A Meta-review of Blockchain Adoption Literature in Supply Chain

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Abstract. Supply chains are increasingly adopting industry 4.0 technologies to meet exceeding stakeholder expectations. Blockchain technology offers an opportunity to facilitate the digital transformation of supply chains. Supply chains can benefit from the characteristics of blockchain including through transparency, traceability, and immutable data, to enable for example quality, sustainability, provenance, and safety. Adoption considerations for blockchain are important to ensure needs are met in the early adoption stages and further stages of deployment. This study aims to explore the adoption considerations for blockchain across supply chain domains reported in the literature, focusing on adoption factors and readiness. Research methodology used is a meta-analysis of literature review studies on blockchain adoption in supply chains to identify themes. The review identified 102 papers from four databases, and 33 are selected for analysis, identifying 64 blockchain adoption factors. Security, system integration, trust, scalability, costs, and traceability are found to be important blockchain adoption factors for supply chain. The adoption factors show a spread over a people-process-technology framework. Limitations of the research and areas for future research are highlighted.

Keywords: Blockchain · Adoption · Meta review · Supply chain

1 Introduction

Industry 4.0 technologies support the digital supply chain. Digital supply chains are those adopting novel technologies to enhance performance and create a competitive edge. Example industry 4.0 technologies are cloud computing, artificial intelligence, big data, internet-of-things, augmented reality, 3D printing, and blockchain technology [1, 2]. Blockchain technologies are increasingly implemented and researched in the field of supply chain management. In principle, blockchain ledgers hold information like other ledger systems, for example, price, quantity, and quality aspects. Blocks containing timestamps, Merkle tree root and parent hash, nBits, and nonce are built together to represent a series of transactions forming the Blockchain [3]. Identified by [4] are some of the important characteristics of blockchain enabling technologies in

W. Abramowicz et al. (Eds.): BIS 2021 Workshops, LNBIP 444, pp. 371–388, 2022.
https://doi.org/10.1007/978-3-031-04216-4_32

supply chain management. These are data safety, accessibility, documentation, data management, and quality. Blockchain technologies are not without criticism, as discussed by [5], legal aspects and privacy are some of the important challenges in blockchain adoption.

Supply chains take raw products through a series of processes to create value added products [6]. Currently, there is a drive towards sustainable supply chains [7]. Digital transformation can disrupt supply chains to meet the sustainability needs of consumers [8]. Research on digitally enabled supply chains is shown in the literature [1, 9, 10]. The requirements for digital platforms in sustainable supply chains are identified in [11, 12]. For example, traceability is identified as a requirement to improve quality and safety assurance, as discussed by [13]. Blockchain offers the ability to support this need, with immutable, transparent, visible, and traceable data, amongst others [14]. To enable digital transformation, knowledge of the building-blocks is important. [15] present a building-block model for digital transformation. This is further developed for blockchain technology in supply chains by [5]. Imperative in the model in [5] is the three-phase implementation process of pre-adoption, adoption, and post-adoption. In addition, the pre-adoption phase discusses the need for adoption readiness. Adoption readiness is discussed as the level in which an organization or supply chain is prepared to adopt technologies. More important, adoption readiness influences the future success of the technology. Within adoption, PPT (people-process-technologies) considerations can support the understanding of categories for adoption considerations [16].

Research on blockchain advantages, challenges, and potential applications are shown [17–19]. As part of the feasibility and adoption process, it is necessary to understand adoption factors for blockchain based supply chains. Adoption factors are playing a role in decision making when implementing technologies. Adoption factors have been investigated in a variety of settings including pharmaceutical industries, smart manufacturing, and supply chain management [16, 20]. However, limited research presents an overview of blockchain adoption factors across several supply chain domains, while considering context and adoption readiness. Therefore, this research aims to identify emerging considerations of blockchain adoption in supply chains through a meta-review. The meta-review focuses on three main areas for contribution. i) The adoption factors between supply chain domains, showing the importance of adoption context ii) the adoption factors of blockchain technology in supply chain, and iii) adoption readiness considerations for blockchain adoption in supply chain. The remaining sections in the paper is a literature review in Sect. 2, followed by the research methodology in Sect. 3. Section 4 presents the results and the discussion. The report is concluded in Sect. 5.

