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VERIFYING THE DETERMINANTS OF BLOCKCHAIN ADOPTION INTENTION: A META-ANALYSIS ON SUPPLY CHAIN STUDIES

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Abstract

Numerous significant variables for the adoption of Blockchain technology in supply chains have been identified empirically. These variables, which influence adoption behavior in a variety of contexts, are discussed theoretically using technology acceptance theories and various other theories and methodological approaches. Given that research have been undertaken in many contexts, it is necessary to validate the previously proposed relationships between factors that facilitate blockchain adoption and the intention to utilize blockchain technology. Therefore, the purpose of this study is to investigate and validate the critical variables that stand out in related studies by using meta-analysis. 38 studies published in SSCI and SCI-E-indexed journals were used after searching WoS, Scopus, and Google Scholar databases and employing various filtering criteria. In addition to the variables considered in the most widely accepted technological, environmental, and organizational classifications, the research results disclose newly emerging or relatively less interesting variables. While the study's empirical findings have managerial implications, this study also provides suggestions for future research agendas.

Keywords: Blockchain Technologies, Technology Adoption, Supply Chain, Meta-Anaysis

JEL Codes: M11, M15

BLOCKCHAIN TEKNOLOJİLERİNİ BENİMSEME NİYETİNİN BELİRLEYİCİLERİNİN DOĞRULANMASI: TEDARİK ZİNCİRİ ÇALIŞMALARI ÜZERİNE BİR META-ANALİZ

Öz

Tedarik zincirlerinde Blockchain teknolojisinin benimsenmesine yönelik öne çıkan birçok faktör ampirik olarak belirlenmiştir. Çeşitli bağlamlarda benimseme davranışı üzerindeki etkili olan bu faktörler teorik açıdan teknoloji kabul teorileri ve diğer farklı teoriler ve metodolojik yaklaşımlarla ele alınmıştır. Çalışmaların birçok farklı bağlamda yapıldığı göz önüne alındığında, blockchain teknolojisinin benimsenmesini kolaylaştıran faktörler ile blockchain teknolojisini kullanma niyeti arasında daha önceden önerilen ilişkilerin doğrulanması gerekmektedir. Bu yüzden, bu çalışmanın amacı meta-analizi yardımıyla ilişkili çalışmalarda öne çıkan kritik faktörlerin araştırılması ve doğrulanmasıdır. WoS, Scopus ve Google scholar gibi veri tabanlarının taranması ve çeşitli eleme kriterlerinin uygulanması sonucu SSCI ve SCI-E indeksli dergilerde yayınlanmış 38 çalışma analizde kullanılmıştır. Araştırma bulguları, literatürde en çok kabul gören teknolojik, çevresel ve organizasyonel sınıflandırma dahilinde ele alınan faktörlere ek olarak, yeni ortaya çıkan ya da nispeten daha az ilgi gören değişkenleri de ortaya koymaktadır. Araştırma ampirik bulgularıyla yönetimsel çıkarımlara katkı sağlarken gelecek çalışmalar için gündem önerileri de sunmaktadır.

Anahtar Kelimeler: Blockchain Teknolojisi, Teknoloji Benimseme, Tedarik Zinciri, Meta-Analizi

JEL Kodları: M11, M15

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INTRODUCTION

In recent years, supply chains (SC) around the world have encountered numerous issues, such as the covid-19 pandemic, terrorist attacks, conflicts, cyber-attacks, and other catastrophes (Dubey, Bryde, Dwivedi, Graham, Foropon, and Papadopoulos, 2023). Consequently, supply distribution and disconnection with suppliers occurred, resulting in economic losses for businesses (Kamalahmadi and Parast, 2016). Integration of new technologies, such as Internet of Things technologies (Birkel and Hartmann, 2020) and other industry 4.0 enablers (Hsu, Zeng, Chang, and Cai, 2022) with SC, has been one of the primary research foci in the current digital era. To overcome the aforementioned problems, blockchain (BC) technology has been identified as a significant tool (Saberi, Kouhizadeh, Sarkis, and Shen, 2019), as BC is anticipated to provide immutability of information (Alazab, Alhyari, Awajan, and Abdallah, 2021), decentralization (Saberi et al., 2019), and product traceability (Kshetri, 2018). Literature discussions indicate that such advantages will eventually assist organizations in designing more resilient (Benabdellah, Zekhnini, Cherrafi, Reyes, Kumar, and El Baz, 2023), responsive (Pimenta, Cezarino, Piato, Silva, Oliveira, and Libona, 2022), and robust (Kim and Laskowski, 2018) SC structures. Therefore, BC technology adoption in SCs is receiving a growing amount of attention from academicians and managers, which explains the fundamental motivation for this study.

Considering BC adoption, scholars have been using some widely accepted theories, such as the technology acceptance model (TAM) (Prisco, Abdallah, Morande, and Gheith, 2022), theory of planned behavior (TRA) (Kumari and Devi, 2023), unified technology acceptance and use of technology (UTAUT) (Pieters, Kokkinou and Kollenburg, 2022), UTAUT 2 (Sheel and Nath, 2020b), technology-organization-environment (TOE) framework (Chittipaka, Kumar, Sivarajah, Bowden, and Baral, 2022) to examine the relations between the adoption enablers and adoption intention in SCs. Scholars have been able to examine various SC adoption enablers and their effects with the aid of these theories, including perceived ease of use, perceived usefulness, facilitating conditions, complexity, competibility, BC trust, regulatory support, partner pressure, security, social influence, and top management support. For instance, Kamble, Gunasekaran, Kumar, Belhadi, and Foropon (2021) found that perceived ease of use and perceived usefulness are highly predictive of BC adoption. According to another study (Pham and Nguyen, 2023), facilitating conditions is a strong indicator of the adoption of BC technology in a SC context. These investigations are essential for advancing and contributing to a phenomenon's general understanding. However, these studies are conducted in various contexts, resulting in context-dependent results. Therefore, more holistic approaches should be taken when reviewing the general picture of relationships between variables. As this implication is the impetus for the present investigation, we adopted a meta-analysis methodology.

