sustainability

MDPI

Article

Items and Constructs of Blockchain Adoption in Software Development Industry: Experts Perspective

Ammar AL-Ashmori [1,*], P. D. D. Dominic [1] and Narinderjit Singh Sawaran Singh [2]

[1] Department of Computer and Information Sciences, University Technology PETRONAS, Seri Iskandar 32610, Malaysia
[2] Faculty of Data Science and Information Technology, INTI International University, Nilai 71800, Malaysia
* Correspondence: ammar_18003398@utp.edu.my

Abstract: The use of Blockchain is becoming a matter of increasing importance, yet the software development industry has not given Blockchain adoption enough consideration. As a result of their inability to modify their software process within the project life cycle, many software development companies struggle to [adopt Blockchain technology. This is because Blockchain Oriented Software (BOS) and its projects have distinctive characteristics that are distinct from traditional software and projects. The constructs and their items to adopt Blockchain in Software development industry have not been identified or investigated. This study aimed to identify technological, organizational, and environmental constructs and their items to adopt Blockchain. Utilizing a quantitative validation approach, 10 interviews and 25 assessment questionnaires were analyzed. The results reveal the identified technological, organizational, and environmental constructs and their items to adopt Blockchain. Experts unanimously agreed with Content Validity Ratio (*CVR*) results. According to most evaluation questionnaire forms and interview transcripts, the top technological construct was "Trialability" and the top organizational construct was "Cost" while the top environmental construct was "Market Dynamics." All other constructs and their items were applicable, as indicated by most evaluation questionnaire forms and interview transcripts. This research gives a comprehensive list of technological, organizational, and environmental constructs and their items that demand the attention of Blockchain adoption researchers and industry players in the software development sector.

Keywords: Blockchain adoption; technology-organization-environment; content validity ratio; software development industry; software process improvement

Citation: AL-Ashmori, A.; Dominic, P.D.D.; Singh, N.S.S. Items and Constructs of Blockchain Adoption in Software Development Industry: Experts Perspective. *Sustainability* **2022**, *14*, 10406. https://doi.org/10.3390/su141610406

Academic Editor: Cheolho Yoon

Received: 5 July 2022
Accepted: 12 August 2022
Published: 22 August 2022

1. Introduction

Recently, Blockchain is garnering a great deal of interest from businesses and academics. Blockchain is a decentralized datasets that keeps a records list validated by the majority active nodes, with committed blocks being immutable. In addition to offering transparency, Blockchain enables auditing of transactions. Firms utilize Blockchain because it helps them to reduce transaction fees by generating intrinsically safe, transparent, and, in certain cases such as immediate payments services, speedier transactions [1]. The information associated with accepted transactions will be stored in a public chain [2,3]. Twenty years ago, couple of researchers at Bellcore presented computed feasible processes for time-stamping electronic documents [4] this was the genesis of the Blockchain idea. The mechanism for timestamping was enhanced to append several files a single chain [5].

With the launch of bitcoin, a digital money, Blockchain became a well-known idea. Satoshi Nakamoto published a paper proposing a payment system that transfers money from one participant to another without the need for a centralized authorization such as a bank [6,7]. Using tamper-resistant and some consensus protocols such as Proof-of-Work (PoW) and Proof-of-Stake (PoS) public ledger solves the double spending issue in electronic money by tying each transaction to the previous one. By evaluating the transaction history

of a coin, this chain enables a network to verify that a coin provided by a user for payment has not yet been spent, hence mitigating the double spending issue [8].

In addition to cryptocurrencies, Blockchain has different applications such as smart contract, electronic identities, educational records, and medical related applications. This is because Blockchain can establish automated and trusted process with any centralized party. A Blockchain network is classified based on its accessibility to public Blockchain, private Blockchain, and consortium Blockchain [9]. The permissionless public network allows anybody to connect, execute, and mine data without any restrictions using consensus techniques such as proof of work and proof of stake. Each joiner possesses complete permission to see all the transactions, add new transactions, and initiate mining to collect rewards.

Permissioned private network enables people to share and exchange data privately between specific groups such as individuals belong to the same organization or organizations belong to the same interest, with mining controlled by the selected organization or individuals. Consortium network is an incompletely private Blockchains in which, rather than a single organization, a predetermined collection of nodes oversees consensus and validation. These nodes determine who may join the network and mine cryptocurrency. In contrast to the private network that is totally centralized for authentication, and the public, which is completely decentralized for authority, the consortium network is partially authority-centralized and governed by chosen nodes.

There are a few theories to investigate innovation adoption concept, including the technology acceptance model (TAM) [10], the theory of planning behavior (TPB) [11], the unified theory of acceptance and use of technology (UTAUT) [12], the diffusion of innovation (DOI) [13], and the technology-organizational-environment framework (TOE) [14]. Most of these theories examine adoption of an innovation at the personal level except the DOI and TOE which focus on the organizational level. TOE was originally proposed in 1990 [14]. This paradigm examines three components to explain the primary variables that affect the adoption of innovation at the organizational level: technological factors, organizational factors, and environmental factors [15]. By taking into consideration technological, organizational, and environmental circumstances as shown in Figure 1, the TOE can provide a unique viewpoint on IT adoption [16]. Various researchers have used TOE to investigate a variety of IS and IT innovations [17–20]. The research demonstrates the useful perceptions provided by the TOE for comprehending the adoption of new technology in a range of sectors.

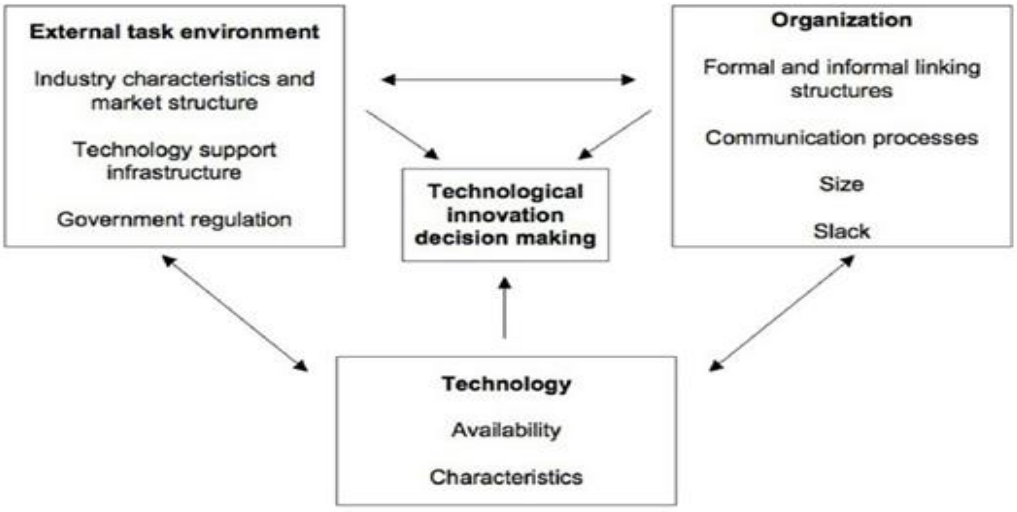

Figure 1. The technology-organization-environment framework.

Despite the fact that Blockchain technology has been implemented in a number of domestic industries, the literature on the subject indicates that no sufficient attention was

paid to adopt Blockchain the software development industry and to the behavioral intention of enterprises in this field to adopt Blockchain [21,22].

Consequently, this study makes a novel contribution to the existing body of research about Blockchain adoption. It discovered and categorized 12 constructs and their items for the effective and sustainable adoption of Blockchain. Innovative technology Adoption is a must for e-business organizations due to its impact on sustainable firm development. In current business models, innovation is heavily reliant on technology and information systems [23,24]. Small and medium-sized organizations (SME) typically perceive the need to employ new technology to aid them in pursuing their sustainability goals [25], whereas large corporations typically recognize the need to implement innovative technology to improve their financial sustainability. Due to the COVID-19 pandemic in early 2020 [26], the adoption of sustainable technologies, such as Blockchain technology, has grown popular, as reported by a few media outlets. To advise firms and governments on appropriate methods for ensuring financial and environmental sustainability, it is necessary to investigate the constructs that shape the sustainability of technology adoption [27,28].

This paper is structured as follows. In the Section 2, the materials and methods are explained. The results are presented in the Section 3 and discussed in the Section 4. In Section 5, the conclusion is presented, and limitation and recommendation of this study are given Section 6.