2 Literature Review

2.1 Blockchain Adoption Factors in Supply Chains

Blockchain adoption research in supply chains is evident in both cross-sector review studies (those that study multiple supply chains) and in specific review studies (those that study individual supply chains). Table 1 shows an overview of the adoption factors

identified in supply chains. As shown in Table 1, cross-sector studies have received the most attention in respect to blockchain adoption in supply chain. The food, automotive, healthcare, and public supply chains have also been focused on in several individual studies. Some adoption considerations are shown more specifically to the supply chain domains suggesting a link towards the importance of adoption context regarding the sectors and technology characteristic considered. For example, in the food supply chain, traceability is identified in [21–23], while in the automotive supply chain supportive and legal, system integration, security, automation, and resources are more identifiable [24, 25]. Trust is important e.g. in the health care supply chain [26, 27], in addition to privacy, which is also identified the financial supply chains focused papers [28, 29]. The pharmaceutical supply chain is the only one reported to identify validity and accuracy [16], while smart manufacturing requires flexibility [30], showing the unique requirement needs in individual supply chain domains. These key characteristics cut across sectors and industries and are indicative for some in the literature.

Table 1. Adoption considerations form literature

Supply chain	Adoption considerations	Source (s)
Agri-Food	Supportive and legal; Privacy; Trust; Efficiency; System Integration; Disintermediation; Usability; Security; Knowledge and Skills; Scalability; Costs; Traceability; Immutability; Socio-demographic; Company/organizational factors; Company capability; Provenance; Audibility; Product safety	[21–23]
Automotive	Supportive and legal; Trust; Support Infrastructure; Efficiency; System' Integration; Supply Chain Integration; Sustainability; Disintermediation; Safe monitoring; Authentication; Usability; Security Knowledge and Skills; Transparency; Scalability; Costs; Traceability; Immutability; Automation; Frugal implementation; Company/organizational factors; Attitude; Resources; Visibility; Ownership and management support; Collaboration; Data quality and integrity; System capability; Permissions	[24, 25]
Cross-sector/non-specified	Supportive and legal; Innovation drive; Privacy; Trust; Support; Infrastructure; Efficiency; System Integration; Supply Chain Integration; Sustainability; Disintermediation; Safe monitoring; Reliability; Authentication; Usability; Security; Knowledge and Skills; Transparency; Scalability; Storage capacity; Costs; Traceability; Immutability; Decentralized or distributed; Automation; Energy consumption; Governance; Speed; Company capability; Provenance; Audibility; Clarity; Awareness; Attitude; Resources; Value creation; Product safety; Visibility; Supply chain digitalization; Ownership and management support; Collaboration; Data quality and integrity; Data sharing; Define Scope; Facilitation effect; Open source; Accessibility	[31–45]
Diamond	Supportive and legal; Trust; Support Infrastructure; Efficiency; Security; Scalability; Costs; Supply chain digitalisation; Risk; Real-time	[46]
Financial	Supportive and legal; Privacy; Trust; Efficiency; System Integration; Disintermediation; Usability; Security; Transparency; Scalability; Traceability; Immutability; Decentralized or distributed; Automation; Energy consumption; Governance	[28, 29]
Healthcare	Supportive and legal; Innovation drive; Privacy; Trust; Support Infrastructure; Usability; Security; Transparency; Traceability; Immutability; Decentralized or distributed; Auditability; Mobility Ownership and management support; Reproducibility; Experts	[26, 27]
Logistics	System Integration Security; Knowledge and Skills; Scalability; Traceability; Resources; Shared benefits; Best practices; Investment from partners	[47]
Pharmaceutical	Innovation drive; Privacy; Trust; Efficiency; System Integration' Supply Chain Integration; Safe monitoring; Reliability; Authentication; Usability; Security; Transparency; Scalability; Storage capacity; Costs; Traceability; Immutability; Decentralized or distributed; Visibility; Data quality and integrity; Accuracy; Validity	[16]
Public sector supply chain	Efficiency; Knowledge and Skills Scalability; Costs; Decentralized or distributed; Energy consumption; Governance; Company/organizational factors; Attitude	[48, 49]
Smart supply chains	Privacy; Trust; System Integration; Supply Chain Integration; Reliability; Security; Transparency; Costs; Energy consumption; Speed; Frugal implementation; Risks; Real-time; Flexibility	[30, 50]

2.2 Industry 4.0 Technologies

Blockchain is not a standalone technology. Other Industry 4.0 technologies are often adopted to enable blockchain capabilities such as AI (Artificial Intelligence), IoT (Internet of Thing), and Big Data [51]. [52] assess blockchain, AI, IoT, and Big Data in the agriculture supply chain. The research suggests that each technology has positive impacts (e.g. improved quality and traceability) and negative impacts (e.g. privacy) within the supply chain. [53] present a framework for food traceability, showing the combination of modules. A blockchain module for secure, open, and transparent data storage, and an IoT module for data collection. In addition, a fuzzy food quality evaluation module to predict aspects such as shelf-life and decay rates. Example benefits of industry 4.0 technologies are present in [52]. For example, AI and big data enable robotics, improve decision support systems, enable mobile expert systems, and assist in predictive analysis, while blockchain can enable smart contracts through compatibility with IoT systems. Recent research by [54] proposes a hybrid design pattern that utilises industry 4.0 technologies, to improve data flow processes within systems The system uses blockchain, IoT and AI. AI reduces the need for data manipulation and therefore increases system efficiency.

