain area.

Keywords: Blockchain; Supply Chain; Design Research Methodology; Adoption Framework.

1. Introduction

Over the past few years, blockchain technology has attracted a lot of attention from academia to practitioners across industries [1]. Its value is undeniably attractive [2], however, a clear adoption framework has still to be discussed, since only recently other management applications of blockchain networks have gained focus [3].

In fact, the technology itself has been around for quite a few years now, considering that its first application was through Bitcoin [4], back in 2008. Without focusing on the cryptocurrency context and highlighting the technology

* Corresponding author.
E-mail address: m20170178@novaims.unl.pt

10.1016/j.procs.2021.01.195

behind it, a blockchain is a distributed ledger, meaning it is a chain of "blocks" of information where each "block" contains a record of valid network activity from when the last block was added [5]. Within the Supply Chain context, the use of a decentralized distributed system, allows to collect, store and manage information of each product throughout its life cycle, and enhances secure transactions, as a product moves across the chain interacting with several actors, for instance, producers, suppliers, manufacturers, distributors and retailers in order to reach the end consumer, which characterizes a Supply Chain [6].

The recent hype around the technology, is justified by the fact that a lot of the benefits provided by blockchains overcome some of the challenges affecting the relationships across Supply Chains [7], making it a very attractive strategical move from a business perspective [8].

Nonetheless, in recent studies [9] some concerns regarding the barriers of adoption have been appointed, such as: Regulatory Issues, Implementation Constraints (when it comes to replacing and adapting existing legacy systems), the Potential Security Threats and so on. In the same study, that followed a survey-like approach, in 2019, only 8% of respondents did not identify barriers to the adoption, which gives room for further analysis. Motivated by these issues, and grounded on the literature review [10–13], this study has as its main objective to identify the main drivers of blockchain adoption applied to supply chains, attempting to provide a clear framework aided by experts' opinions for content validity [10], through the means of survey-like interviews, the study intends to answer the following research question (RQ): *"What are the main drivers for the adoption of blockchain within Supply Chains?"*

In order to do so, the proposed work adopted the Design Science Research (DSR) methodology [14] .

In the following section, the theoretical background for the research is introduced followed by the methodology and implementation, where the main drivers are presented in a conceptual framework. Closing with the conclusions, limitations, and avenues for further research.

2. A Brief Literature Review

Today, Blockchain is perceived as a way to redefine companies and economies, relying on distributed networks, which can change enterprise architectures and affect company's value proposition [15]. IDC predicts that Blockchain will play a significant role in the differentiation strategy of supply chain management for early adopters, as it will create data management and service quality challenges that less prepared organizations will fail to respond to [16]. Therefore, gaining insights over the drivers for its adoption enables us to understand how this process can be accelerated, as the process of its adoption is believed to be gradual and not sudden [17].

Given the context of this study, there is still a need to fill the research gaps that accompany the maturity level of the technology [18]. The literature that supports this study, is from peer-reviewed IS journals and selected IS conferences, following the same approach of [19,20]. The focus on the presented papers, was inspired by the three debates created by [12] around Blockchain when applied to supply chain: 1) the Industry Specific, that included real case applications of blockchain technology and observed benefits, regarding: 1.1) the Automotive Industry [21], with focus on Acceptance and supported by Inter-organizational Trust [22]; 1.2) Transactions on the Diamond Market [23], focusing on trust, through an explorative research, debating and comparing transactions with and without Blockchain; 1.3) the Shipping Industry [24], also following a Design Science Research (DSR), and combining it with a literature review and expert's inputs, examining International Trade Documents being dealt through blockchain; 1.4) Logistics [25], attempting to link blockchain technology to supply chain and logistics, utilizing distributed ledger technology; 2) the Business Relationships, that identified Interrelations verified in a Supply Chain Network, B2B (Business to Business) and B2C (Business to Consumer), both supported by a literature review and the conduction of expert's interviews, concerning: 2.1) Business-To-Consumer and Consumer-To-Consumer [26], that provides insights and describes how blockchain affects consumers; and 2.2) Supply Chain Management and business to business [27], sustained by the Transaction Cost Economics (TCE) and Coase's theory developing a Digital Business Ecosystem architecture as a framework for Digital Supply Chain; and finally, 3) the Comprehensive Approach, which focused on constraints and challenges within the Supply Chain, debating: 3.1) Blockchain Networks on Supply Chain Traceability [28], supported by [29] design criteria for developing an ontology and a layer model; 3.2) Commercially available applications of blockchain [30], while assessing which industries are the most impacted by the technology; 3.3) Effects of blockchain on online businesses [1] developing entrance strategies and blockchain adoption strategies; and 3.4) Blockchain usage in the Logistics area [31], delivering insights on to the major issues in logistics and supply chain (further details of analysis are available from the corresponding author, on request).