2. Materials and Methods

This study's data was gathered and validated through a literature review, an interview, and a questionnaire survey. These methods were used to assemble the knowledge of Blockchain adoption constructs and their items. The identification of the technological, organizational, and environmental constructs was carried out through the literature review. Data was collected from the peer-reviewed articles from the Web of Science and Scopus under the Blockchain adoption field; '("BLOCKCHAIN ADOPTION" OR (BLOCKCHAIN AND (TOE OR "TECHNOLOGICAL FACTORS" OR "ORGANI?ATIONAL FACTORS" OR "ENVIRONMENTAL FACTORS")))' was chosen as the search string for this research. The time period considered was between 2015 and 2021. After the identification of the technological, organizational, and environmental constructs and their items was carried out, interviews had been carried out with experts to validate and investigate their opinions about these constructs and items.

50 experts from academic institutes and from industry were invited to participate in the interview and assessment questionnaire survey about effective Blockchain adoption in the software development industry and the variables influencing its success with relation to the technological, organizational, and environmental point views. A panel of 12 participants was suggested by a previous studies [29,30]. Another study about the evaluation of factors which affect the adoption of Blockchain in the freight logistics field using TOE, suggested 15 participants [31]. The same number was suggested by another study [32]. The saturation factor, in which new participants repeat the same information, is a crucial component in determining the sample size for qualitative investigations [33]. Participants have replied positively to the invitation as 25 of them have chosen to take part in the validation questionnaire survey and 10 agreed to the online interview.

Online interviews with 10 participants were carried out and to analyze the manuscript of the interviews, the thematic analysis was used; the process of thematic analysis consists of the following steps [34]:

1. Becoming familiar with the data by reading it several times helps structure and identify the important information.
2. Coding of data into distinct themes and cohesive categories to respond to the primary questions raised in the interviews. The data is then classified accordingly, from broad inquiries to specific questions. The data for each category is labelled and tabulated.
3. To openly address distinct themes based on the data collected, themes must be established. The subtheme contexts are used to establish the primary themes.

4. The data is turned into relevant sets of findings, and a comprehensive analysis of the issue emerges from all the categories.

A panel of 25 participants evaluated the content of the Blockchain constructs and their items based on their knowledge of this topic. An assessment questionnaire survey was used and sent to each expert on the panel. The survey included the construct and items extracted from the previous stages. Individually, each expert evaluated each item on the survey with one of the three options:

- Essential.
- Useful but not essential.
- Not necessary.

With each item in the survey open ended question is given as an option for each participant to express his/her opinion. Only items evaluated as essential are given one point while items evaluated as useful but not essential or not necessary are given zero point. A hypothesis was made and each which is consistent with the proven psychophysical principle. When more than half of the panel select an item to be essential, it has higher scale of content validity. With this hypothesis in mind, the following formula is calculating content validity Ratio of each item [35]:

$$CVR = (ne - N/2)/(N/2) \quad (1)$$

where ne is the experts' number in the panel who select the item as essential, N is the total of the experts in the panel. In addition, CVR is a linear transformation from the percentage of the experts who selected the item as essential. The expert panel evaluated all the items and the CVR was satisfied based on their content validation. As the panel were 25 experts, the CVR value should be 0.37 at least to meet 5% degree of confidence.

The items whose CVR values have met the threshold of 0.37 are maintained in the final construction and item form. This hypothesis is considered because the use of the CVR to reject items does not prohibit the employment of a discrimination index or other typical item analysis approach to choose the remaining items for the final form [36].

The Content validity index (CVI) indicates the amount whereby a recognized connection exists among the capabilities to perform in a given Blockchain adoption field and the constructs with their items for the investigation. Operationally, it is the mean percentage of commonality between the test constructs with their items and the Blockchain adoption field. Figure 2 illustrates the research method in a flow diagram.

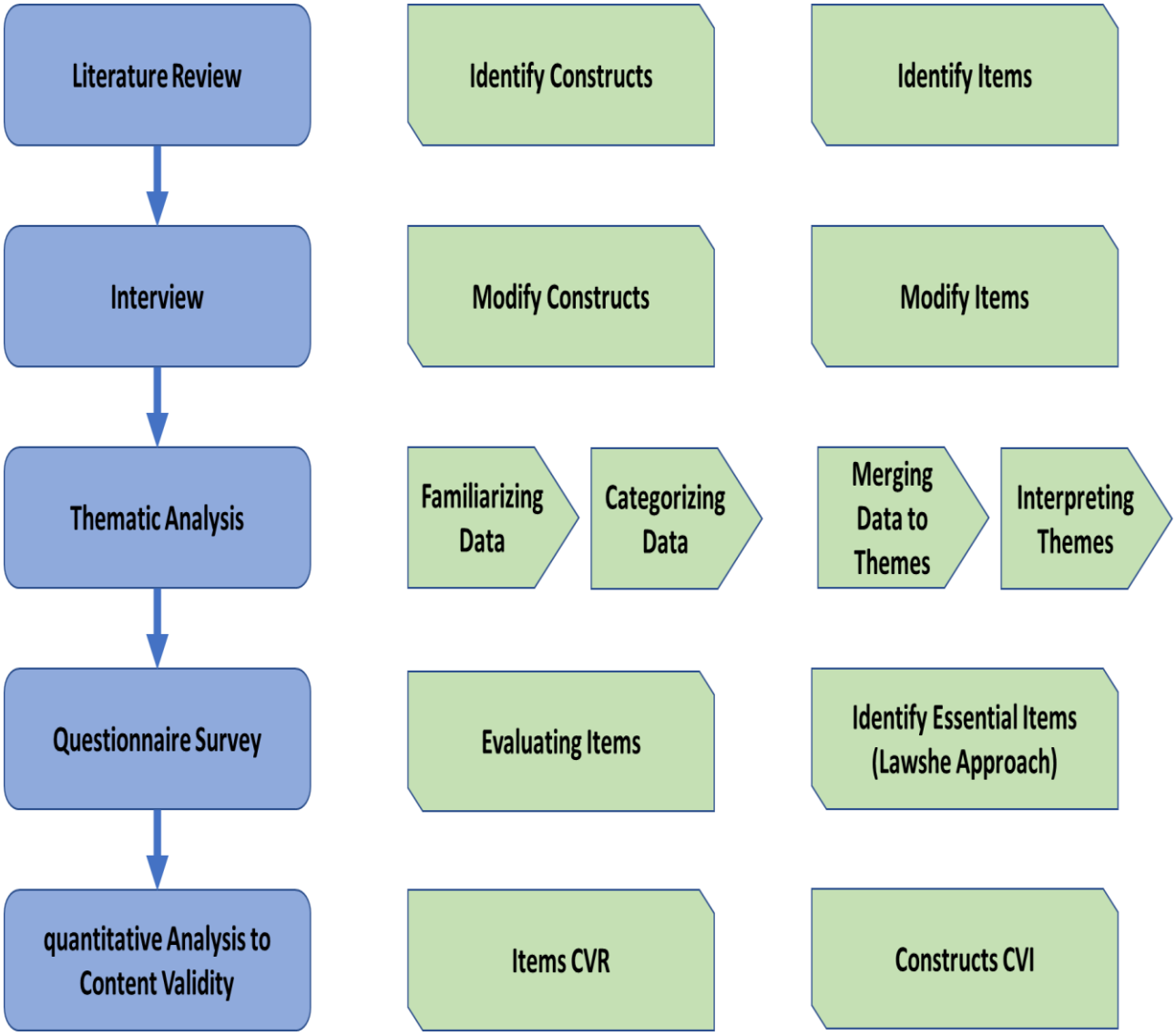

Figure 2. The proposed research methodology flow diagram.

3. Results

The purpose of this study was to fill the gap in the body of knowledge regarding Blockchain adoption in the software development industry and to give a list of technological, organizational, and environmental constructs and their items. The next sections will illustrate the findings of this study.

3.1. Interview Result

The experts on the panel were chosen based on their knowledge and participation in the industry and academic institutes. All the experts' awareness of Blockchain technology is high, and their involvement with Blockchain ranges from 4 to 8 years. The qualifications of the participants are PhD for all the academic participants and between bachelor and master for the industrial participants. Table 1 demonstrates the demographics of the experts who participated in the interview.

Table 1. Experts' demography.