2.3 Blockchain Adoption Frameworks

[31] provide a framework for blockchain adoption highlighting some key phases in adoption. The initiation phase which related to investigating the need for the technology, knowledge, awareness, attitude, and proposing a blockchain provider. Adoption factors are important to assess in this phase. In the framework, the implementation phase includes the actual purchase of the technology, preparing the organization for adopting blockchain through performing trial, acceptance, and use case studies. A three-stage blockchain adoption strategy is presented by [40]. The first is technological assessment of performance, capability, and costs. Second is framework development, focusing on the processes of adopting blockchain, for example, new business models or purchasing processes. The third stage identified for blockchain adoption is to create trust in blockchain technology. Existing adoption frameworks have been adopted in blockchain research, for example, [25] adopt the TOE or technological (compatibility, complexity), organisational (top management support, size of organisation), and environmental (external pressures and support). An increasingly popular framework in blockchain adoption is the PPT model or people-process-technology framework. This model has been applied to assess blockchain adoption in supply chains [16, 30, 55] PPT goes beyond technology assessment and considers the importance of processes and people in adoption of technology.

3 Research Methodology

The overall research approach is shown in Fig. 1 and it is used to analyse the literature on blockchain adoption with an emphasis on three key adoption considerations, a) adoption domain and its context, b) adoption factors, and c) adoption readiness.

Fig. 1. Research framework

Methods are not dissimilar to recent work in respect to blockchain adoption see [55] and [16]. The aim and research objectives are developed and shown see Sect. 1. Following this, a search protocol is developed, and a search is conducted. The papers were screened and then analysed through a meta-review. See [56] for an example of recent work adopting the meta-analysis approach. In Phase 1, literature review is conducted to collect a list of blockchain adoption factors. The first and second step was to select databases and keywords. Databases used for the research included Science Direct, Scopus, IEEE, and Emerald Insight. The literature search used specified keywords and search strings (TITLE-ABS-KEY (blockchain AND adoption AND "systematic literature review"). Search results were Emerald Insight n = 12, Science Direct n = 19, IEEE Explore n = 12 and Scopus n = 59. The selection of papers was limited to the following inclusion criteria: a) only selecting those papers that are systematic literature reviews, b) the study focused on blockchain adoption in supply chains c) the included papers identify blockchain adoption factors in supply chains. Figure 2 shows the search and filtering of selected studies.

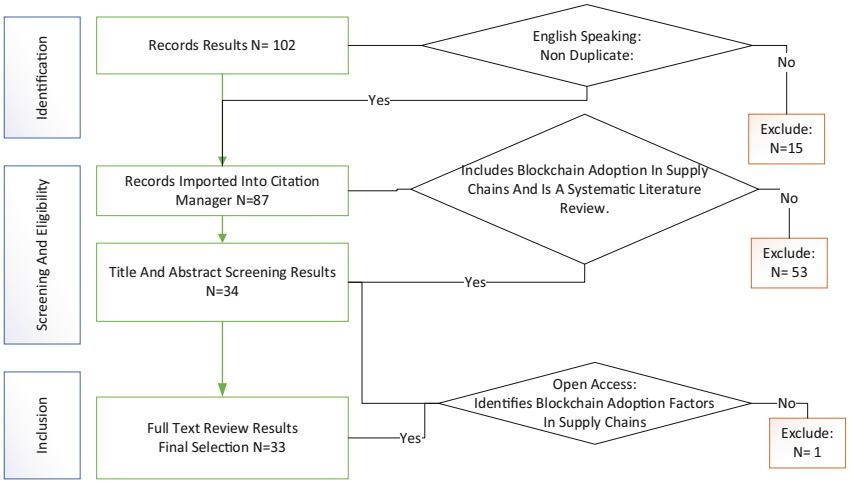

Fig. 2. Paper selection process

The research team assessed the quality of the selected papers, and all 33 papers were found to be of sufficiently good quality for inclusion in the meta-review. Following the final selection of papers (step 3), was the content analysis and coding of included papers. Phase 2 involves statistical analysis of journals extracted. Meta-review

focused on the following taxonomy, 1) Distribution of publications by year. 2) Distribution of paper by supply chains. 3) Adoption factors in supply chains. 4) Adoption domain, and 5) adoption readiness considerations. This was done by re-reading all included papers and extracting referenced text on blockchain adoption in supply chains. Following the results, a proposed framework is used to summarize adoption factors and categories. [16] and [55], in part, guided the assessment of adoption factor categories.