The present study was developed between May 2019 and January 2020, it should be noted that the literature scarcity on the topic was complemented in the meantime with papers that might have been incorporated in its foundational phase, since valid inputs are shed when understanding the adoption behavior at the individual level of blockchain within supply chain management [32] and its challenges and benefits [33].

Provided the above, the literature review covered specific segments of Supply Chains but not on a generally applicable adoption context, hence not being capable of answering, the research question proposed for this research on its own. As to enrich the gathered information, additional sources were added, complementing what was described so far, with generally mentioned characteristics of blockchain, such as: Trust [7], Decentralization [34,35] and Security [36] present on all the articles derived from the literature review and considering factors not inherent to blockchain,

that focused on the company's propensity to adopt a technology, which can impact the adoption decision [37], like: Institutional Pressures [38], Organizational Culture [39,40] and Acceptance [17].

The following section describes the methodology and implementation of the proposed work.

3. Methodology and Implementation

For established technologies and for information management publications with similar objectives, adoption drivers are often identified either through literature research or by qualitative research [41,42]. The authors performed both a literature review, as described in the Theoretical Background section, and an exploratory approach to identify the main drivers of adoption of Blockchain Technology applied to a Supply Chain context [14].

Instead of solely following the Delphi methodology, where participants focus on predefined and precise statements of future outcomes [43], we used a broader methodology, the Design Science Research (DSR) as suggested by [14] to capture and develop the proposed adoption drivers, the analysis focused on both the inductive and deductive reasoning, in which new knowledge is explored and existing knowledge is refined and tested, respectively in rounds [44].

Once the results of the different literature sources were consolidated, a two-part questionnaire, with both open-ended and rated questions, was conducted on experts on the fields of blockchain and supply chain industry, from August until October 2019, as to identify what drivers to consider.

The questionnaire was initially conducted on a pilot sample of 15 participants, identifying whether respondents understood the questions and instructions [45], in order to reduce complexity and filtering out the elements that did not present representability for the study, while detecting possible flaws [46]. Afterwards, with more concise and refined elements, these statements were introduced to a larger number of participants (27), that shared the same characteristics as the original sample, but did not include the same individuals. In this round the statements retrieved from the pilot sample were validated and measured for consensus, determining the elements that define the theoretical framework proposed in this paper.

The experts considered, were chosen taking in consideration their LinkedIn profiles, and guaranteeing that they should have at least some experience in both Supply Chain and in Blockchain technology, following [47] guidelines. Although the identity of respondents will remain anonym, the authors did track the responses during the conduction of the surveys to guarantee continuity of the study.

For both surveys the majority of respondents had a Consultancy background followed by a Software vendor related position. The most prominent industry sector was related to IT and Information and Communication Services. Regarding the number of "Years of experience with Blockchain" the majority of the respondents had 2 or less years, but on the other hand the majority of "Year of experience within Supply Chain" was over 5 or more years of experience. This can eventually be explained by the novelty of Blockchain technology and by the fact that supply chain studies and professionals are well spread across several industries.

The execution methodology used for both surveys was as follows:

Round 1: The original sample to whom the survey was sent had a size of 88 experts. Out of this sample a total of 15 completed answers were considered, given the time frame of the study [48].

The objective of this round was to capture the main dimensions within each identified area. The type of questions proposed was divided in two parts, the rated type attributes, and the open response questions. The questionnaire was divided in 3 sections: the respondents' profiling; the rated questions, for each of the mentioned categories with a number of attributes per each: Trust (10); Decentralization (6); Security (9); Institutional Pressures - Coercive Pressures (4); Institutional Pressures - Normative Pressures (3); Institutional Pressures - Mimetic Pressures (3); Organizational Culture - Flexibility Orientation (4); Organizational Culture - Control Orientation (4); and Acceptance (5); and 10 "open answer" questions derived from the literature review. It resulted in a total of 48 rated attributes divided in 9 categories for the rated questions, and 10 open answered questions. (Questionnaires, respective sections and results are made available from the authors on request)

Round 2: For the second survey, we were able to collect 27 completed answers, and once again incomplete surveys were discarded from the analysis. This round was elaborated based on the results of the first one, where 18 questions were selected out of the initial 58 and adapted into statements (described in the results section), based on expert's opinion. To ensure validity, in this round, the authors requested respondents to rate these statements in terms of significance using a 7-point Likert scale that ranged between Strongly Disagree (1) to Strongly Agree (7).