Some review studies in the literature have analyzed the most prevalent theories and frameworks (Taherdoost, 2022; AlShamsi, Al-Emran, and Shaalan, 2022), using bibliometric and general review methods to propose new frameworks (Zhu, Bai, and Sarkis, 2022). However, these studies do not interpret the relationships between the constructs because they only provide a general overview of the literature and do not concentrate on the explanations of the major variables, indicating a research vacuum. In light of this circumstance, the purpose of the present study is to define and assess relationships between adoption-related constructs found in the literature. By the study's objective, we conducted a meta-analysis to confirm previously suggested relationships between BC adoption enablers and BC adoption intention. Meta-analysis is appropriate for estimating the aggregate or combined effects of parameters (Rana and Paul, 2020). Meta-analysis also enables researchers to develop comprehensive and integrated models that include both the phenomenon's primary antecedents and outcomes (Barari, Ross, Thaichon, and Surachartkumtkun, 2021). For these reasons, we decided to use meta-analysis approach for the review.

This research contributes to the body of knowledge in numerous ways. First, among the BC acceptance studies, this is one of the first meta-analysis studies. Only one study (Mishra, Raj, Jeyaraj, and Gupta, 2023) on BC acceptance in SC employed meta-analysis. While examining the BC adoption descriptors categorized in the literature as technological, environmental, and organizational, the authors also explain the most important variables. We expand these categories and introduce a new category titled user-related variables by supplying additional variables. Second, we contribute to the body of knowledge by proposing and testing a comprehensive and synthesized set of relationships. We believe that research findings have practical and future research agenda implications.

Finally, the organization of the paper is as follows: The methodology is presented in section two. Section three introduces a general review of widely used theories and variables explaining adoption behavior and hypothesis development. While section four includes results, we discuss the importance and contributions of the present study, considering the implications in section five. Section six finishes the paper by indicating limitations and providing a future research agenda.

METHOD

As mentioned earlier, meta-analysis is used in this study following the main purpose. Meta-analysis is one of the approaches conducted to make a systematic literature review (Barari et al., 2021). However, different from other review methods, meta-analysis is quantitatively synthesizing studies conducted in a domain (Paul and Barari, 2022). By shifting the discussion away from specific studies and bringing consensus to inconclusive findings on the significance of drivers, meta-analysis can assist researchers in

identifying gaps in understanding and establishing a research agenda (Turan, 2021). In the next sections, we will provide the procedure for conducting meta-analysis.

Data Gathering and Selection Criteria

Considering similar studies (Barari et al., 2020; Turan, 2021; Mishra et al., 2023), meta-analysis was applied by following three main steps: data gathering, data coding, and conducting the analysis. For data gathering, we used WoS and Scopus databases, empowered by checking also google scholar not to miss any related studies. To narrow the literature, we adopted some keywords such as, "technology adoption," "technology acceptance," "acceptance theories," and "organizational adoption" under the main theme "BC acceptance/adoption" and "supply chain". In the initial search, we reached 50 studies. Then we applied some exclusion criteria to provide better data. We excluded book chapters, conference papers (as they are not full-text), and review studies, leaving 44 studies. Then we delved into the studies as they are expected to provide antecedents of BC adoption, correlations between variables, and p-values. After eliminating 6 studies that did not meet these criteria, it was decided to include the final 38 studies in the analysis. The time span of the analyzed papers ranges from 2019 to 2023. We listed all studies used in the analysis in the references section with a separate title named "references used in analysis".

Data Coding

The coding procedure is important as it can be also considered as data cleaning. Coding mostly requires inter-coders' control to provide reliable data. In our study, two coders prepared different Excel sheets and coded the names of studies, sample features, and each effect size. Then these codes were compared to check if there are any different codings. After assessing inter-coders reliability we also did some groupings as some of the variables from different theories have the same meaning in nature. For example, "perceived usefulness" and "perceived ease of use" from TAM are grouped with "performance expectancy" and "effort expectancy" from the UTAUT model as they are identical. Similarly, "subjective norms" from TPB and "social impact" from UTAUT are examined under the same group. Next thing that researchers should focus that in some studies samples may be divided into two groups according to the context of the study. As such studies provide two different correlations between variables, researchers can include these correlations in the analysis as two different studies, especially, when they belong to independent variables (Barari et al., 2020). For data coding, researchers must also check how many studies the correlations are included in. Literature suggests that at least 3 studies should provide correlations of the

target relationships to provide valid results (Ismagilova, Slade, Rana, and Dwivedi, 2020). After following such rules, we finished the coding phase and provided all antecedents, and decided on new framework[3].

Conducting Meta-Analysis

Following the Hunter and Schmidt (2004) prosedure, first effect sizes are corrected to test measurement error. As the outcome measure, the Fisher r-to-z transformed correlation coefficient (r+) was utilized in the analysis. Compared to the correlation coefficient, Geyskens, Krishnan, Steenkamp, and Cunha (2009) point out that r+ provides a much better normal distribution. Then, the random-effect model was fitted to data with a 95% confidence interval (CI) level, as each study used in the analysis has different samples (Paul and Barari, 2022), enhancing the generalization of the analysis results. As such generalization requires heterogeneity of the effect sizes, Q-statistics, and statistics are used. It is expected to assess significant Q-statistic and higher than 75%, meaning variance in effect sizes (Rana and Paul, 2020). Finally, the fail-safe N values method is used to check the publication bias, meaning that there may be a much larger effect size. Thornton and Lee (2000) state that researchers should prove (<.001) that there is no publication bias to provide the robustness of the results (Paul and Barari, 2022). Fail-safe N, if significant, shows the number of unpublished studies which can increase the p-value above the .05, making the results insignificant.

THEORETICAL BACKROUND

Groundbreaking developments in technology over time have motivated researchers in the context of examining the social integration of these technologies. Considering the development stages they are in, the intention to adopt or behavioral intention by the users before the actual use of these technologies was the main research topic. The behavioral intention (BI) in question can be defined as the dimension of the individual's intention to perform a particular behavior (Hale, Householder and Greene, 2002). This basic descriptive approach to BI has enabled many different theories and theoretical models to be used in technology adoption studies.