4 Results and Discussion

4.1 Descriptive Analysis

33 papers are included in the meta-review. Figure 3 shows the distribution of publications by year (until May 2021). Figure 4 shows distribution papers by journal focus.

Table 2 shows the articles included in this paper, including the source, research questions, and sample size. When research questioned were missing the research objectives were used. If both objectives and questions are missing, the aim is used.

Table 2. Summary table of included papers

Source	Review type	Research question or objectives	Same size
[57]	Comprehensive literature review followed by a case study approach	RQ1: How do organizational factors influence blockchain adoption in organizations based in a developed country?	20
[41]	Systematic review	RQ1: What are the achievable and anticipated benefits of the execution of blockchain technology for the government, financial, manufacturing and healthcare sectors? RQ2 What are the crucial challenges confronted in the execution of blockchain technology for the government, financial, manufacturing and healthcare sectors? RQ3: What are the recent and mutual areas of blockchain enabled government, financial, manufacturing and healthcare sector functionality? RQ4 What are the outcomes of previous studies and their execution in guiding the forthcoming investigation?	168
[42]	Systematic literature review	RQ1: What are the main clusters of research that can be drawn from the literature? RQ2: Which reference theories are applied or invoked in studying the topic at hand? RQ3: What are the boundaries of implementing BT in business today? RQ4:What are the future research avenues proposed in the literature to extend the corpus of knowledge surrounding BT?	47
[24]	Systematic review	RQ1: What are the technological and management challenges and opportunities of blockchain adoption from the lens of the TOE framework for operational excellence in the UK automotive industry?	71
[27]	Systematic review followed by case study	RQ1: Who are the key stakeholders, and how do they collaborate and/or cooperate? RQ1: What are the key readiness dimensions of individual stakeholders, and how do they influence the sector? RQ3: What are the key facilitating conditions?	20
[47]	Systematic literature review	RQ1: How is the industry structured for the transportation sector? Synthesis of academic and trade literature? RQ2: What are the trends in published knowledge on blockchain for the transportation sector? RQ3: How does blockchain impact the activities in the transportation sector?	109

(*continued*)

Table 2. (*continued*)

Source	Review type	Research question or objectives	Same size
[49]	Systematic literature Review	RQ1: What is the current state of the art in research and which are the main challenges faced in adopting blockchain technologies in the domain of e-Government?	21
[35]	Systematic literature review	RQ1: What are the main current blockchain applications in SCM? RQ2: What are the main disruptions and challenges in SCM because of blockchain adoption? RQ3: What is the future of blockchains in SCM?	27
[48]	Systematic literature review	RQ1: What are the main public services potentially affected by blockchain? RQ2: What are the main potential benefits, costs and risks of blockchain in public services for (1) governments, (2) civil servants and (3) citizens?	92
[34]	Systematic literature review	RQ1: Are blockchain-based academic transcript applications converging to a standard? RQ2: Is the blockchain oracle problem sufficiently and efficiently addressed within academic literature?	49
[39]	Systematic literature review	RQ1: What are the main topics and subjects of interest in supply chain studies that utilize blockchain technology; how do they address its core issues; and how have these topics evolved over time?	106
[26]	Systematic literature review	RQ1: How can we guarantee that the patient's data are complete, stored securely, and can be accessed according to the patient consent in a fast and convenient manner?	12
[28]	Systematic literature review	RQ1: How is research on blockchain in the accounting and auditing areas developing? RQ2: How might accountancy organizations manage technological change in a positive, innovative manner? RQ3: What are the main implications of this innovative technology for the everyday activities of organizations? RQ4: What is the future of blockchain in the accounting and auditing professions?	95
[44]	Text mining literature review	RQ1: What are the main aspects of BC technologies and how are these becoming mainstream within consumer trust? • RQ2: What are the aspects of BC technologies mostly addressed by the more prominent application domains, beyond the finance area? RQ3: What are the relations between BC application domains and the aspects of BC technologies and how can these associations be useful to the research BC community?	432
[33]	Systematic literature review	RQ1: How does the business literature define blockchain? RQ2: What research topics have business scholars addressed in current research on blockchain? RQ3: What are the top benefits associated with blockchain in the business literature?	155
[38]	Systematic review of literature and media	RQ1: Which industries are exploring blockchain technology applications? RQ2: How has blockchain been adopted in different industries? RQ3: can blockchain contribute to different industries in the future? RQ4: Have people posting about blockchain on social media, also have blockchain expertise?	116
[32]	Systematic literature review	RQ1: How will the blockchain influence future supply chain practices and policies?	29
[36]	Literature review	RO1: to emphasize blockchain technology as a backbone for various applications, its inner workings, components, security and future adoption aspects	Not stated
[50]	Sytematic literature review	RQ1: How is research on blockchain in the accounting and auditing areas developing? RQ2: How might accountancy organizations manage technological change in a positive, innovative manner? RQ3: What are the main implications of this innovative technology for the everyday activities of organizations? RQ4: What is the future of blockchain in the accounting and auditing professions?	17