A detailed overview of these statements can be found in the next section.

4. Results and Discussion

The analysis was done so that it was possible to reduce complexity and, in a way, answer the proposed research question of this study. For the first round, the analysis was divided in two parts, one for the rated questions, that

consisted on a quantitative analysis, where results were measured by adding up the response scores on related sets of items as Likert scales are "summative" [49]. The open response questions required a qualitative analysis. This analysis followed partially the inductive reasoning present in the DSR methodology, where new knowledge, meaning the experts' inputs is explored [50]. For the validation round, an adaptation of the sample results was needed for the deductive reasoning of the used methodology, as existing knowledge is refined and tested, once again, in this case through the means of a survey. Nonetheless in both results analysis, some elements were dropped for coherence and rectification purposes.

Round 1: The rated attributes results treatment consisted on excluding the least ranked attributes per category, therefore out of the 48 rated attributes, for each of the 9 categories, the ones that summed the highest amount of points were considered. Those 9 questions, that presented to be more significant for the respondents, were rewritten into reconciled statements for the respective categories: 1.) Trust - Adoption of the technology is influenced by the choice of the business partner and its readiness to provide assistance and support; 2.) Decentralization - Blockchain's decentralization is a core strength and an adoption incentive, as a copy of the database file is owned by all actors; 3.) Security - Consensus mechanisms may present Security vulnerabilities that may concern the technology's adoption level; 4.) Institutional Pressures: Coercive Pressures - As an Institutional Coercive Pressure, Customers pressuring for adoption of the technology can play a significant role for business' commitment to blockchain and a determinant element for customer retention; 5.) Institutional Pressures: Normative Pressures - The level of adoption of the technology is increasing, which is an adoption driver for businesses, in general; 6.) Institutional Pressures: Mimetic Pressures - Companies that use blockchain within their Supply Chains will necessarily have a competitive advantage over others. 7.) Organizational culture: Flexibility Orientation - Adopting a new technology, such as blockchain is more prone in organizations emphasizing growth and with a high innovation maturity level; 8.) Organizational Culture: Control Orientation - Adoption of blockchain in an organization that emphasizes outcomes and achievements, will be more prone to adopt the technology; 9.) Acceptance - Considering acceptance of a technology such as blockchain, its success depends highly on the trust level.

Regarding the open response questions, of the 10, only 9 statements were returned from the experts' input, here an empirical analysis was necessary, as statements were created regarding the similarities between answers and the level of response per question, which explains why one of the questions asked was not considered given that none of the experts responded to it. The end result was: 1.) A main incentive to implement a blockchain solution in a Supply Chain environment, is its traceability feature, i.e. tracking and tracing driven by network collaboration; 2.) The current maturity at which blockchain is at, does not allow businesses to evaluate the positive outcomes of adoption; 3.) Smart contracts are a determinant feature of blockchain, when applied to supply chain because they promote transparency, data verifiability, no alterations to data, and allow products and services tracking; 4.) A cost benefit that can prove to be attractive to upcoming adopters of the technology, is the reduction of the bullwhip effect on supply chains (distorted information from one end of a supply chain to the other that can lead to inefficiencies). 5.) A main incentive to implement a blockchain solution in a Supply Chain environment, is that it represents a single source of information, i.e. Several sources integrated in one; 6.) One of the challenges for Blockchain adoption could be the acceptance of the solution by the whole Supply Chain players; 7.) Smart contracts are a determinant feature of blockchain, when applied to supply chain by promoting automation, therefore presenting performance increases and process simplification; 8.) Adoption of blockchain technology presents benefits for custom clearance and dangerous goods transactions, as these are highly regulated which means you might shift knowledge from one business partner to another; 9.) Blockchain can automate processes in a holistic manner over multiple business partners.

Round 2: Based on the list of factors derived from the original sample questionnaire, presented above, an online questionnaire was designed in which experts were asked to rate those factors on a 7-point numerical scale. The decision served as means to enhance the reliability of the study and therefore avoiding ambiguity as data was pre-tested on a sample of respondents different from the final experts' panel. Table 1 describes how the results from the validation round were treated, followed by the description of the analysis process.