The theory of planned behavior (TPB), one of the most widely used theories, was developed by Schifer and Ajzen in 1985 and according to the theory, in addition to attitude (ATT) and subjective norms (SN) on BI (Montano and Kasprzyk, 2008), perceived behavioral control (PBC) is also effective. While TPB was adapted to technology adoption studies carried out in many fields with its strong theoretical infrastructure, it also led to the emergence of new technology-based theories in the following periods. For

[3] Presented in “Research Model and Hypotheses Development” section.

example, the Technology Acceptance Model (TAM), which is based on PBT, is one of the leading theories in this field regarding the examination of the acceptance behavior of the developing information technologies by the users and the revealing of the determinants (Chau, 1996). While BI is determined by one's attitude towards computer use, attitude is also affected by perceived usefulness (PU), which means the degree to which the use of a particular system increases one's performance, and perceived ease of use (PEoU), which means the effortless degree of using a particular system (Davis, 1989; Davis, Bagozzi, and Warshaw, 1989). However, the fact that the effect of PEoU on intention is less consistent in studies and which determinants affect PU, and how these determinants change with increasing system usage experience over time (Venkatesh and Davis, 2000) have led to debates in terms of making the structure more understandable. These complex results provide a catalyst for the development of the model in the context of elucidating the random relationships in various TAM domains.

To create a more holistic and broadly applicable model, Venkatesh, Morris, Davis, and Davis (2003) introduced the Unified Technology Use and Acceptance Theory (UTAUT) by comparing models such as PBT and TAM and combining the main explanation of these theories. This model presented performance expectancy (PE), effort expectancy (EE), social impact (SI), and facilitating conditions (FC) variables as direct determinants of BI to explain technology acceptance. However, theoretical criticisms such as the fact that the model has been developed in an organizational context where adoption behavior may be mandatory (Venkatesh, Thong, and Xu, 2012), the behavior of most end users towards technology is voluntary and self-reliant (Gaitan, Peral, and Jerenimo, 2013), and the different dynamics of technology acceptance behavior for organizations (Chen and Holsapple, 2013) triggered the later development of the UTAUT 2 model (Venkatesh et al., 2012). In addition to the variables in the previous model, UTAUT 2 includes hedonic motivation (HM), price value (PV), and habit (HBT) variables to explain the consumer's acceptance and usage behavior.

As it is technology adoption, some of the .technological characteristics that may have an impact on BI are addressed by theoretical models that reflect various other different perspectives. In this context, innovation diffusion theory (IDT) (Rogers, 2004) deals with many of the comprehensive and widely accepted characteristics in the literature that can have an impact on BI. Relative advantage (RA), compatibility (COM), complexity (CX), trialability (TB), and observability (OB) are presented as the main technological features explaining the BI in a variety of contexts. However, BC adoption studies show that TB and OB are not included in the analysis. One reason might be that TB requires innovation to be fundamentally testable and OB indicates that the results of innovation are visible to other people, but most technologies may have not yet been implemented, resulting in a lack of experience. Finally, the technology-

organization-environment (TOE) framework expands the theoretical view of technology adoption by grouping variables into three domains. TOE is increasingly used in BC adoption studies (Chittipaka et al., 2022), especially since it emphasizes that organizations in supply chains can be affected by some external and internal conditions other than technological features.

Even though the literature provides numerous antecedents for the adoption of BC technologies in supply chains, their integration into the overall framework remains essential. In the next section, we provide a new framework and related hypotheses to fill that gap by delving into each study.

Research Model and Hypotheses Development

Referring to the coding procedure, we decided to include some of the variables in a new framework and conduct the analysis with them. In this direction, Table I provides the main characteristics of the studies.

Table 1: The most common theories and antecedents used in BC adoption studies (N=38)

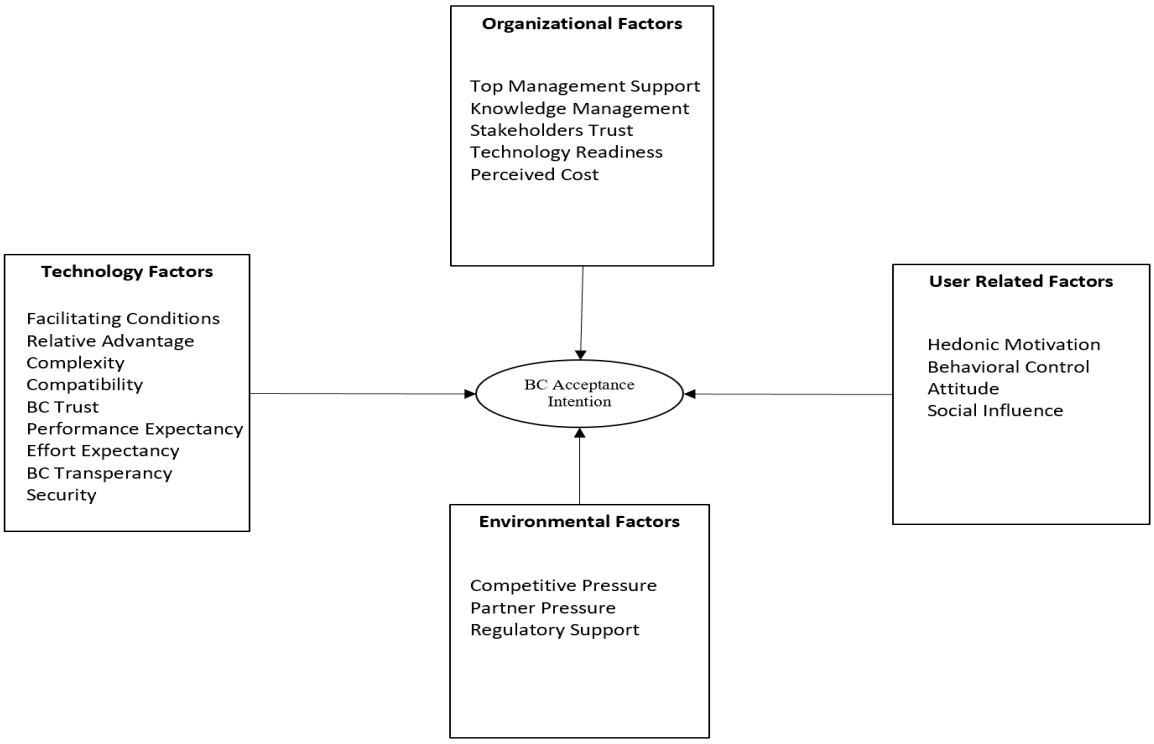
Theories	Antecedents	Descriptions	Studies Examining
TPB	ATT	The person's feelings about the target behavior to be performed.	Kamble et al. 2019; Park 2020; Jain et al. 2020; Ullah et al. 2021; Kumar et al. 2022; Prisco et al. 2022; Kumari and Devi 2023; Mukherjee et al. 2023.
	PBC	The person's perception of difficulty or ease in performing the relevant behavior.	Kamble et al. 2019; Ullah et al. 2021; Prisco et al. 2022; Kumari and Devi 2023; Mukherjee et al. 2023.
UTAUT	PE	Degree of belief that the system used will help the person.	Queiroz and Wamba 2019; Kamble et al. 2019; Wamba and Queiroz 2020; Wong et al. 2020; Park 2020; Jain et al. 2020; Tran and Nguyen 2020; Giri and Manohar 2021; Bhardwaj et al. 2021; Chengyue et al. 2021; Queiroz et al. 2021; Ullah et al. 2021; Kamble et al. 2021; Alazab et al. 2021; Kabir et al. 2021; Kumar et al. 2021; Shahzad et al. 2022; Hamdan et al. 2022; Pieters et al. 2022; Woo and Yoo 2022; Kumar et al. 2022; Prisco et al. 2022; Kumari and Devi 2023; Mukherjee et al. 2023.
	EE	Ease of use of the system.	Kamble et al. 2019; Wong et al. 2020; Park 2020; Jain et al. 2020; Giri and Manohar 2021; Bhardwaj et al. 2021; Chengyue et al. 2021; Queiroz et al. 2021; Kamble et al. 2021; Alazab et al. 2021; Kabir et al. 2021; Shahzad et al. 2022; Hamdan et al. 2022; Pieters et al. 2022; Woo and Yoo 2022; Kumar et al. 2022; Prisco et al. 2022; Mukherjee et al. 2023.
	SI	The perception that people who are important to the individual want to use the new system.	Queiroz and Wamba 2019; Kamble et al. 2019; Park 2020; Tran and Nguyen 2020; Queiroz et al. 2021; Ullah et al. 2021; Alazab et al. 2021; Kabir et al. 2021; Shahzad et al. 2022; Pieters et al. 2022; Woo and Yoo 2022; Prisco et al. 2022; Kumari and Devi 2023; Mukherjee et al. 2023.