#	Field	Qualifications	Experience	Involvement	Blockchain Awareness
1	Academic	PhD	9 years	4 years	High
2	Industrial	Bachelor	8 years	6 years	High
3	Academic	PhD	12 years	6 years	High
4	Academic	PhD	5 years	4 years	High
5	Academic	PhD	8 years	5 years	High
6	Industrial	Master	6 years	4 years	High
7	Industrial	Bachelor	10 years	8 years	High
8	Industrial	Bachelor	7 years	7 years	High
9	Industrial	Master	8 years	4 years	High
10	Industrial	Bachelor	11 years	8 years	High

The experts agreed that Blockchain adoption in Malaysia is still at an early stage, and this is due to Malaysians' lack of awareness and familiarity with Blockchain technology, as well as the absence of relevant regulations. On the other hand, despite the lack of local regulation limiting Blockchain uses, three experts highlighted that the government has taken some steps to adopt Blockchain in some industries such as palm oil and banking. The experts enriched this study with their opinions about the constructs, and they all agreed that TOE is the best way to categorize these constructs based on their relations to the technological, organizational, environmental contexts.

3.1.1. Technological Constructs

The technological context refers to the organization's internal and external technology that is applicable to it [37] The technological constructs, relative advantage, security, and compatibility had been derived from a prior research [38] and had been given to the experts. The panel agreed with security construct and suggested to change relative advantage to trialability and compatibility to complexity. Table 2 introduces the technological constructs and their items generated for Blockchain adoption.

Table 2. Technological constructs and their items.

Construct	Item	Code	References
Trialability	I intend to try out Blockchain in before deciding whether to adopt it in practice	TA1	[39,40]
	A trial period before adopting Blockchain will reduce the perceived risks	TA2	
	Trying out Blockchain is not important in my decision to adopt	TA3	
	In the trial period, I will try to transform the saved records to Blockchain	TA4	
Security	Blockchain capacity is sufficient for high volume transfers	SC1	[19,41–43]
	Exchange value/transactions recorded on Blockchain cannot be altered once they are added	SC2	
	Blockchain adoption will make my company subject to potential fraud	SC3	
	I consider it safe to adopt Blockchain in my company	SC4	
Complexity	Learning Blockchain is complex	CM1	[39,44]
	Learning Blockchain will require much effort	CM2	
	Blockchain tools are easy to use	CM3	
	Blockchain is easy to integrate with existing processes in my organization	CM4	

3.1.2. Organizational Constructs

The organizational context refers to characteristics that influence the adoption and operation of new technology in several aspects [45]. The organizational constructs facilitating conditions and management support had been derived from a prior research [38] and had been given to the experts. The panel agreed with facilitating conditions construct and suggested to change management support to cost and to add innovativeness construct. Table 3 introduces the organizational constructs and their items generated for Blockchain adoption.

Table 3. Organizational constructs and their items.

Construct	Item	Code	References
Cost	Blockchain can lower transaction costs and reduce paperwork	CS1	[19,44]
	Blockchain can eliminate service charges for the financial intermediaries	CS2	
	Blockchain cost is clear and easily understandable	CS3	
	Adopting Blockchain will not decrease hardware and facility cost	CS4	
Innovativeness	Blockchain adoption will excite me	IN1	[42,46]
	I am usually among the first to try blockchain technology	IN2	
	Other people give me suggestion to adopt blockchain in the company	IN3	
	Blockchain adoption will make the company data accessed by me without any help	IN4	
Facilitating conditions	I have the knowledge necessary to adopt blockchain in the company	FC1	[47–51]
	The company has the resources necessary to adopt blockchain in the company	FC2	
	The company will specify person (or group) to assist in case of blockchain adoption related difficulties	FC3	
	The Company top management has expressed interest in blockchain adoption	FC4	

3.1.3. Environmental Constructs

The environmental context refers to factors outside of the organization that influence the adoption and operation of innovations in several ways [45]. The environmental constructs, competitive pressure and regulatory support had been derived from prior research [38] and had been given to the experts. The panel agreed with regulatory support construct and suggested to change competitive pressure to market dynamics and to add partner readiness construct. Table 4 introduces the environmental constructs and their items generated for Blockchain adoption.

Table 4. Environmental constructs and their items.

Construct	Item	Code	References
Market Dynamics	Blockchain customers' preferences are always changing in the industry	MD1	[44]
	Blockchain will increase the sensitivity to changes in the marketplace	MD2	
	Blockchain changes in the industry are difficult to predict	MD3	
	Blockchain customers' requirements in the industry are challenging	MD4	
Regulatory support	Government legislation supports the adoption of Blockchain	RS1	[39,44,52]
	The laws and regulations that exist nowadays are sufficient to protect the use of Blockchain	RS2	
	The company will receive financial support from the government or relevant authorities to adopt Blockchain	RS3	
	The company's decision to adopt Blockchain would depend on industry standards in place	RS4	
Partner readiness	The company's partners are enthusiastic about Blockchain adoption	PR1	[53]
	The company's partners are willing to change their processes and practices for Blockchain adoption	PR2	
	The company's partners recommend Blockchain adoption	PR3	
	The company's partners provide Blockchain applications, influence the company's decision to adopt Blockchain	PR4	

3.2. Content Validation Results

This section was designed to assess the degree of overlap and validate the items and constructs retrieved from the interviews. The interview information was acquired and translated into the structured questionnaire for expert evaluation and assessment of the *CVR* of each item. Serious questions might be raised if the judgement lists do not agree on the importance of the item or construct measured for the proper adoption of Blockchain. Alternatively, if they all concur, we must infer that they are either "all incorrect" or "all right." Since they are specialists in Blockchain adoption, there is no basis for contesting a solid consensus. We are confident that the variable is or is not actually crucial. Problems develop when the strength of the consensus deviates from unanimity and approaches parity [35].

The respondents' demographic details are shown in Table 5. There were (n = 16, 64%) male respondents and (n = 9, 36%) female respondents. By age, the group between 40 years and 50 years was the biggest (n = 12, 48%), followed by those in younger than 40 years (n = 7, 28%) and those in their 50s or older (n = 6, 24%). As shown in the table, the majority of the sample (n = 11, 44%) had a bachelor's degree, PhD (n = 10, 40%), and a master's degree (n = 4, 16%). Table 6 indicates that most sample respondents (n = 17, 68%) had

between 5 to 10 years of work experience. This category is followed by those with less than 5 years of experience (n = 4, 16%) and more than 10 years of experience (n = 4, 16%). Respondents form Academica universities were (n = 12, 48%), followed by senior managers (n = 6, 24%) and junior managers (n = 4, 16%), and executives (n = 3, 12%). The results of the respondents are reported in the parts that follow.

Table 5. Demographic Profile.

	Category	Number	Percentage
Gender	Male	16	64%
	Female	9	36%
Age	40 years and 50 years	12	48%
	Younger than 40 years	7	28%
	Their 50s or older	6	24%
Qualification	Bachelor's degree	11	44%
	PhD	10	40%
	Master's degree	4	16%
Work experience	5 to 10 years	17	68%
	Less than 5 years	4	16%
	More than 10 years	4	16%
Job	Academica universities	12	48%
	Senior managers	6	24%
	Junior mangers	4	16%
	Executives	3	12%

3.2.1. Technological Constructs

The technological constructs, trialability, security, and complexity were evaluated by the experts. Table 6 indicates the CVI for each construct and the *CVR* for each item. The expert Consensually agreed with all the items as they achieved *CVR* value 0.440 and above. The highest *CVR* scores were achieved by TA3 and SC2 with 1.000, and the lowest scores were achieved by TA4, SC1, and SC4. Furthermore, all the technological constructs got close CVI scores of between 0.700 for trialability and 0.600 for security.

Table 6. Technological constructs and their items validity analysis.

Construct	Code	Essential	Useful but Not Essential and Not Necessary	CVR
Trialability	TA1	21	4	0.680
	TA2	21	4	0.680
	TA3	25	0	1.000
	TA4	18	7	0.440
Trialability CVI				**0.700**
Security	SC1	18	7	0.440
	SC2	25	0	1.000
	SC3	19	6	0.520
	SC4	18	7	0.440
Security CVI				**0.600**
Complexity	CM1	23	2	0.840
	CM2	21	4	0.680
	CM3	19	6	0.520
	CM4	19	6	0.520
Complexity CVI				**0.640**

3.2.2. Organizational Constructs

Experts assessed the technical constructs of cost, innovativeness, and facilitating conditions. CVI is shown in Table 7 for each construct, as well as *CVR* for each individual item. The *CVR* values of 0.440 and higher were unanimously agreed upon by the experts. The greatest *CVR* value was IN1 with 1.000, while CS1 and FC13 had the lowest *CVR* ratings. CVI of innovativeness was rated the highest with 0.840, and cost CVI was 0.720, while facilitating conditions CVI was 0.600.