Table 1. Statistical Results of the rated statements regarding blockchain adoption within supply chain, by experts on the second-round survey

Statement – Validation Round	SD	Sum (Ri)	Rank*	Q1	Q3	IQR	Cut-Off = 1
A main incentive to implement a blockchain solution in a Supply Chain environment, is that it represents a single source of information, i.e. Several sources integrated in one.	0.59	162	1st	6	7	1	acceptable consensus
One of the challenges for Blockchain adoption could be the acceptance of the solution by the whole Supply Chain players.	0.71	160	2nd	6	7	1	acceptable consensus
A main incentive to implement a blockchain solution in a Supply Chain environment, is its traceability feature, i.e. tracking and tracing driven by network collaboration.	0.87	160	3rd	6	7	1	acceptable consensus
Adoption of the technology is influenced by the choice of the business partner and its readiness to provide assistance and support.	0.71	155	4th	6	7	1	acceptable consensus
Blockchain can automate processes in a holistic manner over multiple business partners.	0.80	154	5th	6	7	1	acceptable consensus
Smart contracts are a determinant feature of blockchain, when applied to supply chain because they promote transparency, data verifiability, no alterations to data and allow products and services tracking.	1.03	154	6th	6	7	1	acceptable consensus
The level of adoption of the technology is increasing, which is an adoption driver for businesses, in general.	0.93	153	7th	6	7	1	acceptable consensus
A cost benefit that can prove to be attractive to upcoming adopters of the technology, is the reduction of the bullwhip effect on supply chains (distorted information from one end of a supply chain to the other that can lead to inefficiencies).	1.05	153	8th	6	7	1	acceptable consensus
Considering acceptance of a technology such as blockchain, its success depends highly on the trust level.	1.41	152	9th	6	7	1	acceptable consensus
Smart contracts are a determinant feature of blockchain, when applied to supply chain by promoting automation, therefore presenting performance increases and process simplification.	1.09	147	10th	5	7	2	no consensus
Companies that use blockchain within their Supply Chains will necessarily have a competitive advantage over others.	1.41	145	11th	5	7	2	no consensus
Blockchain's decentralization is a core strength and an adoption incentive, as a copy of the database file is owned by all actors.	1.10	143	12th	5	7	2	no consensus
Adoption of blockchain technology presents benefits for custom clearance and dangerous goods transactions, as these are highly regulated that means you might shift knowledge from one business partner to another.	1.50	140	13th	4	7	3	no consensus
As an Institutional Coercive Pressure, Customers pressuring for adoption of the technology can play a significant role for business' commitment to blockchain and a determinant element for customer retention.	1.42	137	14th	4	7	3	no consensus
Adopting a new technology, such as blockchain is more prone in organizations emphasizing growth and with a high innovation maturity level.	1.86	133	15th	5	7	2	no consensus
An organization that emphasizes outcomes and achievements, will be more prone to adopt blockchain technology.	1.59	131	16th	4	7	3	no consensus
Consensus mechanisms may present security vulnerabilities that may concern the technology's adoption level.	1.50	114	17th	4	5	1	acceptable consensus
The current maturity at which blockchain is at, does not allow businesses to evaluate the positive outcomes of adoption.	1.61	100	18th	3	5	2	no consensus

*Corrected by the Standard Deviation (SD), and based on the total number of points given by Sum-Ri value

Following [51,52] approach to measure consensus on scaled inquiries, the Interquartile Range (IQR) was used with a threshold of acceptance of 1, therefore results with IQR over 1 were labeled with "no consensus", and the ones with IQR equal to 1 with the label "acceptable consensus". As there were tied answers, the original rank given by the total number of points was corrected by the standard deviation of rates per question. Although 10 statements reached that target, only the first ranked 9 elements had a positive response rate, as the seventeenth ranked element presented a low response rate, meaning experts agree that security vulnerabilities of consensus mechanisms are not representative for adoption. Hence, this element is not included on the adoption framework conceptualized in Figure 1.

The nine adoption factors considered were divided in two categories: Adoption Incentives (A.I.) and Adoption Challenges (A.C.) The Adoption Challenges consider external elements, that may condition the adoption process, such as the dependence of other players acceptance and adoption, the support and assistance given by the technology provider, and the trust level deposited on the technology itself. The Adoption Incentives category enumerated benefits and characteristics inherent to the technology like the automation and inefficiencies reduction, traceability, and information tracking, as well as the transparency guaranteed by smart contracts.