	FC	The belief that organizational and technical infrastructures will support the use of the system.	Queiroz and Wamba 2019; Wong et al. 2020; Park 2020; Tran and Nguyen 2020; Queiroz et al. 2021; Alazab et al. 2021; Kabir et al. 2021; Shahzad et al. 2022; Mukherjee et al. 2023.
UTAUT 2	HM	The pleasure that comes from the use of technology.	Sheel and Nath 2020; Pieters et al. 2022; Shahzad et al. 2022.
	PV	Cognitive trade-off between perceived benefit and cost.	Wong et al. 2020; Bhardwaj et al. 2021; Shahzad et al. 2022; Guan et al. 2023
IDT	RA	The degree to which an innovation is better than the practice it replaces.	Wong et al. 2020; Bhardwaj et al. 2021; Hashimy et al. 2022; Chittipaka et al. 2022; Nath et al. 2022; Guan et al. 2023.
	COM	The degree to which the innovation is consistent with the needs and current values.	Bhardwaj et al. 2021; Chittipaka et al. 2022; Nath et al. 2022; Hamdan et al. 2022; Kumari and Devi 2023; Guan et al. 2023.
	CX	The perceived difficulty of potential users' ease of use and innovation understanding.	Wong et al. 2020; Bhardwaj et al. 2021; Hashimy et al. 2022; Hamdan et al. 2022; Guan et al. 2023.
TOE	CP	The impact of competition on technology adoption.	Wong et al. 2020; Kamble et al. 2021; Chittipaka et al. 2021; Hashimy et al. 2022; Guan et al. 2023.
	PP	Partners effect on adoption.	Wamba et al. 2020; Chittipaka et al. 2022; Nath et al. 2022; Guan et al. 2023.
	RS	The effect of legal authority regulations on adoption.	Yang 2019; Wong et al. 2020; Bhardwaj et al. 2021; Li et al. 2021; Chittipaka et al. 2022; Nath et al. 2022; Pham and Nguyet 2023.
	TR	The organization's readiness for new technologies with all its resources.	Wong et al. 2020; Bhardwaj et al. 2021; Kamble et al. 2021; Mukherjee et al. 2023; Pham and Nguyet 2023; Guan et al. 2023.
	KS	Gaining knowledge about the use of new technologies.	Wamba et al. 2020; Chengyue et al. 2021; Nath et al. 2022; Sun et al. 2022; Guan et al. 2023.
	ST	Stakeholders' trust in technology.	Queiroz and Wamba 2019; Alazab et al. 2021; Guan et al. 2023.
	TMS	The tendency of top management to adopt new technologies.	Wong et al. 2020; Bhardwaj et al. 2021; Hashimy et al. 2022; Chittipaka et al. 2022; Nath et al. 2022; Wamba and Queiroz 2022; Hamdan et al. 2022.
	BCT	General trust in technology.	Queiroz and Wamba 2019; Wong et al. 2020; Chengyue et al. 2021; Queiroz et al. 2021; Alazab et al. 2021; Kabir et al. 2021; Chittipaka et al. 2022; Nath et al. 2022; Mukherjee et al. 2023.
	TRAN	The expectation of BC to bring transparency.	Queiroz and Wamba 2019; Tran and Nguyen 2020; Wamba et al. 2020; Iranmanesh et al. 2023.

On the other hand, Figure I proposes a new framework after evaluating the studies. Here, different from the literature, we generated a new group named "user-related factors" to expand and contribute to general knowledge. In another words, variables grouped under user-related factors have been suggested by TPB, UTAUT, and UTAUT 2 reflecting the characteristics of individual users, but never conceptualized and examined by conducting meta-analysis. Therefore, this study conceptualizes HM, PBC, ATT, and SI as user-related factors. In addition, we integrated TPB, UTAUT, UTAUT 2, and TOE frameworks to indicate

adoption behavior at the organizational level. Accordingly, the research hypotheses are defined and discussed.

