An empirical study on factors impacting the adoption of digital technologies in supply chain management and what blockchain technology could do for the manufacturing sector of Bangladesh

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Abstract

This paper employed an integrated model for examining behavioral intention to adopt blockchain technology in the supply chain management of manufacturing industries in Bangladesh. The proposed conceptual model was empirically tested using data collected from 189 supply chain managers working in manufacturing organizations in Bangladesh. The findings suggest that perceived usefulness, trading partners' pressure, and competitive pressure are the most important determinant of behavioral intention.

Keywords: TAM-TOE; Blockchain technology; Covid-19; Supply chain management

1. Introduction

The supply chain (SC) network consists of several supply chain members and to maintain coordination among all silos, it is necessary to enhance the efficiency of the whole network (Asgari et al., 2016). The traditional supply chain management (SCM) process has several problems regarding information flow, capital flow, tampering with information, tracing logistics, etc., which creates enhanced opportunity costs. Hence it becomes a requirement to shift from traditional SCM processes to more digitized ones. In this context, the 4th industrial revolution (IR 4.0) is an unparallel one, which comprises several technologies such as cloud computing, big data, the internet of things (IoT), blockchain technology (BCT), and, cyber-physical system (CPS). Among all, the emergence of blockchain technology helps to enhance supply chain performance by solving a series of problems (Agi and Jha, 2022; Wu and Zhang, 2022). Blockchain technology is one, which can provide a shared IT infrastructure to maintain smooth workflow and information flow among all partners of SC. During the Covid-19 pandemic, global SCM has gone through huge disruption. Every silo of SC has faced some challenges due to several reasons as consumer demand shifting towards online, labor shortages in manufacturing sites, and trade bans causing supply shortages (Lin and Lang, 2020; Linton and Vakil, 2020; Rowan and Laffey, 2020). In developing countries like Bangladesh, the port's activities become very limited in such a situation and as a result, the necessary imported materials could not reach at destination in a timely manner. As a result, large business entities in this country have faced disruptions in their regular SC activities (The businesses standard, 2020). Consequently, governments and business entities have started thinking of adopting and implementing digitization such as blockchain technology (BCT) to develop the current SC process, especially in the post-Covid-19 era. BCT has distributed ledger that has a shared database which led to immutability, traceability, security (Wu and Zhang, 2022), integrity, and easy data retrieval (Khan et al., 2022). This sort of system ensures a safe and secured data transaction and creates trust among all authorized entities (Tasnim et al., 2022a) such as logistic providers, suppliers, manufacturers, distributors, retailers, and end customers. Through a BCT-driven SCM system, source and destination can be traced, and any deviation of data or any risks can be traced and controlled (Wu and Zhang, 2022).

A firm can search for more innovative technologies to improve its supply chain. It can become more responsive and efficient with an effective supply chain process (Kamble et al., 2020). Lately, traditional supply chains have gone through various problems regarding transparency, product traceability, and accountability (Min, 2019; Mangla et al., 2018). According to Hewett et al. (2020) blockchain is considered one of the six megatrends that are going to shape up and can bring huge improvements to SC processes (Kamble et al., 2018; Kamble et al., 2020).

Recently, the Covid-19 pandemic created a huge challenge in supply chain activities in various industries (Tasnim et al., 2022b; Singh et al., 2021; Kapoor et al., 2021; Golan et al., 2020; Haren et al., 2020). Hence the industries require strong supply chain processes (Remko, 2020; Iyengar et al., 2020) by adopting more innovative technologies (Wamba et al., 2020). Blockchain technology is the most discussed one among digital technologies because of the benefits it offers over traditional supply chain management processes (Kshetri, 2018; Shareef et al., 2020) and provides a sustainable SCM process (Yousefi and Tosarkani, 2022). BCT can bring cost savings; fewer intermediaries are involved in the process and ensure a better tracking process.