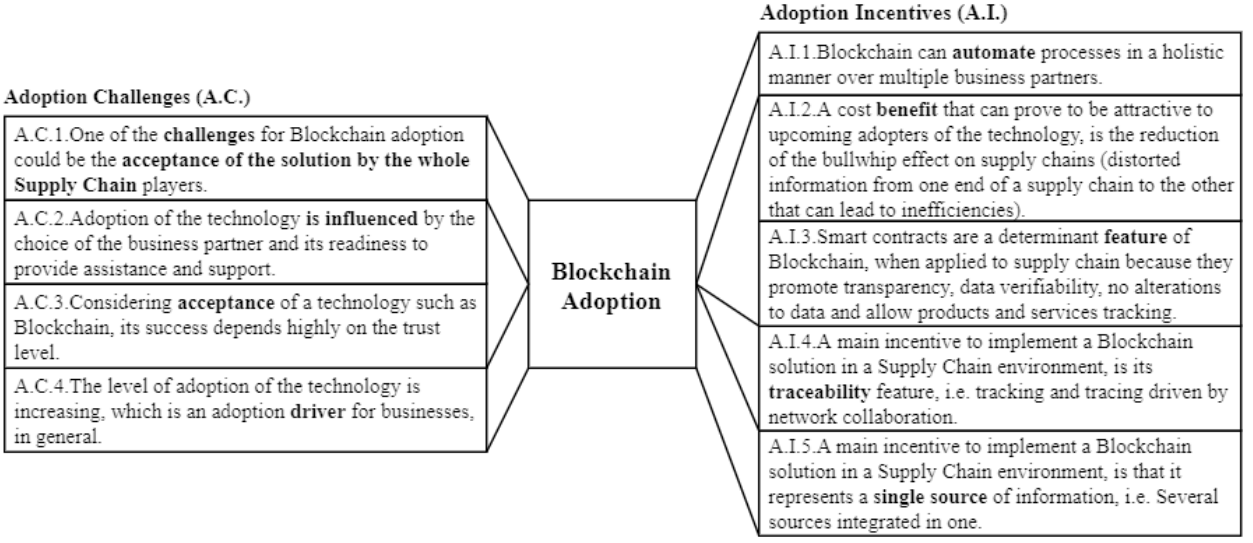

Figure 1. Findings of the main drivers of Blockchain adoption within Supply Chain

Considering the observations of more recent publications, concerning the same topic, [32] divided their results in several categories: Behavioral Expectation and Intention, that reflected the intention of using blockchain in a short time, as the paper compared 2 different regions, these observations are not translated in our results; Blockchain Transparency described in our results as an adoption incentive - A.I.3; Facilitating Conditions, that indicate organizations' infrastructure and capabilities to support blockchain technologies as an adoption factor. Although this consideration was contemplated in the present study, within the Institutional Pressures, Organizational Culture, and Acceptance categories, it ended up not being part of the presented framework given the low significance level given by the experts; Performance Expectancy, considered the benefits derived from using the technology, that here are highlighted in a general way in all 5 incentives of adoption; Trust of Supply Chain Stakeholders, that is contemplated in this paper as a challenge A.C.3; Social Influence, suggesting that supply chain professionals can influence blockchain adoption, which is mirrored in all 4 challenges we provide;

These seven categories were also highly dependent of one another which proved similar to the results of this study. Nonetheless the discrepancy on the number of indicators considered in each paper, may prove that our study may need to be furthered. Moreover, and supporting our findings, other papers [53] that focused on the barriers of adoption, also highlight transparency and Smart Contract capabilities (Adoption Incentives) as benefits of the adoption and emphasize that supply chain partners need to understand and plan for these obstacles for blockchain implementations, which goes along with the challenges we provide. IDC reports that blockchain has already associated drivers playing in its favor, since it is emerging in an age of innovation, creating accelerated disruption and maximizing data value [16], but the relevance of the appointed drivers is too generic unlike this analysis intends to be. Contemplating the model developed by [54], that considers drivers emerging from the application of blockchain technology in supply chains from four perspectives: Technology, Trust, Trade and Traceability/Transparency, our results also consider each of these perspectives, as the main drivers of adoption presented go hand in hand with the current findings of fellow researchers.

5. Conclusions, Contributions, Limitations and Further Research

Considering the main drivers of adoption, this study answers its research question with nine drivers, that consist on the acceptance by other supply chain players, the adoption trends verified by the market, the trust level deposited not only on the technology but also on the technology provider, the perceived benefits of the technology and smart contracts, the automatization of processes, the cost-benefits provided by the reduction of inefficiencies and the overall benefits to supply chains. The observations of this paper, provide academia and practitioners with a theoretical framework that considers the drivers of adoption from two points of view for potential adopters, one being the possible challenges encountered, the other one the incentives that may foment this adoption and encourage other players to follow that trend, as synergies derive from adoption of all stakeholders of the supply chain [55].