Table 7. Organizational constructs and their items' validity analysis.

Construct	Code	Essential	Useful but Not Essential and Not Necessary	CVR
Cost	CS1	18	7	0.440
	CS2	24	1	0.920
	CS3	21	4	0.680
	CS4	23	2	0.840
Cost CVI				**0.720**
Innovativeness	IN1	25	0	1.000
	IN2	24	1	0.920
	IN3	20	5	0.600
	IN4	23	2	0.840
Innovativeness CVI				**0.840**
Facilitating conditions	FC1	19	6	0.520
	FC2	22	3	0.760
	FC3	18	7	0.440
	FC4	21	4	0.680
Facilitating conditions CVI				**0.600**

3.2.3. Environmental Constructs

The experts assessed the environmental constructs of market dynamics, regulatory support, and partner readiness. Table 8 lists the CVI and *CVR* for each construct and item, respectively. All of the items received unanimous expert approval since they all had *CVR* values of 0.440 or above. The *CVR* value of PR2 scored 1.000 as the highest, while MD1, had the lowest result. Additionally, the CVI ratings for environmental constructs ranged closely between 0.860 for partner readiness and 0.580 for market dynamics.

Table 8. Environmental constructs and their items' validity analysis.

Construct	Code	Essential	Useful but Not Essential and Not Necessary	CVR
Market dynamics	MD1	18	7	0.440
	MD2	20	5	0.600
	MD3	20	5	0.600
	MD4	21	4	0.680
Market dynamics CVI				**0.580**
Regulatory support	RS1	21	4	0.680
	RS2	19	6	0.520
	RS3	21	4	0.680
	RS4	20	5	0.600
Regulatory support CVI				**0.620**
Partner readiness	PR1	21	4	0.680
	PR2	25	0	1.000
	PR3	24	1	0.920
	PR4	23	2	0.840
Partner readiness CVI				**0.860**

4. Discussion

The goal of this study was to pinpoint crucial constructs and their items that affect the Blockchain adoption in Malaysia software development industry based on the technological, organizational, and environmental contexts. A few previous studies about Blockchain adoption have used TOE in 10 studies [19,31,39,44,47,48,53–57] out of the 30 studies as shown in Table 9.

Table 9. Summary of the publications' theories for Blockchain adoption.

#	Study	Theory
1	[53]	TAM TOE
2	[48]	UTAUT TOE
3	[58]	TAM
4	[41]	TAM
5	[59]	TAM UTAUT
6	[60]	TAM
7	[61]	TAM
8	[47]	UTAUT TOE
9	[19]	TOE
10	[62]	UTAUT TAM
11	[50]	UTAUT
12	[63]	TAM
13	[42]	TAM
14	[40]	DOI TAM
15	[64]	UTAUT TTF
16	[54]	TOE
17	[51]	UTAUT
18	[65]	TPB
19	[31]	TOE
20	[66]	TAM TRI
21	[67]	UTAUT
22	[55]	TOE
23	[46]	TAM
24	[29]	UTAUT
25	[68]	TRAM
26	[39]	TOE
27	[56]	TOE
28	[44]	TOE
29	[43]	TAM TRI TPB
30	[52]	UTAUT

TOE deals not only with technology acceptance, but also other dynamics related to organization and environment [69]. According to TOE, three aspects are likely to influence

an organization's process of adopting and implementing technological innovations: technological, organizational, and environmental. The other adoption frameworks are not as comprehensive as the TOE due to the additional organizational and environmental factors included in the TOE. TOE was adopted to identify the organization's technology, and external environment as quite useful elements in adoption [70]. Similarly, the usefulness of this framework in small enterprises when a perception-based electronic data interchange adoption model with some determinants was proposed [71]. In addition, all the experts in the interview sessions approved that TOE is the most suitable way to classify these constructs based on their relations to the technological, organizational, and environmental contexts. Therefore, TOE was favorable to studying the Blockchain adoption in the software development industry.

This study covers discussion for a new Blockchain adoption framework based on integrating the TOE and used to determine the factors of Blockchain adoption by software development companies in Malaysia. Moreover, this includes factors for the technological readiness trialability, security, and complexity; factors for the organizational readiness cost, innovativeness, and facilitating conditions, and factors for the environmental readiness market dynamics, regulatory support; and partner readiness based on the experts' recommendations. Additionally, it is categorized into the broad theoretical field of technology adoption, and based on the technology adoption research, factors which may affect the adoption of a technology are organizational factors, technological factors, and environmental factors. Previous research has shown that these characteristics show a solid connection with technology adoption.

From this study's results, organizational context is found to be the most significant one. The organizational constructs cost CVI, innovativeness CVI, and facilitating conditions CVI scored 0.720, 0.840, and 0.600, respectively, as shown in Figure 3.

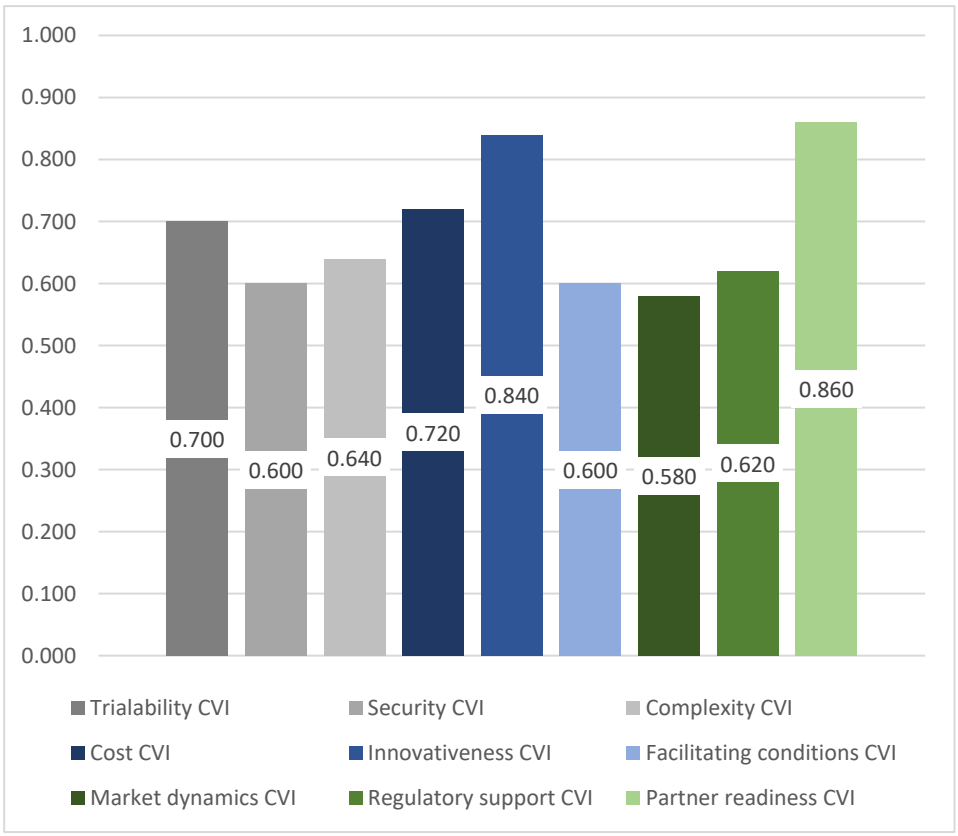

Figure 3. Constructs CVI results summary.

The organizational construct cost here refers to the saving would be made by adopting Blockchain technology. Blockchain has potentially disrupted the financial services sector by making it cost-effective and in banking by reducing the processing costs [19]. Blockchain deployment in the supply chain management provides encouraging benefits in enhancing reducing costs and risks [54]. Additionally, Blockchain is expected to influence management goals such as cost [31].

Innovativeness is a personal characteristic that prompts individuals to attempt new IT and acts optimistic role in adoption behavior [72]. Innovativeness is a trustworthy predictor of person's attitude and IT approval [42]. Moreover, innovativeness explains the degree of innovations that is being adopted by organization to upon IT technology adoption [73]. It is an ambition to lead technology and be a visionary [74]. Innovativeness is measured as the incentives of technology [75].

The technological construct that enables system utilization within a company is referred to as "facilitating conditions" by employees. Furthermore, facilitating conditions refers to an awareness of the resources available to organizations to support the implementation of blockchain technology. In other words, customers are more likely to have a simple and delightful experience with the technology and, as a result, be more engaged with it, if they perceive a sufficient degree of technological, organizational, network, and people support when using Blockchain. In fact, the Blockchain keeps a record of every transaction, strengthening the system and simplifying transaction monitoring for all parties. The average of these three organizational constructs, cost, innovativeness, and facilitating conditions CVIs was 0.720 as the highest one as shown in Figure 4.