BCT has a unique data structure, where each block contains a cryptographic hash of the previous block, timestamp, and multiple transactions. For every new transaction, a new block is created linked with the prior one, and stored in the distributed ledger (Aslam et al., 2021). When a transaction is added to the system, a decentralized consensus is used instead of a centralized one. Moreover, BCT enhances the whole SCM process by providing the opportunity for direct interaction within all involved entities and each tamper-proof data. In addition, BCT based system enables better tracking and all information about the origin of the product is visible to all authorized entities, so the authenticity of information and product through the supply chain network is ensured. BCT-based systems use cryptography hash functions and are tamper-proof in nature and therefore can verify any transactions automatically. Therefore, it is a very complicated and expensive process to alter any information that is stored in the system (Azim, 2019; Esmaeilian et al., 2020). All transactions can be highly cross-checked based on the characteristics of the blockchain, thereby ensuring the high reliability of transaction information (Aslam et al., 2021; Wu and Zhang, 2022).

In developed countries, the industries have skilled resources, better training facilities, technology, and infrastructure support to adopt digital technologies such as blockchain. Also adopting BCT benefited the industry sectors in gaining cost-effectiveness, fewer intermediaries, better record-keeping, safe transactions, and safe digital platforms in developed countries. But blockchain has not been widely adopted in developing countries. These countries are still struggling with this technology's adoption. The main reasons behind this are the lack of in-house skills and the lack of training facilities in technology. Many companies have less knowledge about technology adoption and lack expert skilled workers as well. Additionally, some organizations face different obstacles to adopting BCT such as regulatory issues, lack of industry structure, and lack of infrastructure and technology support. Though few sectors in developing economies are adopting BCT for better supply chain performance, it may take around 4-5 years to completely adopt BCT by most industries. So, there is room for further studies in developing country context in terms of BCT adoption considering different industry sectors (Kumar et al., 2019). Moreover, Saif et al. (2022), highlighted several challenges of adopting BCT in developing countries that include technological, governance, organizational, environmental, and knowledge-related challenges. Despite having many obstacles, BCT can be beneficial for developing countries and help to overcome the loopholes of the traditional SCM process. Moreover, BCT adoption can help to achieve efficient operations and economic growth and enhance performance in multiple sectors. Therefore, it is necessary to sort out the factors that impede the adoption of BCT in developing countries

During the Covid-19 pandemic, it was challenging to maintain coordination through the supply chain network. Product flow and information flow tracking become critical as due to the pandemic the world was facing lockdown more or less everywhere. Hence the authenticity of the source, products, and information was questionable as it was not possible to track everything physically (Tasnim, 2020; Choi et al., 2020). As a consequence, maintaining transparency and tracking becomes a big challenge for many companies. Especially developing countries faced a lot of challenges in this regard because most of the companies in developing countries were doing all supply chain-related activities manually. Whereas most companies in developed countries have already applied digitized technologies such as BCT. As a result, they faced fewer challenges during the Covid-19 pandemic as they could track everything digitally. Despite having many advantages, the intention to adopt blockchain within SCM is still in the nascent stage in many industrial sectors (Orji et al., 2020; Queiroz and Wamba, 2019).

Furthermore, more studies are available from a developed country perspective rather than a developing country context (Wong et al., 2020). Till now most of the studies are based on developing a conceptual framework (Min, 2019; Durach et al., 2020) and fewer studies are on empirical analysis, which is mainly based on the unified theory of acceptance and use of technology (UTAUT) (Queiroz and Wamba, 2019; Clohessy et al., 2019) and technology adoption model (TAM) (Kamble et al., 2018) and therefore, this study aims to consider the factors that are needed for determining the intention to adopt blockchain in a developing country context.

Considering the issues, this study aims to answer the following research questions:

RQ1: Which factors influence the intention of manufacturing industries to adopt BCT in SCM?

RQ2: Which factors have more impact on adoption intention?

RQ3: What are the barriers that impede the intention to adopt blockchain for SCM?

For the rest of the paper, Section 2 explains the concepts of BCT, how SCM is affected by the impact of Covid-19, and the underpinning theories. In Section 3, the development of hypotheses is described with the conceptual framework derived from the literature. Details of the research methodology are presented in section 4 which contains the population, sampling method, and data analysis process. Section 5 deals with a discussion based on analysis followed by the next sections on theoretical and managerial implications, conclusions, study limitations, and recommendations for future research.