This study fills a literature gap by debating its results with similar studies, that also used experts' input to validate and generate content, proving this method to be a popular resort, given the current maturity of blockchain applications. The Design Science Research (DSR) approach demonstrated to be essential in order to avoid ambiguity of results, as the metrics of analysis were opinion based, therefore consolidation of results for further validation was empirical. Nevertheless, the findings presented sustainability as they were validated across the presented papers.

Overall, it contributes to the growing body of knowledge of blockchain applications within the supply chain landscape with two major implications: Managerial Implications, providing considerations for industry professionals of the implications to their current operations, with the possibility of designing an adoption strategy around the identified elements. It provides insights for vendors on how their reputation may influence clients' adoption, highlighting the importance of all the participants in the supply chain. As the integration of the technology allows the combination of several sources into one single point of information, it also gives adopters a higher control over their supply chain networks, bettering their processes in a holistic manner; and Academic Implications, as this paper provides the academic community with a theoretical framework that combines existing literature into a structured framework validated by experts on the matter.

Furthermore, our study presents the adoption drivers as a research framework for future work extensions, such as the conduction of a quantitative study [56], as base to empirically test these nine drivers with a large-scale survey in firms [41,57].

References

[1] Zhang, Xiaoqing. (2018) "How Will Blockchain Change the Market Structure?" *ICIS 2018 Proceedings*.

[2] Warren, Sheila and Treat, David. (2019) "Building Value with Blockchain Technology : How to Evaluate Blockchain' s Benefits" *White Paper in Word Economic Forum 2019*.

[3] Woodside, Joseph M, Augustine, Fred K, and Giberson, Will. (2017) "Blockchain Technology Adoption Status and Strategies" *Journal of International Technology and Information Management* 26 (2): 65–93.

[4] Nakamoto, Satoshi. (2008) "Bitcoin: A Peer-to-Peer Electronic Cash System" *Manubot*.

[5] Bogart, Spencer and Rice, Kerry. (2015) "The Blockchain Report: Welcome to the Internet of Value" *Needham* 05 (09): 1–10.

[6] Abeyratne, Saveen A. and Monfared, Radmehr P. (2016) "Blockchain Ready Manufacturing Supply Chain Using Distributed Ledger" *International Journal of Research in Engineering and Technology* 05 (09): 1–10.

[7] Kwon, Ik Whan G and Suh, Taewon. (2004) "Factors affecting the level of trust and commitment in supply chain relationships" *Journal of Supply Chain Management* 40 (1): 4–14.

[8] Viriyasitavat, Wattana and Hoonsopon, Danupol. (2019) "Blockchain characteristics and consensus in modern business processes" *Journal of Industrial Information Integration* 13: 32–9.

[9] Deloitte,. (2019) "Deloitte's 2019 Global Blockchain Survey: Blockchain Gets Down to Business" *Deloitte*.

[10] Grant, Joan S and Davis, Linda L. (1997) "Selection and use of content experts for instrument development" *Research in Nursing & Health* 20 (3): 269–74.

[11] Hackius, Niels and Petersen, Moritz. (2017) "Blockchain in Logistics and Supply Chain: Trick or Treat?" *In Digitalization in Supply Chain Management and Logistics: Smart and Digital Solutions for an Industry 40 Environment Proceedings of the Hamburg International Conference of Logistics (HICL)* 23: 3–18.

[12] Pranto, Samuel, Jardim, Leonor, Oliveira, Tiago, and Ruivo, Pedro. (2019) "Literature Review on Blockchain with focus on Supply Chain" *In Proceedings of the 19th Portuguese Association of Information Systems Conference: Digital Disruption: Living between Data Science, IoT and . People*: 51.

[13] Treiblmaier, Horst. (2018) "The impact of the blockchain on the supply chain: a theory-based research framework and a call for action" *Supply Chain Management* 23 (6): 545–59.

[14] Gregor, Shirley and Jones, David. (2007) "The anatomy of a design theory" *Journal of the Association for Information Systems* 8 (5): 312–35.

[15] Labazova, Olga. (2019) "Towards a Framework for Evaluation of Blockchain Implementations" *Fortieth International Conference on Information Systems*: 1–16.

[16] Muscolino, Holly, Buttita, Megan, and Leary, Ryan O. (2020) "IDC FutureScape IDC FutureScape : Worldwide Future of Work 2020 Predictions": 1–22.

[17] Iansiti, Marco, and Karim R Lakhani. (2017) "The Truth about Blockchain." *Harvard Business Review* 95 (1): 118–27.

[18] Casino, Fran, Dasaklis, Thomas K, and Patsakis, Constantinos. (2019) "A systematic literature review of blockchain-based applications: Current status, classification and open issues" *Telematics and Informatics* 36: 55–81.