(*continued*)

Table 2. (*continued*)

Source	Review type	Research question or objectives	Same size
[22]	Comprehensive literature review	RQ1a: Which major international regulatory regime(s) are responsible for promoting in situ agrobiodiversity conservation and its equitable access, use and benefit-sharing? • RQ1b: Which shortcomings, if any, in these regimes, may be contributing to sub-optimal in situ conservation, research and innovation with agrobiodiversity? • RQ2: Is the promotion of research and innovation with agro-biodiversity conserved in situ an appropriate blockchain use case? • RQ3: How, and to what extent, can a blockchain-based solution help: – RQ3a: address the identified shortcomings and challenges (RQ1b), and – RQ3b: provide incentives for farmers to use, innovate with, and share traditional know-how and agrobiodiversity conserved in situ	Not stated
[23]	Sytematic literature review	RQ1 To review and synthesize the literature of these two technological applications in the agricultural sector. This enables us to identify the distinctiveness of each technological application and compile a comprehensive understanding of relations between ICTs and BTs. RQ2 we demonstrate possible avenues for research to (1) conduct comparative investigations of these techniques in precision agriculture; (2) study interactive effects of factors indicated in previous literature; (3) consider the heterogeneity of regions in terms of technological applications.	157
[21]	Systematic literature review followed by case study	RQ1: How much research activity in the field of blockchain applied to the food industry has there been in the last years? RQ2: Which countries are leading the research studies in this field? RQ3: Where have these documents been published? RQ4: What are the main strengths and limitations of current research?	48
[40]	Systematic literature review	Research Aim to present a systematic literature review (SLR) showing the benefits, challenges and future research of blockchain technology (BT) for the supply chain (SC), also suggesting how the features of BT can change the organizational aspects of the SC	270
[29]	Comprehensive literature review	RQ1: How has blockchain technology been defined under financial services? RQ2: How the technology was examined (i.e. the methodology)? RQ3: What were the results of using blockchain technology in a financial system?	77
[16]	Systematic literature review	Research Aim To specifically explore the adoption Blockchain technology in pharmaceutical industry to look for the essential success factors.	18
[30]	Systematic literature review	RQ1: what are the blockchain adoption factors that can be used for smart manufacturing? And RQ2: Do technology governance creates value added for the adoption?	14
[43]	Systematic literature review	RQ2: how BT can facilitate SCMS open issues? What is the BT impact in the SCM area?	13
[58]	Systematic literature review	RQ1: We present a comprehensive survey on BC for the diamond industry. We highlight the opportunities and challenges for the adoption of BC in the diamond industry. RQ2: Being a novel topic, this article explores various limitations of the existing diamond industry, such as authenticity, forgery, and ethical sourcing of diamonds and discusses the role of BC in overcoming these shortcomings. RQ3: We present a solution taxonomy for tasks, such as provenance, supply chain management, transaction, and SC employing BC technology. Moreover, we also present their probable extensions to the diamond industry. RQ4: Moreover, we also summarize the main findings, emphasizing the research challenges and open issues pertaining to the integration of BC in the diamond industry	Not stated

(*continued*)

Table 2. (*continued*)