2. Literature review

Global SCM processes are complicated (Kshetri, 2018; Shareef et al., 2019) and the recent pandemic situation for Covid-19 has revealed the fragility of traditional SCM processes (Haren et al., 2020). As a consequence, the requirement for more digitized supply chain processes arises and blockchain technology is the most discussed option in this context (Kshetri, 2018). The current section reviews the related existing literature.

2.1 Blockchain concepts in supply chain management

The covid-19 pandemic has created unrivaled damage in the SCM field (Wamba et al., 2020; Büyükozkan et al., 2018). The worldwide lockdown due to covid-19 pandemic has had a tremendous effect on manufacturing SC (Kapoor et al., 2021; Haren et al., 2020; Hobbs, 2020). Burgos and Ivanov (2021) highlighted that firms should address this issue and take measures to overcome this situation. Adopting digital technologies is the best option in this regard. Thus the need for a strong and sustainable supply chain, innovative approaches (Remko, 2020), and implementation of information and communication technology (Wamba et al., 2020; Frank et al., 2019; Chen, 2019; Schniederjans et al., 2020; Graça et al., 2017) has been focused, unlike traditional system. Conventional supply chains need to be maintained physically which needs a lot of intermediaries (Büyüközkan et al., 2018). Therefore, more digitized SCM based on blockchain is required (Kshetri, 2018; Queiroz and Wamba, 2019), cloud computing (Wong et al., 2020; Novais et al., 2019; Kochan et al., 2018), artificial intelligence (Baryannis et al., 2018) and big data analytics (Govindan et al., 2018).

BCT is one of those information and communication technologies (ICT) that can have the capability to reshape the supply chain process and provide an enhanced data security in various context (Dwivedi et al., 2022a; 2022b; Schuetz and Venkatesh, 2020; Azzi et al., 2019; Chang et al., 2019; Dolgui et al., 2020; Janssen et al., 2020; Helo and Hao, 2019; Longo et al., 2019; Schmidt and Wagner, 2019; Banerjee, 2018; Viryasitavat et al., 2018). BCT offers several benefits such as cost-effectiveness transparency, traceability, and sustainability (Thakur et al., 2020; Kshetri, 2018). Blockchain is a decentralized ledger that records all value transactions and information. The database is run by a network of computers called nodes, so there is no single point of failure, and information can be accessed in real time which ensures decentralization and transparency (Javaid et al., 2021). The traditional SCM processes are prone to several challenges and risks due to the pool of participants in the process. As many parties are involved, there is a possibility of fraud and there is a question of authenticity. In the BCT-based SCM system, all information is recorded and checked by multiple parties (Wu and Zhang, 2022) Because BCT is a distributed ledger that can be either decentralized or centralized and provide every specific user with special rights (Dutta et al., 2020). If Blockchain is designed such that verification of transactions is shared among multiple users, it is decentralized; if one central entity is the primary decision-maker, then it is centralized. In BCT based system, all data are stored in a shared database and all network participants have access to the distributed ledger. As the whole database is transparent to all parties involved, hence if any changes occur, it is notified to all authorized entities immediately. Thus, BCT based process is transparent, has less risk of fraud, and has privacy and security (Bumblauskas et al., 2020; Esmaeilian et al., 2020). According to Wu and Zhang (2022), trust is a crucial issue in supply chain management, and blockchain-based supply chain processes can provide trust in terms of information flow, logistics, and, capital flow. Nowadays, trust becomes a big issue among supply chain participants as nothing could be verified physically due to the lockdown. Hence, it was tough to verify sourcing information, and tracing product and information flow which can be overcome by blockchain technology.