Figure 1: BC technology adoption framework



Technology factors

Facilitating conditions (FC) were first introduced by the UTAUT to explain technology adoption by describing one of the .technological aspects that can be used to advance general knowledge. FC primarily refers to the fact that organizations are aware of their resources for implementing and promoting new technologies (Alazab et al., 2021). In some instances, FC may also reflect the optimistic beliefs of employees that the use of new technology will foster trust and transparency within the system and assist them in tracking products (Mukherjee, Baral, Lavanariya, Nagariya, Patel, and Chittipaka, 2023). In other words, FC encompasses both organizational readiness and influential support for technology adoption (Kabir and Islam, 2021). Considering BC adoption in supply chains, prior research has supported the positive impact of FC on BC adoption intention (Queiroz and Wamba, 2019; Queiroz, Fosso, Bourmont, and Telles, 2021; Shahzad, Zhang, Khan, Ashfaq, and Hafeez, 2022). Thus, related hypotheses is as follows:

H1: *There is positive relationship between FC and BC adoption intention.*

Relative advantage (RA) is derived from IDT and represents the superiority of the target technology in comparison to other technologies. Consequently, BC technology offers several significant benefits, including transaction tracking, data integrity, verifiable records, and transparency (Bhardwaj, Garg, and Gajpal, 2021). Organizations appear to be aware of these benefits, but uncertainty, risks, and cost may prevent them from implementing BC technology (Hashimy, Jain, and Grifell-Tatjé, 2023). However, BC technology has been found to play a crucial role in supply chains (Nath, Khayer, Majumder, and Barua, 2022; Wong, Leong, Hew, Tan, and Ooi, 2020a), thereby enhancing productivity and performance (Chittipaka et al., 2022). Thus, related hypotheses is as follows:

H2: *There is positive relationship between RA and BC adoption intention.*

Complexity (CX) refers to the difficulty of comprehending the technology at hand. Considering the significance of CX, organizations can sometimes place greater emphasis on the advantages of the new technology (Guan, Ding, Zhang, Verny, and Hao, 2023). CX should be considered seriously when implementing such complex technologies as BC, especially for businesses that may lack sufficient capital, resources, and experience (Hamdan, Aziguli, Zhang, Sumarliah, and Usmanova, 2022). In addition, there is evidence that the degree to which businesses perceive BC to be too complex has a negative impact on their adoption intention (Bhardwaj et al., 2021; Hashimy et al., 2023). According to the research and evidence, we anticipate that CX has a negative correlation with adoption intention. Related hypotheses is as follows:

H3: *There is negative relationship between CX and BC adoption intention.*

Compatibility (COM) indicates the extent to which the new technology meets the requirements of the organization, taking into account all available resources. COM can play a crucial role by fostering a positive attitude toward BC technology, as it is a reliable predictor of the perceived total benefits of BC adoption (Kumari and Devi, 2023). Thus, it is anticipated that COM will have a significant impact on the intention to adopt BC when organizations determine that BC technology will be compatible with their procedures, values, policies, and overall system (Nath et al., 2022). Finally, the literature appears to support the positive effect of COM on BC adoption in various supply chain studies (Chittipaka et al., 2022; Guan et al., 2023). Therefore, related hypotheses is as follows:

H4: *There is positive relationship between COM and BC adoption intention.*

BC Trust (BCT) denotes that BC technology is able to deliver on its promises and fulfill its responsibilities. Scholars have recently focused on BCT because trust in technology may be related to other factors that explain BC adoption behavior (Chengyue, Prabhu, Goli, and Sahu, 2021). BC technology

enables businesses to maintain their documents, transactions, and contracts, thereby resolving related issues and developing trust (Mukherjee et al., 2023). This facilitating function of BC may guarantee BCT (Nath et al., 2022), resulting in flexibility and innovation supported by the top managers (Chittipaka et al., 2022). BCT appears to be one of the most important factors in this regard (Queiroz et al., 2021). Therefore, related hypotheses is as follows:

H5: *There is positive relationship between BCT and BC adoption intention.*

Performance Expectation (PE) is one of the most frequently used factors in the literature (Ullah, Al-rahman, and Alkhalifah, 2021; Wamba and Queiroz, 2022; Pieters, Kokkinou, and Kollenburg, 2023; Giri and Manohar, 2023) pertaining to the advantages of utilizing BC technology. These benefits can be both functional (convenient transaction, data integrity, automation, traceability, etc.) and social (in terms of value creation), thereby strengthening the adoption intention (Behl, Sampat, Pereira, Jayawardena, and Laker, 2023). PE is the strongest predictor of BC acceptance compared to other variables, according to the majority of studies (Kamble, Gunasekaran, Kumar, Belhadi, Foropon, 2021; Woo and Yoo, 2023). The integration of BCT and PE raises the bar for BC adoption intention, as these two constructs are highly correlated (Kumar, Upreti, and Mohan, 2021). Finaly, related hypotheses is as follows:

H6: *There is positive relationship between PE and BC adoption intention.*

Effort Expectancy (EE) is a UTAUT factor, but as mentioned previously, it is identical in nature to the PEoU of TAM, indicating the perceived ease of use of the target technology (Pieters et al., 2022). While the direct and positive effect of EE on BC adoption intention has been extensively reported (Chengyue et al., 2021; Giri and Manohar, 2023), EE can also facilitate trust and PE (Kumar et al., 2021), thereby increasing adoption intention (Queiroz et al., 2021). Following the literature, related hypotheses is as follows:

H7: *There is positive relationship between EE and BC adoption intention.*

BC Transparency (TRAN) refers to the visibility of all operations offered by a model whereby organizations report and disseminate their actions throughout the entire supply chain (Queiroz and Wamba, 2019). TRAN enables businesses to conduct more efficient transactions and maintain a current supply chain (Tran and Nguyen, 2021). TRAN is a strong enabler of BC adoption, based on its benefits and organizations' attitudes towards it, according to studies (Wamba, Queiroz, and Trinchera, 2020; Iranmanesh, Maroufkhani, Asadi, Ghobakhloo, Dwivedi, and Tseng, 2023). In addition, supply chain networks typically lack transparency, which creates uncertainty among members of the chain (Queiroz and Wamba, 2019).