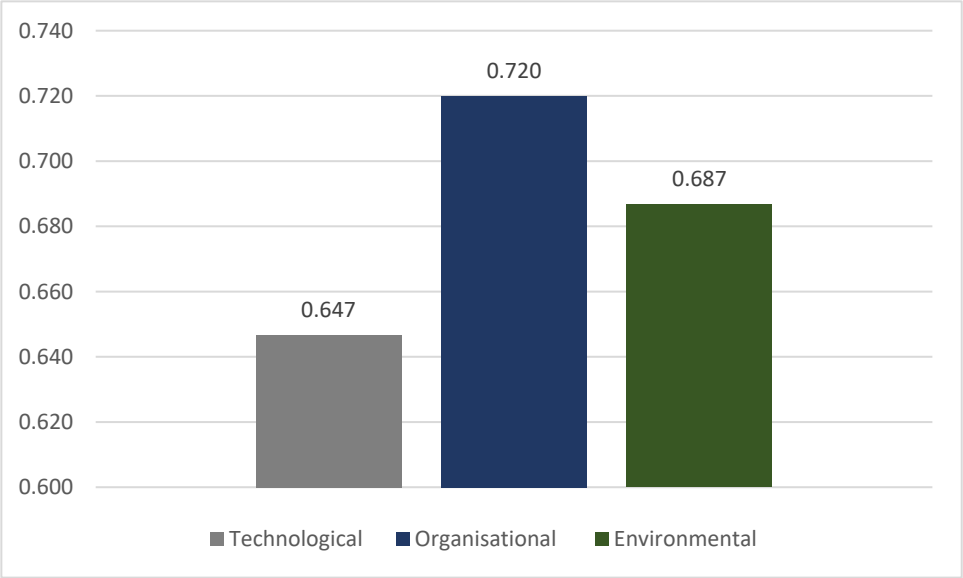

Figure 4. CVI average by Contexts summary.

The average of these three environmental constructs, market dynamics, regulatory support, partner readiness CVIs, was 0.687. Market dynamics refers to the constant transformation of a highly competitive and intricate market [76,77] employs a Blockchain maturity model for Blockchain adoption that considers market dynamics based on a 5-stage taxonomy model, advising enterprises to do comprehensive feasibility studies before deployment. It also refers to the internal pressure and the desire to obtain a competitive edge that motivates organizations to embrace innovative technology while facing pressure from upstream and downstream players as well as new advancements in business models and industry standards [78,79] noted that challenges associated with legislation and practical implementations of decentralized systems remain unresolved and urged the creation of industry standards without delay. The market dynamics was an important

determinant of Blockchain adoption, according to researches [80,81] and the experts in the interview sessions.

Regulatory support refers to legal frameworks put in place by the state to monitor, ensure that users and technology service providers uphold their promises, and stop violations. For e-commerce and service quality monitoring, as well as for authorizing and deploying new technologies within a country's rule of law, government regulation and legislation are essential [82]. These laws are used as a safety net to ensure that all procedures are fair and efficient. The same is true for customer behavior when it comes to Blockchain technology and cryptocurrency. To reduce or lessen any emerging uncertainty, regulation is necessary. Customers' willingness to trust technology and secure its use may be impacted by governmental regulations and directions. However, there are also other barriers to the global adoption of cryptocurrencies, such as insufficient governmental oversight [83]. During the interviews, all the experts agreed that the regulatory support is very important, and it will have a big impact to accelerate the adoption of Blockchain. Most of them are concerned about the legal protection while using Blockchain as there is a lack of government laws supporting the implementation of Blockchain. These results indicate that substantial effort must be expended to further elucidate these challenges. While there is some progress towards tighter government regulation in Malaysia, further effort is required to clarify the legal elements of Blockchain.

Partner readiness refers to the effectiveness of Blockchain deployment is contingent on the degree of organization integration with current organization partners [49]. The partners' desire and collaboration to participate in the Blockchain project is a crucial aspect of its execution, which is impossible if their connections are wrong [84]. Literature suggests that an organization that adopts an innovation would expect its partners to have a comparable innovation process in order to fully exploit the innovation on an inter-organizational level [85]. The partner readiness was discussed with the experts. While most of them believe that international partner readiness, they were worried about local partners' readiness to collaborate and participate in developing Blockchain oriented software.

The average of trialability, security, and complexity, the three technological CVIs was 0.647. Trialability is described as "the degree to which an innovation is amenable to limited testing" [13]. According to [86], the chance of successful adoption rises when individuals and organizations are given the opportunity to sample an innovation prior to its actual implementation. According to a research by [87].

Trialability is a significant element that impacts business application adoption. In their research of e-commerce adoption, [88] discovered that trialability is a crucial factor that influences the adoption of technologies. In a separate research, [89] emphasized the necessity for a testing phase prior to the actual deployment of Blockchain smart contracts. As organizations transition from traditional contracts to smart contracts based on Blockchain, these new contractual systems and technologies will need to be evaluated to promote the growth of user confidence in such technologies. Trials will aid in avoiding failure and bugs [89]. Since previous researchers, such as [87,88] have demonstrated that trialability is relevant to technological innovation acceptance, it is obvious that trialability will also affect Blockchain adoption in the Software development business. This study's respondents expect to test Blockchain in a restricted scope before choosing whether to implement it in practice, and they also believe a trial period before adopting Blockchain will lower perceived risks.

Security is defined as "the capacity to protect the information and transaction data of stakeholders throughout transmission" [90]. Blockchain technology offers a high level of IS [91] and lets users conduct transactions anonymously by virtue of special properties such as a protected database [92] and a privacy-preserving design. Threats to information security are identified in the literature as a factor that influences technology adoption [93,94]. The advantage of Blockchain with relation to security was highlighted by the experts; they believe Blockchain will foster a sense of security and confidence among project participants due to the inherent noncentralized systems that safeguard all the transactions.

Complexity is defined as "the perceived difficulty of learning to utilize and comprehend a new system or technology" [95]. Scalability [96,97], and a shortage of computational capacity are the primary drivers of complexity in Blockchain applications [98]. Scalability refers to the phenomenon in which a corporation that adopts an invention expects its affiliates to have a comparable innovation process in order to implement the innovation on an inter-organizational level. Another concern was the difficulty to learn Blockchain technology, which experts believe it would affect the adoption of Blockchain, on the other hand, the experts believe that Blockchain tools are easy to be implemented and used.

5. Conclusions

The present research is intended to identify the constructs and their items that influence Blockchain adoption in Malaysia's software development sector. The study evaluates three primary contexts based on TOE: technological context (trialability, security, and complexity); organizational context (cost, innovativeness, and facilitating conditions), and environmental context (market dynamics, regulatory support, and partner readiness). A few constructs were found in the literature and were eliminated by the 10 interviewed experts, such as relative advantage, compatibility, management support, and competitive pressure. The nine constructs and their items are verified by the content evaluation method using a questionnaire survey with 25 experts. Findings reveal that the categorizing of the constructs best follows TOE theory, and that the organizational context is more significant than technological and environmental contexts. Additionally, partner preparedness is the most important construct, whilst security and enabling conditions are the least important ones. The research's theoretical contribution may be seen from a few perspectives. This study is the first to explore the constructs and their items that influence the software development industry's intent to adopt Blockchain, so the data provided here constitutes a significant contribution to the expanding body of research in this emerging field. This study is the first use of the TOE framework to investigate the adoption of Blockchain in the software development industry specifically, which is beneficial for analyzing a comprehensive collection of technological, organizational, and environmental constructs that might influence the inclusive decision-making process of an organization. The study provides some insight into the role of cost, innovativeness, and facilitating conditions in the software development industry's choice to adopt Blockchain which implies that organizational context has a role in promoting the adoption of Blockchain decisions. Finally, this study sets the path for future research avenues. Blockchain adoption in the Malaysian software industry remains in the developing stages, and future studies may track the diffusion of the innovation as it progresses from "early adopters" to "laggards" on the innovation diffusion curve [13]. The role of Blockchain in software development process improvement and in the industry of software is a potential source of major theoretical and managerial contributions, and so demands great consideration. Indeed, Blockchain's technology advancements must be matched with a deeper grasp of software process improvement and the necessary organizational aspects. Therefore, further study is required to investigate the integration of Blockchain into software project management processes in greater depth.