Source	Review type	Research question or objectives	Same size
[31]	Systematic literature review	RQ1: What challenges have been addressed in the current research on Blockchain? The blockchain is nowadays considered to be a novel and main-stream technology. Understanding the challenges will help to mitigate risks and barriers associated with the Blockchain technology.RQ2: What opportunities have been addressed in the current re-search on Blockchain? Acknowledging opportunity is a critical pathway to build Blockchain applications and market leadership. The answer to this question helps to understand opportunity space for utilizing Blockchain. RQ3: What applications have been addressed in the current research on Blockchain?	89
[37]	Systematic literature review	Purpose/Aim: To present a systematic a systematic literature review (SLR) that portraits the current state of the art to verify the nature of the impacts of blockchain technology on sustainability in supply chains	37
[45]	Literature review	RQ1: What solutions and applications are being made available by Blockchain platforms in SC? RQ2: Are the features presented in the theory in line with the proposed solutions and applications?	92
[55]	Systematic literature review	Purpose/Aim: this research tries to elaborate the latest adoption of Blockchain technology in SCM by using Systematic Literature Review (SLR) methodology	40
[59]	Systematic literature review	RQ1: What BT functionalities and organisational factors are related to BT connectivity in SC? RQ2: How do BT functionalities and organisational factors influence interaction or vice versa? RQ3: How does the BT connectivity affect SC interaction and resilience? Or what BT connectivity inhibitors can negatively affect SC interaction and resilience?	89

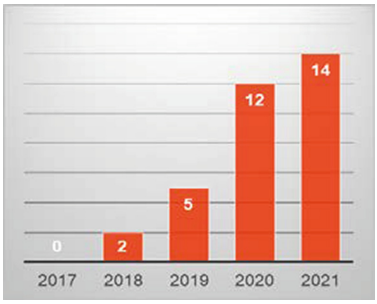

Fig. 3. Distribution of Papers by Year

Fig. 4. Distribution of papers by Journal Focus

4.2 Emerging Considerations

A) Adoption Context and Adoption Factors

The importance of pre-adoption considerations is evidenced in the studies. Important pre-adoption considerations include the supply chain adoption domain and its context regarding sectors, adoption factors, and adoption readiness. The supply chain domain identified falls under food, healthcare, financial, automotive, logistics, diamonds, sustainable and public sector supply chains, see Fig. 5. Most papers

included has a cross-sector focus. Figure 6 shows the ranked adoption factors identified in the research. Blockchain adoption in supply chain literature shows security, system integration, trust, traceability, scalability, costs, privacy, and transparency as commonly discussed adoption factors. Looking towards the diverse supply chain domains, and supporting [60], findings show the importance of adoption context regarding sector-specific considerations when assessing specific supply chains. For example, literature by [21–23] focusing on food supply chains all identified traceability related to the importance of food quality, food safety and reducing risks throughout supply chains. While financial and healthcare supply chains identified trust as a critical factor [26–29]. In addition to context awareness, adoption factors are built to support blockchain adoption enabling value creation in the post-adoption stages. Adoption factors consider post-adoption considerations shown by [5], focusing on potential impacts, both positive and negative. For example, privacy, security, sustainability, immutability, and trust are shown ln existing literature as both positive (sources) and negative impacts of blockchain adoption.

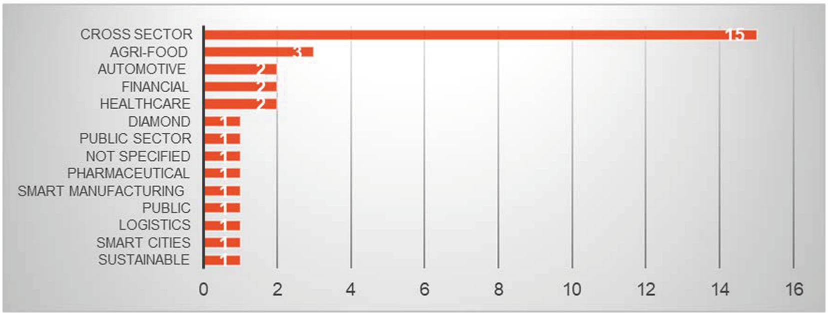

Fig. 5. Blockchain adoption by supply chain domain

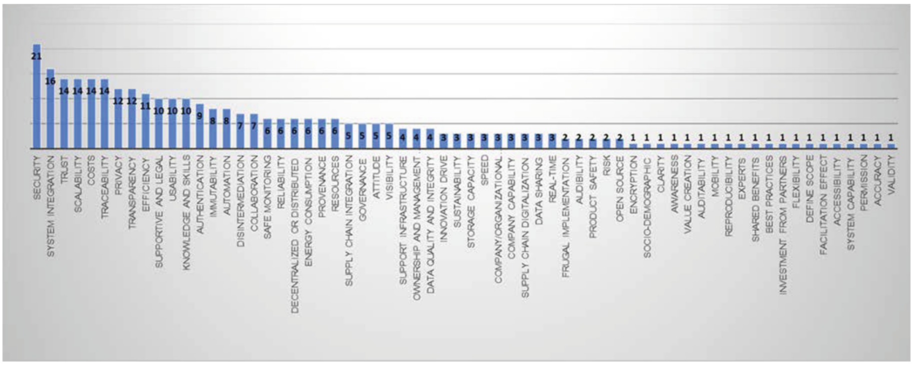

Fig. 6. Blockchain adoption factors in supply chains

B) Adoption Readiness

Adoption readiness is important for later stages of technology success [61] and is a novel term in respect to blockchain technology. Existing literature identifies 8 important readiness considerations, see Table 3.