[19] Webster, Jane and Watson, Richard T. (2002) "Analyzing the Past to Prepare for the Future: Writing a Literature Review." *MIS Quarterly* 26 (2): xiii–xxiii.

[20] Côrte-Real, Nadine, Ruivo, Pedro, and Oliveira, Tiago. (2014) "The Diffusion Stages of Business Intelligence & Analytics (BI&A): A Systematic Mapping Study" *Procedia Technology* 16: 172–9.

[21] Supranee, Sowichaya and Rotchanakitumnuai, Siriluck. (2017) "The acceptance of the application of blockchain technology in the supply chain process of the Thai automotive industry" *Proceedings of the International Conference on Electronic Business (ICEB)* 2017-Decem: 252–7.

[22] Liu, Hefu, Ke, Weiling, Wei, Kwok Kee, and Hua, Zhengsheng. (2015) "Influence of power and trust on the intention to adopt electronic supply chain management in China" *International Journal of Production Research* 53 (1): 70–87.

[23] Loebbecke, Claudia, Lueneborg, Leon, and Niederle, Denis. (2018) "Blockchain technology impacting the role of trust in transactions: Reflections in the case of trading diamonds" *26th European Conference on Information Systems: Beyond Digitization - Facets of Socio-Technical Change, ECIS 2018*.