6. Limitation and Recommendation

This study focuses on the adoption of Blockchain in Malaysian software development companies. This study employed qualitative semi-structured interviews and structured questionnaires to collect data from Malaysian academic and industrial experts. The results indicate that the presented constructions are reliable, as shown by the interview and the judgments of experts. It is advised that future research examine the relationship between these constructs. Likewise, research into the presented constructions in other developed countries is advantageous for the global adoption of Blockchain technology. In addition, a possible extension of the present study could be additional investigation through an exhaustive quantitative questionnaire survey to evaluate the readiness of Malaysian

organizations based on the constructs and their items found in this study; these constructs can be modeled based on TOE hypothesis to study their impact on users' attitude towards Blockchain and their intention to use it. Finally, other studies can develop a framework for successful Blockchain adoption based on the constructs provided in this study, as well as a framework to address the necessary improvement in the software development process caused by the adoption of Blockchain in software development companies.

Author Contributions: Conceptualization, A.A.-A.; methodology, N.S.S.S.; validation, P.D.D.D.; formal analysis, P.D.D.D.; investigation, A.A.-A.; resources, N.S.S.S.; data curation, A.A.-A.; writing—original draft preparation, A.A.-A.; writing—review and editing, P.D.D.D.; visualization, N.S.S.S.; supervision, P.D.D.D.; project administration, A.A.-A.; funding acquisition, N.S.S.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Available on request.

Acknowledgments: The author wishes to extend his sincere thanks to Faculty of Data Science and Information Technology, INTI International University, Malaysia for guiding and supporting in providing re-sources for this research.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Brühl, V. Bitcoins, Blockchain und Distributed Ledgers. *Wirtschaftsdienst* **2017**, *97*, 135–142. [CrossRef]
2. Yli-Huumo, J.; Ko, D.; Choi, S.; Park, S.; Smolander, K. Where Is Current Research on Blockchain Technology?—A Systematic Review. *PLoS ONE* **2016**, *11*, e0163477. [CrossRef] [PubMed]
3. Tapscott, D.; Tapscott, A. *Blockchain Revolution: How the Technology behind Bitcoin Is Changing Money, Business, and the World*; Penguin: London, UK, 2016.
4. Haber, S.; Stornetta, W.S. How to time-stamp a digital document. In *Conference on the Theory and Application of Cryptography*; Spring: Berlin/Heidelberg, Germany, 1990; pp. 437–455.
5. Bayer, D.; Haber, S.; Stornetta, W.S. Improving the efficiency and reliability of digital time-stamping. In *Sequences II*; Springer: Berlin/Heidelberg, Germany, 1993; pp. 329–334.
6. Nakamoto, S.; Bitcoin, A. A Peer to Peer Electronic Cash System. 2009. Available online: https//bitcoin.org/bitcoin.pdf (accessed on 17 May 2022).
7. Al-Ashmori, A.; Dominic, P.D.D.; Basri, S.; Muneer, A.; Naji, G. Literature Review: Blockchain-Oriented Software Characteristics and New Stream for Software Process Improvement. In Proceedings of the 2022 International Conference on Decision Aid Sciences and Applications (DASA), Mueang Chiang Rai, Thailand, 22–23 March 2022; pp. 905–910.
8. Akbar, N.A.; Muneer, A.; ElHakim, N.; Fati, S.M. Distributed Hybrid Double-Spending Attack Prevention Mechanism for Proof-of-Work and Proof-of-Stake Blockchain Consensuses. *Future Internet* **2021**, *13*, 285. [CrossRef]
9. Puthal, D.; Malik, N.; Mohanty, S.P.; Kougianos, E.; Das, G. Everything you wanted to know about the blockchain: Its promise, components, processes, and problems. *IEEE Consum. Electron. Mag.* **2018**, *7*, 6–14. [CrossRef]
10. Davis, F.D. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q.* **1989**, *13*, 319–340. [CrossRef]
11. Ajzen, I. The Theory of Planned Behavior. *Organ. Behav. Hum. Decis. Processes* **1991**, *50*, 179–211. [CrossRef]
12. Venkatesh, V.; Morris, M.G.; Davis, G.B.; Davis, F.D. User acceptance of information technology: Toward a unified view. *MIS Q.* **2003**, *27*, 425–478. [CrossRef]
13. Rogers, E.M.; Singhal, A.; Quinlan, M.M. Diffusion of innovations. In *An integrated Approach to Communication Theory and Research*; Routledge: London, UK, 2014; pp. 432–448.
14. Depietro, R.; Wiarda, E.; Fleischer, M. The context for change: Organization, technology and environment. *Processes Technol. Innov.* **1990**, *199*, 151–175.
15. Fu, H.-P.; Su, H.-T. A Framework for a technology-organization-environment implementation model in Taiwan's traditional retail supermarkets. *Int. J. Organ. Innov.* **2014**, *6*, 393–416.
16. Pan, Y.; Froese, F.; Liu, N.; Hu, Y.; Ye, M. The adoption of artificial intelligence in employee recruitment: The influence of contextual factors. *Int. J. Hum. Resour. Manag.* **2021**, *33*, 1125–1147. [CrossRef]
17. Chong, A.Y.-L.; Lin, B.; Ooi, K.-B.; Raman, M. Factors affecting the adoption level of c-commerce: An empirical study. *J. Comput. Inf. Syst.* **2009**, *50*, 13–22.