Therefore, supply chains require the incorporation of technologies such as BC to mitigate these issues. Here, related hypotheses is as follows:

H8: *There is positive relationship between TRAN and BC adoption intention.*

BC technology, with its prospective instruments, is a candidate technology for addressing security (SEC) issues such as cyber concerns, data privacy, fraud, and transactional trust (Chittipaka et al., 2022). If organizations have confidence in BC technology and perceive fewer hazards when adopting BC, SEC can be highlighted as one of the most significant variables influencing organizations to implement BC technology (Kumar et al., 2022). Without data integrity and security, supply chain transactions may not be conducted, resulting in massive disruptions (Kamble et al., 2021). Despite the benefits of BC technology, organizations may still have security concerns, which may hinder their adoption efforts (Bhardwaj et al., 2021). However, we believe that BC technology has attracted managers and convinced them to implement this technology. Therefore, related hypotheses is as follows:

H9: *There is positive relationship between SEC and BC adoption intention.*

User related factors

Hedonic Motivation (HM) is one of the UTAUT 2 factors that represent the end-users feelings of joy or fulfillment after utilizing the target technology. However, HM is not particularly prevalent in BC acceptance studies, as we were only able to find a few. Sheel and Nath (2020) are one of these studies, and they discovered that HM has a significant influence on the BC adoption intention in the Indian context. Whether used for professional or personal purposes, BC utilization that provides users with pleasure and enjoyment is anticipated to increase adoption intention (Pieters et al., 2022). In addition, Shahzad et al. (2022) have already determined that HM affects the intention to adopt BC technology. Accordingly, related hypotheses is as follows:

H10: *There is positive relationship between HM and BC adoption intention.*

Perceived Behavioural Control (PBC) is one of the TPB factors, and we regard it to be user-related because it reflects the user's perception of the technology's simplicity of adoption. Therefore, PBC can be combined with adoption intention to predict multiple actions, as PBC is dependent on users' understanding of their capacity to carry out the target action (Ullah et al., 2021). Recent research indicates that PBC is a strong predictor of the intention to implement BC (Kamble et al., 2019; Prisco et al., 2022). This could be the result of simple access, user training, and assistance from professionals (Kumari and Devi, 2023), which

give users the impression that they can easily control and utilize BC technology. Following these implications, related hypotheses is as follows:

H11: *There is positive relationship between PBC and BC adoption intention.*

Attitude (ATT) is a well-established predictor of behavioral intention, which is supported by research in the context of BC adoption (Kamble et al., 2019; Jain et al., 2020; Prisco et al., 2022; Kumari and Devi, 2023). ATT can be defined as users' favorable or unfavorable attitudes toward performing the objective behavior. ATT can demonstrate users may comprehend the significance of adopting BC technology (Mukherjee et al., 2023). Finaly, we present related hypotheses as follows:

H12: *There is positive relationship between ATT and BC adoption intention.*

Social Influence (SI) indicates that a user's decision to utilize the target technology may be influenced by his or her social environment. Studies have demonstrated that at the organizational level, SI has a significant impact on the intention to embrace BC technology (Queiroz and Wamba, 2019; Queiroz et al., 2021). Shahzad et al. (2002) state that potential users may search out information to increase their awareness and exert some pressure to employ BC technology. When individuals value the opinions of others, such as family, colleagues, or friends, their intention to adopt BC technology may increase (Mukherjee et al., 2023). Finaly, related hypotheses is as follows:

H13: *There is positive relationship between SI and BC adoption intention.*

Environmental factors

According to the TOE framework, Regulatory Support (RS), Partner Pressure (PP), and Competitive Pressure (CP) are effective environmental factors in BC adoption (Chittipaka et al., 2021; Pham and Nguyet, 2023; Guan et al., 2023). Even though regulatory standards have been identified as a barrier to the implementation of new technologies in some instances (Li et al., 2021), CP has always been viewed as a staunch supporter of BC acceptance (Yang, 2019) to avoid falling behind the competition. In addition, trading partners, such as suppliers and retailers, can compel organizations to implement new technologies because they are on the same team in the competition, and the expertise of trading partners can also initiate a situation like this (Wamba et al., 2020). Thus, related hypotheses are as follows:

H14: *There is positive relationship between RS and BC adoption intention.*

H15: *There is positive relationship between PP and BC adoption intention.*

H16: *There is positive relationship between CP and BC adoption intention.*

Organizational factors

TOE framework provides more organizational factors, including Technology Readiness (TR), Knowledge Sharing (KS), Stakeholders Trust (ST), Top Management Support (TMS), and Perceived Cost (PC). Wamba and Queiroz (2022) assert that TMS is the primary enabler for organizations to adopt new technology, given that their culture and perspective influence such decisions. TR has been demonstrated to be an important indicator (Wong et al., 2020; Pham and Nguyet, 2023), reflecting the organization's adequate resources, culture, expertise, employees, and experience in incorporating new technology. KS has also attracted the attention of academics because KS between partners or through the organization increases trust in BC technology (Nath et al., 2022; Guan et al., 2023), sustainable chain performance (Sun, Shahzad, and Razzaq, 2022), and BC adoption intention (Wamba et al., 2020). PC can be viewed as an obstacle to adopting new technologies (Shahzad et al., 2022); however, some studies indicate PC can increase BC adoption intention (Guan et al., 2023) when ST towards BC technology (Queiroz and Wamba, 2019; Alazab et al., 2021) and other factors are involved. Thus, related hypotheses are as follows:

H17: *There is positive relationship between TR and BC adoption intention.*

H18: *There is positive relationship between KS and BC adoption intention.*

H19: *There is positive relationship between TMS and BC adoption intention.*

H20: *There is positive relationship between ST and BC adoption intention.*

H21: *There is positive relationship between PC and BC adoption intention.*

RESULTS

Four tables containing technology, user-related, environmental, and organizational factors are used to present the results of the meta-analysis, covering 38 selected papers. In the tables, CI-LB and CI-UB represent the lower and upper limits, respectively. Here, Table II displays the technological factors that influence the intention to adopt BC. FC appears to be the most influential variable (r= 0.787, p.001***), followed by COM (r= 769, p.001***), surpassing the most significant variables PE (r= 0.705, p.001***) and EE (r= 0.533, p.001***). All hypotheses with the exception of H3 (CX) are accepted. According to Q and I^2 values, determining the degree of heterogeneity across all studies, except for SEC (I^2= 36.7%), the remaining studies demonstrate that heterogeneity is provided as I2 exceeds the 70% acceptable limit

(Mishra et al., 2023). It can also be inferred that study results can provide variation that is not due to coincidence. Finaly, as the failsafe N values are anticipated to be greater than 100, all meta-analysis relationships, except for CX and BC adoption intention, indicate that the results are positive and robust.