Table 3. Readiness categories

Readiness factor	Description	Source
Technology readiness	The ability to adopt modern technologies within an organization. Examples include availability, compatibility with existing systems, security, infrastructure, and ability to facilitate innovative technology	[24–27, 42]
Organizational readiness	Specific resources from an organization including human resources, infrastructure, and financial resources specifically related to the adoption of new technologies	[25, 31, 41, 49, 59]
Value chain readiness	Readiness beyond that of an organization	[25]
Business model readiness	How well technologies adapt to current business models and the dynamic capability to shift business models to facilitate new technologies	[25]
Motivational readiness	The recognized need for change and is the key reason for the change. Often resulting from dissatisfaction in current practices	[27]
Engagement readiness	Clear understanding of challenges and benefits in addition to knowledge and awareness of recent technology. This for example reflects on impacts, costs, risks, and value	[27]
Structural readiness	Availability of non-technical resources for example financial resources. Experts, time, money, and personal	[27]
Operational readiness	Institutional engagement factors that include available budget and funds, skilled workforce and relevant infrastructure, good relationships with buyers and suppliers, and good levels of governance	[31]

[25] and [27] provided significant insights in respect to blockchain readiness assessment. In addition, [31] introduces operational readiness. Adoption readiness research should consider various levels of readiness assessment. Figure 7 present an emerging framework for considering readiness assessment factors which is a further development of the PPT framework by [55] and [30]. Adoption readiness assessment categories closely represent the PPT framework. People for motivational and engagement readiness. Process for organisational, business model, value chain, operational, and structural readiness. Technology readiness focuses on the technical adoption considerations. The term adoption readiness is introduced in only one of the included literature reviews assessed in this study, showing the novelty of the term in blockchain adoption setting. Eight important readiness considerations have been proposed to assess adoption readiness across supply chains. The readiness considerations can be supported through the PPT framework covering people-processes-technology when assessing adoption readiness in supply chains. The proposed framework (Fig. 7) contributes to the existing literature by gathering assessment factors required for the readiness of blockchain adoption.

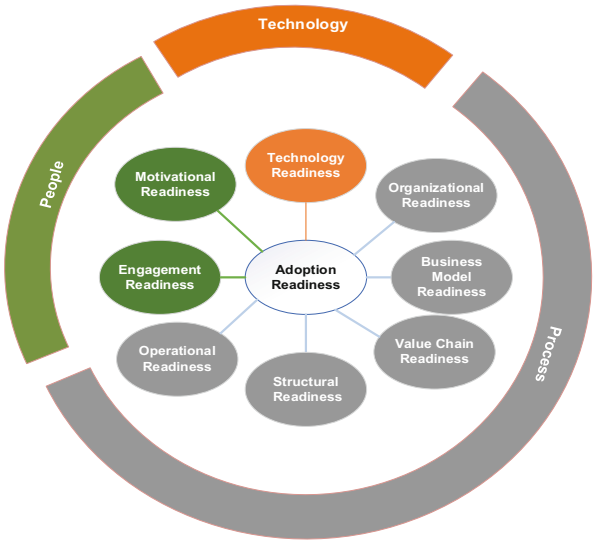

Fig. 7. A PPT framework for blockchain adoption readiness

C) PPT Framework for Blockchain Adoption

Table 4 explores the PPT framework considering adoption readiness for the top 30 adoption factors identified in the literature. The 30 adoption factors represent a rank in the top 11 of all identified factors, as some have a tying rank. Figure 8 summarizes the PPT framework for blockchain adoption across supply chains using existing literature, see [30] and [16] as a guide.