18. Oliveira, T.; Martins, M.O. Determinants of information technology adoption in Portugal. In *Proceedings of the International Conference on e-Business, Milan, Italy, 7–10 July 2009*; Scitepress: Setúbal, Portugal, 2009; Volume 1, pp. 264–270.
19. Kulkarni, M.; Patil, K. Block chain technology adoption using toe framework. *Int. J. Sci. Technol. Res.* **2020**, *9*, 1109–1117.
20. Gutierrez, A.; Boukrami, E.; Lumsden, R. Technological, organisational and environmental factors influencing managers' decision to adopt cloud computing in the UK. *J. Enterp. Inf. Manag.* **2015**, *28*, 788–807. [CrossRef]
21. Al-Ashmori, A.A.; Basri, S.; Dominic, P.D.D.; Muneer, A.; Al-Tashi, Q.; Al-Ashmori, Y. Blockchain-Oriented Software Development Issues: A Literature Review. In Proceedings of the Computational Methods in Systems and Software, Prag, Czech Republic, 14–17 October 2021; pp. 48–57.
22. Ammar, A.-A.; Dominic, P.D.D.; Basri, S.; Al-Tashi, Q.; Muneer, A.; Ghaleb, E.A.A. Software Process Improvement During the Last Decade: A Theoretical Mapping and Future Avenues. In Proceedings of the 2021 International Congress of Advanced Technology and Engineering (ICOTEN), Online, 4–5 July 2021; pp. 1–5.
23. Bigi, M.; Greenan, N.; Hamon-Cholet, S.; Lanfranchi, J. The human sustainability of ICT and management changes: Evidence for the French public and private sectors. *Sustainability* **2018**, *10*, 3570. [CrossRef]
24. Ahmed, F.; Qin, Y.J.; Martínez, L. Sustainable Change Management through Employee Readiness: Decision Support System Adoption in Technology-Intensive British E-Businesses. *Sustainability* **2019**, *11*, 2998. [CrossRef]
25. Rahman, R.U.; Shah, S.A.; El-Gohary, H.; Abbas, M.; Khalil, S.H.; Al Altheeb, S.; Sultan, F. Social Media Adoption and Financial Sustainability: Learned Lessons from Developing Countries. *Sustainability* **2020**, *12*, 10616. [CrossRef]
26. Tenakwah, E.S.; Tenakwah, E.J.; Amponsah, M.; Eyaa, S.; Boateng, E.; Okhawere, N. Adoption of Sustainable Technologies during Crisis: Examining Employees' Perception and Readiness across Cultures. *Sustainability* **2022**, *14*, 4605. [CrossRef]
27. Paradza, D.; Daramola, O. Business Intelligence and Business Value in Organisations: A Systematic Literature Review. *Sustainability* **2021**, *13*, 11382. [CrossRef]
28. Chauhan, V.; Yadav, R.; Choudhary, V. Analyzing the impact of consumer innovativeness and perceived risk in internet banking adoption: A study of Indian consumers. *Int. J. Bank Mark.* **2019**, *37*, 323–339. [CrossRef]
29. Chillakuri, B.; Attili, V.S.P. Role of blockchain in HR's response to new-normal. *Int. J. Organ. Anal.* **2021**. *ahead of print*. [CrossRef]
30. Guest, G.; Bunce, A.; Johnson, L. How many interviews are enough? An experiment with data saturation and variability. *Field Methods* **2006**, *18*, 59–82. [CrossRef]
31. Orji, I.J.; Kusi-Sarpong, S.; Huang, S.; Vazquez-Brust, D. Evaluating the factors that influence blockchain adoption in the freight logistics industry. Transp. *Res. Part E Logist. Transp. Rev.* **2020**, *141*, 102025. [CrossRef]
32. Fowler, F.J., Jr. *Improving Survey Questions: Design and Evaluation*; Sage: New York, NY, USA, 1995.
33. Mason, M. Sample Size and Saturation in PhD Studies Using Qualitative Interviews 2010. Available online: http://www.qualitative-research.net/index.php/fqs/article/view/1428/3027 (accessed on 17 May 2022).
34. Gamil, Y.; Alhagar, A. The impact of pandemic crisis on the survival of construction industry: A case of COVID-19. *Mediterr. J. Soc. Sci.* **2020**, *11*, 122. [CrossRef]
35. Lawshe, C.H. A Quantitative approach to content validity. *Pers. Psychol.* **1975**, *28*, 563–575. [CrossRef]
36. Wilson, F.R.; Pan, W.; Schumsky, D.A. Recalculation of the Critical Values for Lawshe's Content Validity Ratio. *Meas. Eval. Couns. Dev.* **2012**, *45*, 197–210. [CrossRef]
37. Rui, G. Information Systems Innovation Adoption among Organizations—A Match-Based Framework and Empirical Studies. 2007. Available online: https://core.ac.uk/download/pdf/48629863.pdf (accessed on 17 May 2022).
38. Al-Ashmori, A.; Bin Basri, S.; Dominic, P.D.D.; Capretz, L.F.; Muneer, A.; Balogun, A.O.; Gilal, A.R.; Ali, R.F. Classifications of Sustainable Factors in Blockchain Adoption: A Literature Review and Bibliometric Analysis. *Sustainability* **2022**, *14*, 5176. [CrossRef]
39. Badi, S.; Ochieng, E.; Nasaj, M.; Papadaki, M. Technological, organisational and environmental determinants of smart contracts adoption: UK construction sector viewpoint. *Constr. Manag. Econ.* **2020**, *39*, 36–54. [CrossRef]
40. Ullah, N.; Mugahed Al-Rahmi, W.; Alzahrani, A.I.; Alfarraj, O.; Alblehai, F.M. Blockchain Technology Adoption in Smart Learning Environments. *Sustainability* **2021**, *13*, 1801. [CrossRef]
41. Palos-Sanchez, P.; Saura, J.; Ayestaran, R. An Exploratory Approach to the Adoption Process of Bitcoin by Business Executives. *Mathematics* **2021**, *9*, 355. [CrossRef]
42. Nuryyev, G.; Wang, Y.-P.; Achyldurdyyeva, J.; Jaw, B.-S.; Yeh, Y.-S.; Lin, H.-T.; Wu, L.-F. Blockchain Technology Adoption Behavior and Sustainability of the Business in Tourism and Hospitality SMEs: An Empirical Study. *Sustainability* **2020**, *12*, 1256. [CrossRef]
43. Kamble, S.; Gunasekaran, A.; Arha, H. Understanding the Blockchain technology adoption in supply chains-Indian context. *Int. J. Prod. Res.* **2018**, *57*, 2009–2033. [CrossRef]
44. Wong, L.-W.; Leong, L.-Y.; Hew, J.-J.; Tan, G.W.-H.; Ooi, K.-B. Time to seize the digital evolution: Adoption of blockchain in operations and supply chain management among Malaysian SMEs. *Int. J. Inf. Manag.* **2019**, *52*, 101997. [CrossRef]
45. Oliveira, T.; Martins, M.F. Literature review of information technology adoption models at firm level. *Electron. J. Inf. Syst. Eval.* **2011**, *14*, 110–121.
46. Ullah, N.; Alnumay, W.S.; Al-Rahmi, W.M.; Alzahrani, A.I.; Al-Samarraie, H. Modeling Cost Saving and Innovativeness for Blockchain Technology Adoption by Energy Management. *Energies* **2020**, *13*, 4783. [CrossRef]
47. Nazim, N.F.; Razis, N.M.; Hatta, M.F.M. Behavioural intention to adopt blockchain technology among bankers in islamic financial system: Perspectives in Malaysia. *Rom. J. Inf. Technol. Autom. Control.* **2012**, *31*, 11–28. [CrossRef]

48. Park, K.O. A study on sustainable usage intention of blockchain in the big data era: Logistics and supply chain management companies. *Sustainability* **2020**, *12*, 670. [CrossRef]
49. Wamba, S.F.; Queiroz, M.M.; Trinchera, L. Dynamics between blockchain adoption determinants and supply chain performance: An empirical investigation. *Int. J. Prod. Econ.* **2020**, *229*, 107791. [CrossRef]
50. Queiroz, M.M.; Wamba, S.F.; De Bourmont, M.; Telles, R. Blockchain adoption in operations and supply chain management: Empirical evidence from an emerging economy. *Int. J. Prod. Res.* **2020**, *59*, 6087–6103. [CrossRef]
51. Tran, L.T.T.; Nguyen, P.T. Co-creating blockchain adoption: Theory, practice and impact on usage behavior. *Asia Pac. J. Mark. Logist.* **2021**, *33*, 1667–1684. [CrossRef]
52. Wong, L.-W.; Tan, G.W.-H.; Lee, V.-H.; Ooi, K.-B.; Sohal, A. Unearthing the determinants of Blockchain adoption in supply chain management. *Int. J. Prod. Res.* **2020**, *58*, 2100–2123. [CrossRef]
53. Kamble, S.S.; Gunasekaran, A.; Kumar, V.; Belhadi, A.; Foropon, C. A machine learning based approach for predicting blockchain adoption in supply Chain. *Technol. Forecast. Soc. Change* **2020**, *163*, 120465. [CrossRef]
54. Gökalp, E.; Gökalp, M.O.; Çoban, S. Blockchain-Based Supply Chain Management: Understanding the Determinants of Adoption in the Context of Organizations. *Inf. Syst. Manag.* **2020**, *39*, 100–121. [CrossRef]
55. Clohessy, T.; Acton, T. Investigating the influence of organizational factors on blockchain adoption: An innovation theory perspective. *Ind. Manag. Data Syst.* **2019**, *119*, 7. [CrossRef]
56. Fernando, Y.; Rozuar, N.H.M.; Mergeresa, F. The blockchain-enabled technology and carbon performance: Insights from early adopters. *Technol. Soc.* **2021**, *64*, 101507. [CrossRef]
57. Ghaleb, E.; Dominic, P.; Fati, S.; Muneer, A.; Ali, R. The Assessment of Big Data Adoption Readiness with a Technology–Organization–Environment Framework: A Perspective towards Healthcare Employees. *Sustainability* **2021**, *13*, 8379. [CrossRef]
58. Albayati, H.; Kim, S.K.; Rho, J.J. Accepting financial transactions using blockchain technology and cryptocurrency: A customer perspective approach. *Technol. Soc.* **2020**, *62*, 101320. [CrossRef]
59. Ferri, L.; Spanò, R.; Ginesti, G.; Theodosopoulos, G. Ascertaining auditors' intentions to use blockchain technology: Evidence from the Big 4 accountancy firms in Italy. *Meditari Account. Res.* **2020**, *29*, 1063–1087. [CrossRef]
60. Shrestha, A.K.; Vassileva, J.; Joshi, S.; Just, J. Augmenting the technology acceptance model with trust model for the initial adoption of a blockchain-based system. *Peer J. Comput. Sci.* **2021**, *7*, e502. [CrossRef]
61. Kabir, M.R. Behavioural intention to adopt blockchain for a transparent and effective taxing system. *J. Glob. Oper. Strat. Sourc.* **2021**, *14*, 170–201. [CrossRef]
62. Queiroz, M.M.; Wamba, S.F. Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA. *Int. J. Inf. Manag.* **2018**, *46*, 70–82. [CrossRef]
63. Jain, G.; Singh, H.; Chaturvedi, K.R.; Rakesh, S. Blockchain in logistics industry: In fizz customer trust or not. *J. Enterp. Inf. Manag.* **2020**, *33*, 541–558. [CrossRef]
64. Alazab, M.; Alhyari, S.; Awajan, A.; Abdallah, A.B. Blockchain technology in supply chain management: An empirical study of the factors affecting user adoption/acceptance. *Clust. Comput.* **2020**, *24*, 83–101. [CrossRef]
65. Lin, X.; Chang, S.-C.; Chou, T.-H.; Chen, S.-C.; Ruangkanjanases, A. Consumers' Intention to Adopt Blockchain Food Traceability Technology towards Organic Food Products. *Int. J. Environ. Res. Public Health* **2021**, *18*, 912. [CrossRef]
66. Muhamad, W.N.W.; Afiza, N.; Wook, M.; Khalil, K.; Mohd, N.; Asiakin, N.; Ramli, S. Evaluation of Blockchain-based Data Sharing Acceptance among Intelligence Community. *Int. J. Adv. Comput. Sci. Appl.* **2020**, *11*, 597–606. [CrossRef]
67. Khazaei, H. Integrating Cognitive Antecedents to UTAUT Model to Explain Adoption of Blockchain Technology Among Malaysian SMEs. *JOIV Int. J. Inform. Vis.* **2020**, *4*, 85–90. [CrossRef]
68. Razali, N.A.M.; Wan Muhamad, W.N.; Ishak, K.K.; Saad, N.J.A.M.; Wook, M.; Ramli, S. Secure Blockchain-Based Data-Sharing Model and Adoption among Intelligence Communities. *IAENG Int. J. Comput. Sci.* **2021**, *48*, 18–31.
69. Tornatzky, L.G.; Fleischer, M.; Chakrabarti, A.K. *Processes of Technological Innovation*; Lexington Books: Lanham, MD, USA, 1990.
70. Van Everdingen, Y.; Van Hillegersberg, J.; Waarts, E. Enterprise resource planning: ERP adoption by European midsize companies. *Commun. ACM* **2000**, *43*, 27–31. [CrossRef]
71. Kuan, K.K.Y.; Chau, P.Y.K. A perception-based model for EDI adoption in small businesses using a technology—Organization—Environment framework. *Inf. Manag.* **2021**, *38*, 507–521. [CrossRef]
72. Kim, C.; Mirusmonov, M.; Lee, I. An empirical examination of factors influencing the intention to use mobile payment. *Comput. Hum. Behav.* **2010**, *26*, 310–322. [CrossRef]
73. Colby, C.L.; Parasuraman, A. *Techno-Ready Marketing: How and Why Customers Adopt Technology*; Simon and Schuster: New York, NY, USA, 2001.
74. Godoe, P.; Johansen, T.S. Understanding adoption of new technologies: Technology readiness and technology acceptance as an integrated concept. *J. Eur. Psychol. Stud.* **2012**, *3*, 38. [CrossRef]
75. Pattansheti, M.; Kamble, S.S.; Dhume, S.M.; Raut, R.D. Development, measurement and validation of an integrated technology readiness acceptance and planned behaviour model for Indian mobile banking industry. *Int. J. Bus. Inf. Syst.* **2016**, *22*, 316–342.
76. Wu, C.H.; Kao, S.; Lin, H. Acceptance of enterprise blog for service industry. *Internet Res.* **2013**, *23*, 260–297.
77. Wang, Y.; Han, J.H.; Beynon-Davies, P. Understanding blockchain technology for future supply chains: A systematic literature review and research agenda. *Supply Chain Manag.* **2018**, *24*, 62–84. [CrossRef]