Due to globalization, supply chain activities have become more complicated to maintain. Transactions, tracing products, and access to information become quite difficult (Aslam et al., 2021; Ivanov et al., 2019). BCT can be implemented to overcome these challenges (Kshetri, 2018). Moreover, the chances of cooperation among partners enhance (Aste et al., 2017). Furthermore, in the SCM, the intention to adopt blockchain can enhance customers' trust, provides transparency (Kshetri, 2018; Zou et al., 2018), traceability (Saberi et al., 2019), and minimize fraud activities (Chen et al., 2020; Chen, 2018; Lu and Xu, 2017), enhance cyber security (Kshetri, 2019), enhance safety and security (Niu et al., 2021), enhance information sharing (Wamba et al., 2020) and eventually reshape the global SCM (Hughes et al., 2019). In addition, blockchain incorporates sustainable activities, focuses on environmental activities, social issues protection, and social reforms, and revises existing supply chain systems (Munir et al., 2022; Tsai et al., 2021; Khanfar et al., 2021).

Although the intention to adopt blockchain drivers provides various benefits, the adoption intention of blockchain in the SCM context is not in an advanced stage despite having several benefits (Angelis and Silva,2019; Queiroz and Wamba, 2019), especially in underdeveloped countries. Moreover, few studies address barriers to BCT adoption intention (Wong et al., 2020). Since blockchain is in the infancy stage, extensive studies are required before the adoption of this technology. Till now most of the studies are based on developing a conceptual framework (Durach et al., 2021) and fewer studies are on empirical analysis based on the technology adoption model (TAM) (Kamble et al., 2018) and UTAUT model (Queiroz and Wamba, 2019; Clohessy et al., 2019). According to Joshi and Sharma (2022), the SCM process in developing countries faced huge challenges due to poor logistic and infrastructure support, less traceability, less tracking of product source and distribution, and less collaboration among SCM partners compared to those of developed countries. Therefore, changes are required to adopt digital technologies to become more flexible and overcome the challenges of traditional systems in developing countries.

2.2 Technology adoption model (TAM) and Technology, organization, and environment (TOE) model

An important contribution to technology adoption was created by Davis (1989) which is known as the technology adoption model (TAM). He initiated a model consisting of two fundamental variables named perceived usefulness (PU) and perceived ease of use (PEU). Later on, Venkatesh et al. (2003) mapped TAM and other adoption models to propose a new one named the unified theory of acceptance and use of technology (UTAUT). Performance expectancy, effort expectancy, social influence, and facilitating conditions are four fundamental variables of this theory. This model consists of four moderating variables as gender, age, experience, and voluntariness of use. UTAUT model has been extended as the UTAUT 2 model consisting of three constructs habit, hedonic motivation, and price value (Venkatesh et al., 2012), and many researchers have done research based on this model (Alalwan et al., 2017). Till now many researchers have applied TAM and UTAUT models for BCT adoption (Wamba et al., 2020; Zhou et al., 2020; Queiroz and Wamba, 2019; Kamble et al., 2018).

Queiroz and Wamba (2019) recently used UTAUT constructs in the Brazilian supply chain. The authors stated social influence as a strong determinant of performance expectancy, effort expectancy, and facilitating conditions to predict the intention for adopting blockchain. Moreover, in another research, Kamble et al. (2018) investigated that PEU is a strong predictor of PU for BCT adoption in the Indian SCM context by using the TAM model. Another study showed relative advantage, cost, complexity, and competitive pressure as strong predictors of behavioral intention to adopt BCT by applying the “Technology, Organization and Environment” (TOE) framework for Malaysian small-medium enterprises and other technology adoption studies (Kamble et al., 2021; Wong et al., 2020; Clohessy et al., 2019). So far, several studies are about developing a conceptual framework for technology adoption (Min, 2019; Francisco et al., 2018) and fewer studies are on empirical analysis based on the TAM model (Malik and Annuar, 2021; Kamble et al., 2018) and UTAUT model (Queiroz and Wamba, 2019; Clohessy et al., 2019). According to Kamble et al. (2020), integration of the TOE model with TAM can work better for behavioral intention. Moreover, as the TOE framework integrates technological, environmental, and organizational factors, this model can work better than other technology adoption models (Awa et al., 2017).