[24] Nærland, Kristoffer, Beck, Roman, Müller-Bloch, Christoph, and Palmund, Søren. (2018) "Blockchain to Rule the Waves - Nascent Design Principles for Reducing Risk and Uncertainty in Decentralized Environments" *ICIS 2017: Transforming Society with Digital Innovation*.
[25] Baruffaldi, Giulia and Sternberg, Henrik. (2018) "Chains in Chains - Logic and Challenges of Blockchains in Supply Chains" *Proceedings of the 51st Hawaii International Conference on System Sciences*: 3936–43.
[26] Schlegel, Manuel, Zavolokina, Liudmila, and Schwabe, Gerhard. (2018) "Blockchain Technologies from the Consumers' Perspective: What Is There and Why Should Who Care?" *Proceedings of the 51st Hawaii International Conference on System Sciences*.
[27] Korpela, Kari, Hallikas, Jukka, and Dahlberg, Tomi. (2017) "Digital Supply Chain Transformation toward Blockchain Integration" *Proceedings of the 50th Hawaii International Conference on System Sciences (2017)*.
[28] Seebacher, Stefan and Maleshkova, Maria. (2018) "A Model-driven Approach for the Description of Blockchain Business Networks" *Proceedings of the 51st Hawaii International Conference on System Sciences*.
[29] Gruber, Thomas R. (1995) "Toward principles for the design of ontologies used for knowledge sharing" *International Journal of Human - Computer Studies* 43 (5–6): 907–28.
[30] Salviotti, Gianluca, De Rossi, Leonardo Maria, and Abbatemarco, Nico. (2018) "A structured framework to assess the business application landscape of blockchain technologies." *Proceedings of the 51st Hawaii International Conference on System Sciences*.
[31] Akram, Asif; Bross, Philip. (2018) "Trust , Privacy and Transparency with Blockhain Technology in Logistics" *Mediterranean Conference on Information Systems 2018, MCIS 2018*: 1–17.
[32] Queiroz, Maciel M and Fosso Wamba, Samuel. (2019) "Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA" *International Journal of Information Management* 46: 70–82.
[33] Wamba, Samuel Fosso and Queiroz, Maciel M. (2020) "Blockchain in the operations and supply chain management: Benefits, challenges and future research opportunities" *International Journal of Information Management*: 102064.
[34] Zheng, Zibin, Xie, Shaoan, Dai, Hongning, Chen, Xiangping, and Wang, Huaimin. (2017) "An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends" *Proceedings - 2017 IEEE 6th International Congress on Big Data, BigData Congress 2017*: 557–64.
[35] Sultan, Karim, Ruhi, Umar, and Lakhani, Rubina. (2018) "Conceptualizing blockchains: Characteristics & applications" *Proceedings of the 11th IADIS International Conference Information Systems 2018, IS 2018*: 49–57.
[36] Li, Xiaoqi, Jiang, Peng, Chen, Ting, Luo, Xiapu, and Wen, Qiaoyan. (2017) "A survey on the security of blockchain systems" *Future Generation Computer Systems*.
[37] DeCanio, Stephen J, Dibble, Catherine, and Amir-Atefi, Keyvan. (2000) "Importance of organizational structure for the adoption of innovations" *Management Science* 46 (10): 1285–99.
[38] Liu, Hefu, Ke, Weiling, Wei, Kwok Kee, Gu, Jibao, and Chen, Huaping. (2010) "The role of institutional pressures and organizational culture in the firm's intention to adopt internet-enabled supply chain management systems" *Journal of Operations Management* 28 (5): 372–84.
[39] Yeung, Arthur, Brockbank, Joseph Wayne, and Ulrich, Dave. (1991) "Organizational culture and human resource practices: An empirical assessment" *Research in Organizational Change and Development* 5 (1): 59–82.
[40] Deshpandé, Rohit, Farley, John U, and Webster, Frederick E. (1993) "Corporate Culture, Customer Orientation, and Innovativeness in Japanese Firms: A Quadrad Analysis" *Journal of Marketing* 57 (1): 23–37.
[41] Ruivo, Pedro, Johansson, Björn, Sarker, Saonee, and Oliveira, Tiago. (2020) "The relationship between ERP capabilities, use, and value" *Computers in Industry* 117: 103209.
[42] Ruivo, Pedro, Santos, Vítor, and Oliveira, Tiago. (2014) "Data Protection in Services and Support Roles – a Qualitative Research amongst ICT Professionals" *Procedia Technology*.
[43] Ruivo, Pedro, Santos, Vitor, and Oliveira, Tiago. (2015) "Success factors for data protection in services and support roles: Combining traditional interviews with delphi method" *International Journal of Human Capital and Information Technology Professionals*.
[44] Lee, Jong Seok, Pries-Heje, Jan, and Baskerville, Richard. (2011) "Theorizing in design science research" *International Conference on Design Science Research in Information Systems*: 1–16.
[45] Kelley, Kate, Clark, Belinda, Brown, Vivienne, and Sitzia, John. (2003) "Good practice in the conduct and reporting of survey research" *International Journal for Quality in Health Care* 15 (3): 261–6.
[46] Teijlingen, Edwin van and Hundley, Vanora. (2002) "The importance of pilot studies" *Nursing Standard* 16 (40): 33–6.
[47] Ha-Thuc, Viet, Venkataraman, Ganesh, Rodriguez, Mario, Sinha, Shakti, Sundaram, Senthil, and Guo, Lin. (2015) "Personalized expertise search at LinkedIn" *Proceedings - 2015 IEEE International Conference on Big Data, IEEE Big Data 2015*: 1238–47.
[48] Kitchenham, Barbara and Pfleeger, Shari Lawrence. (2003) "Principles of survey research part 6" *ACM SIGSOFT Software Engineering Notes* 28 (2): 24.
[49] Wigley, Charles J. (2013) "Dispelling Three Myths about Likert Scales in Communication Trait Research" *Communication Research Reports* 30 (4): 366–72.
[50] Gregory, Robert Wayne and Muntermann, Jan. (2011) "Theorizing in design science research: Inductive versus deductive approaches" *International Conference on Information Systems 2011, ICIS 2011* 2: 888–904.
[51] Ramos, Delfina, Arezes, Pedro, and Afonso, Paulo. (2016) "Application of the Delphi Method for the inclusion of externalities in occupational safety and health analysis" *DYNA* 83 (196): 14–20.
[52] Persai, Divya, Panda, Rajmohan, Kumar, Ravi, and Mc.ewen, Andy. (2016) "A Delphi study for setting up tobacco research and practice network in India" *Tobacco Induced Diseases* 14 (1): 4.
[53] Saberi, Sara, Kouhizadeh, Mahtab, Sarkis, Joseph, and Shen, Lejia. (2019) "Blockchain technology and its relationships to sustainable supply chain management" *International Journal of Production Research* 57 (7): 2117–35.
[54] Pournader, Mehrdokht, Shi, Yangyan, Seuring, Stefan, and Koh, SC Lenn. (2019) "Blockchain applications in supply chains, transport and logistics: a systematic review of the literature" *International Journal of Production Research*: 1–19.
[55] Kim, Joon Seok and Shin, Nina. (2019) "The impact of blockchain technology application on supply chain partnership and performance" *Sustainability* 11 (21): 6181.
[56] Ruivo, Pedro, Oliveira, Tiago, and Neto, Miguel. (2012) "ERP use and value: Portuguese and Spanish SMEs" *Industrial Management & Data Systems*.
[57] Côrte-Real, Nadine, Ruivo, Pedro, Oliveira, Tiago, and Popovič, Aleš. (2019) "Unlocking the drivers of big data analytics value in firms" *Journal of Business Research* 97: 160–73.