78. Shi, P.; Yan, B. Factors affecting RFID adoption in the agricultural product distribution industry: Empirical evidence from China. *SpringerPlus* **2016**, *5*, 2029. [CrossRef]
79. Guo, Y.; Liang, C. Blockchain application and outlook in the banking industry. *Financ. Innov.* **2016**, *2*, 24. [CrossRef]
80. Lindman, J.; Tuunainen, V.K.; Rossi, M. Opportunities and Risks of Blockchain Technologies—A Research Agenda. 2017. Available online: https://scholarspace.manoa.hawaii.edu/items/54250164-e7f4-49d9-b2c9-00f2170ea3ff/full (accessed on 17 May 2022).
81. Swan, M. *Blockchain: Blueprint for a New Economy*; O'Reilly Media, Inc.: Middlesex, MA, USA, 2015.
82. Peters, G.; Panayi, E.; Chapelle, A. Trends in cryptocurrencies and blockchain technologies: A monetary theory and regulation perspective. *J. Financ. Perspect.* **2015**, *3*, 3.
83. Lu, Y. Blockchain: A survey on functions, applications and open issues. *J. Ind. Integr. Manag.* **2018**, *3*, 1850015. [CrossRef]
84. Mougayar, W. We Need to Improve the Blockchain's Lack of Mass Understanding. 2017. Available online: https://medium.com/@wmougayar/we-need-to-improve-the-blockchains-lack-of-mass-understanding-ed72b9bc70b2 (accessed on 29 March 2021).
85. Hameed, M.A.; Counsell, S. Assessing the influence of environmental and CEO characteristics for adoption of information technology in organizations. *J. Technol. Manag. Innov.* **2012**, *7*, 64–84. [CrossRef]
86. Lin, A.; Chen, N.-C. Cloud computing as an innovation: Percepetion, attitude, and adoption. *Int. J. Inf. Manag.* **2012**, *32*, 533–540. [CrossRef]
87. Ramdani, B.; Chevers, D.; Williams, D.A. SMEs' adoption of enterprise applications: A technology-organisation-environment model. *J. Small Bus. Enterp. Dev.* **2013**, *20*, 4. [CrossRef]
88. Kendall, J.D.; Tung, L.L.; Chua, K.H.; Ng, C.H.D.; Tan, S.M. Receptivity of Singapore's SMEs to electronic commerce adoption. *J. Strat. Inf. Syst.* **2001**, *10*, 223–242. [CrossRef]
89. Mason, J. Intelligent contracts and the construction industry. *J. Leg. Aff. Dispute Resolut. Eng. Constr.* **2017**, *9*, 4517012. [CrossRef]
90. Hua, Y.; Jiang, H.; Zhu, Y.; Feng, D.; Tian, L. SmartStore: A new metadata organization paradigm with semantic-awareness for next-generation file systems. In Proceedings of the Conference on High Performance Computing Networking, Storage and Analysis, Dallas, TX, USA, 13–18 November 2009; pp. 1–12.
91. Ouaddah, A.; Elkalam, A.A.; Ouahman, A.A. Towards a novel privacy-preserving access control model based on blockchain technology in IoT. In *Europe and MENA Cooperation Advances in Information and Communication Technologies*; Springer: Berlin/Heidelberg, Germany, 2017; pp. 523–533.
92. Huckle, S.; Bhattacharya, R.; White, M.; Beloff, N. Internet of Things, Blockchain and Shared Economy Applications. *Procedia Comput. Sci.* **2016**, *98*, 461–466. [CrossRef]
93. Ali, R.F.; Dominic, P.D.D.; Ali, S.E.A.; Rehman, M.; Sohail, A. Information security behavior and information security policy compliance: A systematic literature review for identifying the transformation process from noncompliance to compliance. *Appl. Sci.* **2021**, *11*, 3383. [CrossRef]
94. Belkhamza, Z.; Wafa, S.A. The effect of perceived risk on the intention to use e-commerce: The case of Algeria. *J. Internet Bank. Commer.* **1970**, *14*, 1–10.
95. Sonnenwald, D.H.; Maglaughlin, K.L.; Whitton, M.C. Using innovation diffusion theory to guide collaboration technology evaluation: Work in progress. In Proceedings of the Tenth IEEE International Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises (WET ICE 2001), Cambridge, MA, USA, 30 September 2001; pp. 114–119.
96. Eyal, I.; Gencer, A.E.; Sirer, E.G.; van Renesse, R. Bitcoin-NG: A Scalable Blockchain Protocol. In Proceedings of the 13th USENIX Symposium on Networked Systems Design and Implementation (NSDI 16), Santa Clara, CA, USA, 17–18 March 2016; pp. 45–59.
97. Khan, M.A.; Salah, K. IoT security: Review, blockchain solutions, and open challenges. *Future Gener. Comput. Syst.* **2018**, *82*, 395–411. [CrossRef]
98. Bentov, I.; Gabizon, A.; Mizrahi, A. Cryptocurrencies without proof of work. In Proceedings of the International Conference on Financial Cryptography and Data Security, Santa Clara, CA, USA, 18–22 February 2016; pp. 142–157.