As such, more research is required to get a clear concept of the intention to adopt BCT in the SCM for less wealthy parts of the world (Wong et al., 2020; Aslam et al., 2021). In this issue, the integration of different technology adoption studies can offer the opportunity to better understand the concept of technology adoption (Queiroz and Wamba, 2019). Therefore, considering the above literature this study integrates two theories such as TAM and TOE as underpinning theories to build the conceptual framework for this study. According to Gangwar et al. (2015), the constructs of the TAM and TOE model vary across contexts and should be investigated for different contexts due to a lack of generalizability. According to Wong et al. (2020), the TOE model has been used in different techniques such as blockchain technology adoption studies widely and can be adopted in various conditions. Cause, the environmental, organizational, and technological factors will vary in different cultures and contexts. According to Kamble et al. (2021), various obstacles such as the capability of the current system, complexity, high cost, and less technically sufficient employees are several challenges that can occur during blockchain adoption. Hence these factors need to be analyzed from an institutional context to identify crucial factors which are required for adopting blockchain in the SCM.

Therefore, TAM and TOE model integration is crucial. As such previous studies using similar concepts were considered (Kamble et al., 2020; Wong et al., 2020), and following those studies, no variables are skipped from the models to build up the conceptual framework for this study. For this purpose, organizational factors, technological factors, and environmental factors from the TOE model and perceived usefulness (PU), perceived ease of use (PEU), and behavioral intention to adopt blockchain (BA) from the TAM model are incorporated to build the conceptual framework for this study.

3. Development of hypothesis and conceptual model

This study is based on TAM-TOE integration and has considered all constructs from the models such as relative advantage, technology readiness, complexity, organizational readiness, top management support, employees' knowledge, competitive pressure, and trading partner pressure from TOE and PU, PEU and BA from TAM. These constructs create the conceptual framework and hypotheses for the study.

3.1 Technological factors

Factors like a relative advantage, technology readiness, and complexity were considered to develop hypotheses. These factors are discussed below.

1) Relative advantage (RA)

Relative advantage is "the degree to which an innovation is perceived as being better than the idea it supersedes" (Kamble et al., 2020). Relative advantage is the difference between the benefits an organization can achieve and the effort needed to adopt a technology (Wong et al., 2020). Relative advantage plays a vital role in technology adoption in the SCM (Bhattacharya et al., 2018). Adopting technologies like blockchain can provide many benefits in the SCM process including accountability, transparency (Kshetri, 2018; Zou et al., 2018), traceability (Helo and Shamsuzzoha, 2020), security (Rahmanzadeh et al., 2019; Xu et al., 2018), trust (Reyna et al., 2018), fraud prevention (Chen, 2019), confidence (Lu and Xu, 2017), and cost-effectiveness (Roeck et al., 2019). The transparency of a system enhances productivity and improves customer service and support (Werner et al., 2021). Several prior studies showed a significant relationship between relative advantage with both TAM constructs (Kamble et al., 2020; Davis, 1989). Therefore, on the ground of the above references, the first hypothesis was created:

H1: Relative advantage has a significant impact on perceived usefulness.

2) Technology readiness (TR)

Technology readiness is an organization's ability to provide proper guidance for technology implementation and operations. Technology adoption can be a challenge without sufficient knowledge and awareness about technology (Kamble et al., 2020). If existing technology is combined with existing resources, then the productivity of a system can be improved. Thus, a system becomes more useful. The usefulness of any technology depends on factors like applications, use, and generation (Wong et al., 2020). Technology readiness impacts the PU of technology. Users find technology easy to use and less complicated if users have technology-related knowledge (Kamble et al., 2020). Therefore, the following hypotheses were created:

H2a: Perceived ease of use is significantly influenced by technology readiness.
H2b: Perceived usefulness is significantly influenced by technology readiness.

3) Complexity (COMP)

Complexity in technology refers to the struggle toward learning, using, and implementing technology. Any complicated and complex technology is difficult for users to use and understand which eventually negatively affects the adoption tendency of that technology (Wong et al., 2020). It is evident from past studies that there is a strong correlation between technology adoption and the simplicity or difficulty in fusing that technology (Alwan et al., 2017; Dwivedi et al., 2017). BCT has some technical complexity and consequently, this technology needed to be integrated into existing systems to get its full benefits. Blockchain's transaction mechanisms and scalability are complex operations and according to perceived complexity, complexity level remarkably influences both PEU and PU (Saberi et al., 2019). Therefore, the third hypothesis was created:

H3: Perceived usefulness is significantly influenced by complexity.