Under Technology, adoption factors are security, legal, energy consumption, and data quality and integrity. Security is discussed in research as both a potential benefit [38], but also a challenge and is a crucial consideration throughout the adoption stages. Under the process category is authenticity, provenance, governance, visibility, and support infrastructure. Falling into both the technology and process category are system integration, scalability, traceability, immutability, automation/smart contracts, reliability, and resources. For example, scalability and system integration relating to both technological and process considerations support the theory by [32, 39, 45]**.** Trust and privacy fall under both people and technological categories. From a people perspective, blockchain enables trust, however, privacy is a key concern with blockchain technologies. Falling between the people and process categories are costs, efficiency, knowledge and skills, disintermediation, collaboration, attitude, supply chain integration, and ownership/management commitment. This category identifies critical non-technical resources required for successful adoption [37]. The PPT Framework presents four adoption factors in all three PPT categories. These are transparency, usability and decentralized/distributed.

Table 4. PPT assessment of blockchain adoption factors

LV	Adoption Factor	People	Process	Technology	Total Sourced	Percentage
F1	Security			x	21	6.52%
F2	System integration		x	x	16	4.97%
F3	Trust	x		x	14	4.35%
F4	Scalability		x	x	14	4.35%
F5	Cost	x	x		14	4.35%
F6	Traceability		x	x	14	4.35%
F7	Privacy	x		x	12	3.73%
F8	Transparency	x	x	x	12	3.73%
F9	Efficiency	x	x		11	3.42%
F10	Supportive and legal			x	10	3.11%
F11	Usability	x	x	x	10	3.11%
F12	Knowledge and skills	x	x		10	3.11%
F13	Authenticity		x		9	2.80%
F14	Immutable		x	x	8	2.48%
F15	Automation/Smart Contracts		x	x	8	2.48%
F16	Disintermediation	x	x		7	2.17%
F17	Collaboration	x	x		7	2.17%
F18	Safe monitoring		x	x	6	1.86%
F19	Reliability		x	x	6	1.86%
F20	Decentralization/Distributed.	x	x	x	6	1.86%
F21	Energy consumption			x	6	1.86%
F22	Provenance		x		6	1.86%
F23	Resources		x	x	6	1.86%
F24	Supply Chain Integration	x	x		5	1.55%
F25	Governance		x		5	1.55%
F26	Attitude	x	x	x	5	1.55%
F27	Visibility		x		5	1.55%
F28	Support Infrastructure		x		4	1.24%
F29	Ownership and management support	x	x		4	1.24%
F30	Data quality and integrity			x	4	1.24%

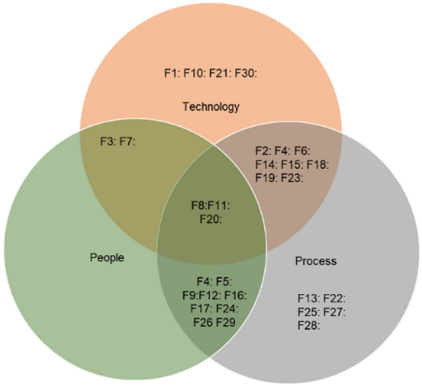

Fig. 8. Adapted PPT assessment for blockchain adoption factors

5 Conclusion

A meta-review on blockchain adoption is conducted in this paper and three main themes are identified and discussed with some emphasis on pre-adoption. Systematic literature review studies on blockchain adoption in supply chains were assessed showing growth in 2021 and an upward trend. Emerging from text is the importance of adoption context. Systematic literature reviews identified primarily take a cross-sector

approach for review, with limited focus on specific supply chains for example agri-food, healthcare, and financial supply chains. The adoption context in terms of sector and related blockchain characterises related to supply chain domain is important to several types of blockchain based supply chains, for example, traceability to enable and ensure quality in food supply chains. The second key theme is adoption readiness, and the importance to consider different readiness aspects. This research proposes an inclusive adoption readiness assessment based on people-process-technology framework. Adoption factors have emerged from systematic literature reviews. 64 adoption factors are identified, and the top 30 factors are analysed using the proposed people-process-technology framework considering adoption readiness. Security, a critical adoption factor, is followed closely by system integration. Other important blockchain adoption factors include trust, costs, traceability, privacy, and transparency. The proposed framework contributes to the existing literature by consolidating adoption readiness considerations into an inclusive model for blockchain technologies. Conceptually, the research also provides further insight into the importance of context awareness and adoption readiness and identifies/evaluates blockchain adoption factors. Practitioners should consider the themes identified when adopting blockchain technologies in specific situations. An important limitation of the meta-review is the theoretical approach and the focus on systematic literature review papers. In addition, the scope of the research is wide, considering different supply chains. So also, is the subjective evaluation of the factors in terms of the PPT framework. A focused empirical study would support the understanding of context aware blockchain adoption in specific supply chains. In addition, further research on blockchain adoption factors would provide more insight into their importance in respect to adoption readiness, through a extensive field study.

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