Table 2: Meta-analysis results for BC technology adoption technology drivers

Drivers	H(s)	r+	N	k	se	Z	p	CI LB	CI UB	Q	I^2%	Fail-safe N
FC	H1	0.787	2574	10	0.076	10.4	<0.001	0.639	0.936	140.72	92.8	5956***
RA	H2	0.698	1979	6	0.115	6.05	<0.001	0.472	0.924	120.58	95.9	2064***
CX	H3	0.034	1507	5	0.186	0.183	NS	0.331	0.399	166.40	97.9	NS
COM	H4	0.769	2237	6	0.132	5.81	<0.001	0.510	1.028	194.51	97.3	2726***
BCT	H5	0.616	3413	10	0.060	10.2	<0.001	0.497	0.735	139.02	91.4	4236***
PE	H6	0.705	6858	26	0.089	7.86	<0.001	0.529	0.880	1187.8	98.1	32940**
EE	H7	0.533	4616	18	0.052	10.1	<0.001	0.430	0.636	242.59	91.8	8359***
TRAN	H8	0.776	1512	5	0.083	9.27	<0.001	0.612	0.940	38.780	90.2	1694***
SEC	H9	0.260	1238	4	0.037	7.02	<0.001	0.187	0.332	5.0570	36.7	115***

Note: <0.001***, <0.005**, <0.01*, NS= not supported.

According to Table III, ATT (r= 0.830, p<.001***) is the most significant variable among others as expected in terms of BC adoption intention. All hypotheses are accepted (H0-H13), and I^2 values also suggest that heterogeneity is assesed. Again fail-safe N values prove that there is no publication bias.

Table 3: Meta-analysis results for BC technology adoption user related drivers

Drivers	H(s)	r+	N	k	se	Z	p	CI LB	CI UB	Q	I^2%	Fail-safe N
HM	H10	0.459	857	3	0.107	4.27	<0.001	0.248	0.669	19.719	89.6	185***
PBC	H11	0.652	1198	5	0.069	9.52	<0.001	0.518	0.787	20.780	81.6	903***
ATT	H12	0.830	1797	8	0.123	6.77	<0.001	0.590	1.070	164.94	96.2	3592***
SI	H13	0.597	4096	15	0.080	7.38	<0.001	0.439	0.756	310.04	96.1	8641***

Note: <0.001***, <0.005**, <0.01*, NS= not supported.

CP is leading variable (r= 0.821, p<.001***) among other environmental variables (Table IV). While RS can not assess heterogeneity, all variables indicate no publication bias regarding fail-safe values.

Table 4: Meta-analysis results for BC technology adoption environmental drivers

Drivers	H(s)	r+	N	k	se	Z	p	CI LB	CI UB	Q	I^2%	Fail-safe N
RS	H14	0.258	2369	8	0.030	8.56	<0.001	0.199	0.317	13.135	47.8	417***
PP	H15	0.759	2542	4	0.235	3.23	<0.001	0.298	1.220	435.17	99.3	2275***
CP	H16	0.821	1325	5	0.134	6.12	<0.001	0.558	1.083	126.04	96.8	1994***

Note: <0.001***, <0.005**, <0.01*, NS= not supported.

Finaly, Table V presents organizational drivers of BC adoption intention. Reults point that KS is an important driver (r= 0.836, p<.001***) followed by ST (r= 0.814, p<.001***). All hypotheses are accepted (H17-H21), providing heterogeneity (>70%) and no publication bias (fail-safe values> 100).

Table 5: Meta-analysis results for BC technology adoption organizational drivers

Drivers	H(s)	r+	N	k	se	Z	p	CI LB	CI UB	Q	I^2%	Fail-safe N
TR	H17	0.655	1934	6	0.065	10.1	<0.001	0.528	0.783	35.515	86.8	1774***
KS	H18	0.836	2355	5	0.245	3.41	<0.001	0.356	1.315	548.10	99.3	3560***
TMS	H19	0.542	2553	8	0.081	6.69	<0.001	0.383	0.701	104.06	93.8	2183***
ST	H20	0.814	1816	4	0.125	6.52	<0.001	0.569	1.059	93.164	96.4	1802***
PC	H21	0.280	1291	4	0.129	2.16	<0.031	0.026	0.533	42.677	94.8	119***

Note: <0.001***, <0.005**, <0.01*, NS= not supported.

DISCUSSION

The purpose of this study is to investigate the effects of each driver on BC adoption by combining them and generalizing the resulting relationships. Consequently, we performed a meta-analysis by calculating the corrected correlations of each relationship across multiple samples and contexts. To expand the TOE framework and our general knowledge, we also created a new group titled user-related factors. We defined and tested 21 hypotheses consisting of technology, user-related, environmental, and organizational factors, which were derived from 38 empirical studies, and their impact on the intention to adopt BC. Technological characteristics may be regarded as the most influential factors, but our findings demonstrate otherwise, making them novel contributions. In this section, we discuss the theoretical and practical implications of our findings.

CX is the only technology factor-related hypothesis that cannot be supported. There could be several reasons for this situation. For instance, Hashimy et al. (2023) discovered that the degree to which users

perceive BC technology to be complicated decreases the intention to adopt it. In addition, Guan et al. (2023) assert that CX is not a significant indicator of BC adoption. Thus, it can be concluded that there is no consistency between studies, rendering the effect of CX on BC intention insignificant in our study. Our findings also demonstrate the importance of FC, which has a greater impact than PE and EE, contrary to the claim of Venkatesh et al. (2012) that PE is the most influential variable in explaining technology adoption behavior. Shahzad et al. (2022) and Kabir et al. (2021) are the only studies that corroborate our conclusion. The effect size of FC is also more than that reported by Mishra et al. (2023), who found FC to be relatively small compared to the effect sizes of other technical factors. It can be inferred that FC is prioritized by organizations that place a premium on a robust infrastructure and system for implementing BC technology.

TRAN demonstrates, contrary to the literature, that its significance in terms of BC adoption intention is the second most essential technology factor. Even Queiroz and Wamba (2019) were unable to identify a significant effect of TRAN on the intent to adopt in BC. However, another meta-analaysis study conducted by Mishra et al. (2023) supports our findings as the study indicates that TRAN is the most important technological factor. TRAN is a prominent factor in providing resilience and preventing disruptions to operations, and it appears to be a crucial variable based on the total sample size (N= 1512). A new contribution is that COM is an important technology factor, suggesting that organizations give priority to ensuring that BC technology is compatible with their systems, cultures, values, and employees' expertise.

ATT is already recognized as the most important predictor of behavioral intention. In the context of BC acceptance, ATT is the second most effective variable among all others. This finding supports the conclusion of Ullah et al. (2021) that ATT has the greatest impact on BC technology adoption intention. The significance of ATT indicates that consumers must have positive feelings about BC technology prior to forming adoption intentions. In addition, we discuss the positive effects of PBC, HM, and SI. Positive perception of control over the BC increases the intention to adopt (Kamble et al., 2019; Mukherjee et al., 2023). Users appear to take pleasure in utilizing new technologies (Sheel and Nath, 2020; Pieters et al., 2022), and their social environment influences their decision to implement BC (Queiroz and Wamba, 2019; Woo and Yoo, 2022). While the significance of ATT compared to other variables is a novel discovery, our findings regarding PBC, HM, and SI support previous research.

CP and PP are significant environmental variables due to their major impact on BC adoption intention. The competition in the market compels businesses to implement new technologies to enhance their existing systems. On the other hand, business partners, particularly suppliers, guide businesses in terms of BC technology adoption. However, the relatively minimal impact of RS may explain why regulatory support for the adoption of new technologies is insufficient.

Our findings demonstrate that organizational factors play a significant role in the adoption of BC technologies. KS is the primary variable because it has the greatest influence on BC adoption when analyzing all of the relationships. The perception that the initial trading partner does not use the information for its benefit, which is supported by the effect of ST on adoption intention, may foster trust between trading partners. In addition, sharing experiences with new technologies will assist other organizations in adopting the intended technology. In contrast, PC does not appear to have a major impact on BC adoption decisions, which is also consistent with Mishra et al. (2023)' findings. It can be inferred that managers consider other ascpects of BC technology when deciding to adopt. While TR plays an essential function in this respect, TMS remains behind other organizational factors, which contradicts the findings of Mishra et al. (2023) showing that TMS is a prominent factor considering its effect size. Our findings suggest that considering different contexts or industries, TMS's effect on BI highly differs.

Theoretical Implications

Regarding the study's findings, we make numerous contributions to the theory. Initially, we propose a new category titled "user-related factors" that includes HM, SI, PBC, and ATT. Therefore, this study broadens the original TOE framework. With this novel framework, 21 antecedents of BC adoption were taken into account, constituting the most extensive review to date. In this regard, we believe we contribute to general knowledge by collecting and analyzing a large number of variables compared to previous research.

Second, we discuss the various effects of antecedents on the adoption of BC in supply chains. KS (r= 0.836, p.001***) is the most influential variable among the overall findings, overlapping with those of Nath et al. (2022), followed by ATT (r= 0.830, p.001***) and CP (r= 0.821, p.001***). This suggests that both internal and external KS enhance the intention to adopt. As BC technology is relatively new and complex, it is essential for enlightening potential adopters. ATT was identified as another prominent antecedent. ATT increases BC adoption intention, indicating that prospective users have developed favorable sentiments toward BC technology, likely as a result of their prior exposure to various technologies. Findings also indicate that organizations are compelled by competition to implement new technologies such as BC. CP is the third strongest antecedent and demonstrates how innovations and new technological systems position businesses at the forefront of competitive markets. In such an environment, businesses must be adaptable, autonomous, and resilient to avoid being affected by abrupt changes, and BC technology is a candidate for providing these advantages.

Practical Implications

Finally, this study has implications for practice. Organizational factors significantly influence the adoption intentions of BC technology. The findings suggest that managers should be prepared for the implications of new technologies and motivate their organizations to make changes. Additionally, TR suggests that organizations should configure and adapt all of their sources for new technologies. Before determining BC implementation, it appears that managers should also consider the expectations of their partners. On the other hand, the findings suggest that managers should listen to their surroundings. Managers appear to value the advice of others when deciding whether to adopt BC.

LIMITATIONS AND RESEARCH AGENDA

This study is not devoid of some limitations. The first limitation pertains to the quantity of databases employed for paper retrieval. While WoS, Scopus, and Google Scholar are widely recognized and comprehensive databases, there are other databases that may offer supplementary resources. Second, the exclusion of relevant articles such as book chapters, unpublished articles, and proceedings papers is a significant limitation of this study. Even though we adhered to certain exclusion criteria, these sources may have had an impact on the results.

Due to meta-analysis, we were only able to investigate bivariate relationships between structures. However, our findings indicate that some surprising relationships should be investigated in a more complex and systematic manner. In this direction, new antecedents can be considered because the nature of BC adoption intention is complex. Meta-analysis structural equation modeling (Meta-SEM) is the one appropriate technique for analyzing such complex relationships. Using this method, scholars can benefit from large data samples and investigate each variable by focusing on its antecedents. Mediation analysis is also possible with Meta-SEM. Researchers can determine which variables interact and which variables transform insignificant relationships into significant ones.

AUTHOR STATEMENT

The researchers reported that the first author contributed 60% and the second author contributed 40% to the article. Researchers have not declared any conflict of interest.

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