3.2 Organizational factors

Top management support, organizational readiness, and employees' knowledge were considered as organizational factors in this study to develop hypotheses. These factors are discussed below.

1) Organizational readiness (OR)

Organizational factors refer to the fact that an organization possesses the technical and financial ability and competency to adopt new technology (Wong et al., 2020). Organizational factors are positively influenced by the PU of technology (Kemble et al, 2020). Internal capability, as well as inter-organizational readiness, plays a crucial role. Digital technologies such as blockchain technology are adopted in an inter-organizational context to enhance the overall performance of an organization in terms of traceability, reduced and reliable transactions, and the creation of trust (Werner et al., 2020). However, therefore, the fourth hypothesis was created:

H4a: Organizational readiness significantly influences perceived usefulness.
H4b: Organizational readiness significantly influences perceived ease of use.

2) Top management support (TMS)

Upper management support is defined as what top management perceives about the significance of adopting blockchain (Wong et al., 2020). Management support is crucial for technology adoption intention and implementation decisions. Conversely, upper management adoption decision depends on the fulfillment of desired output (Dubey et al., 2018). Management support is usually contingent upon a few factors such as overcoming any barrier and creating an environment of innovation and commitment. Top management support influences the PEU and PU (Kamble et al., 2020). Therefore, the fifth hypothesis was created:

H5: Top management support significantly influences perceived usefulness.

3) Employees' knowledge (EK)

Employees' knowledge and skills are important factors in adopting new technology. A lack of skilled human resources can create a hindrance to adoption intentions (Kamble et al., 2018). It is necessary to train people in an organization to operate and recognize the usefulness of blockchain technology better (Kamble et al., 2020). Therefore, the sixth hypothesis was created:

H6: Perceived usefulness is significantly influenced by employees' knowledge.

3.3 Environmental factors

Environmental factors considered in this study to develop hypotheses are competitive pressure and trading partners' pressure. These factors are discussed below.

1) Competitive pressure (CP)

An organization faces competitive pressure from the rivals of the industry. Companies must adopt advanced technologies to gain a competitive advantage. Blockchain technology is such an advanced technology that can help a company to gain competitive advantage (Wong et al., 2020). Competitive pressure drives companies to adopt innovative technologies (Shi and Yan, 2016). Moreover, by adopting information systems organizations might be able to compete with their rivals in the industry (Kamble et al., 2020). Based on both qualitative and quantitative data, Werner et al. (2021) concluded that adopting blockchain technology can enhance a company's competitive advantage by focusing on verifiability, transparency, traceability, and immutability in inter-organizational database systems. Therefore, the seventh hypothesis was created:

H7: Behavioral intention to adopt blockchain (BA) is significantly influenced by competitive pressure.

2) Trading partners' pressure (TPP)

Blockchain implementation depends on the willingness and cooperation of the trading partners of a company and how they all are integrated (Queiroz and Wamba, 2019). When an organization wants to adopt innovative technology, then its partners are expected to have a similar system for applying the process at the inter-organizational level. It is assumed that trading partners' pressure will significantly affect the intention to adopt BCT. Therefore, the eighth hypothesis was created:

H8: Trading partners' pressure influences behavioral intention to adopt blockchain (BA).

3.4 TAM constructs: perceived usefulness, perceived ease of use, and behavioral intention to adopt technology

According to a few authors, PEU and PU are fundamental predictors of technology adoption. Perceived usefulness is defined as the benefits one can achieve by adopting technology and perceived ease of use is defined as the degree of effort needed to adopt a technology (Venkatesh and Davis, 2000; Davis, 1989). PU and PEU are important predictors of intention to adopt blockchain in the SCM context (Kamble et al., 2021). In addition, Gangwar et al. (2015) used the TAM-TOE model in their study and investigated that PU and PEU are strong predictors of behavioral intention to adopt blockchain (BA). Therefore, we hypothesize that:

H9: Perceived ease of use has a remarkable impact on behavioral intention to adopt BCT.
H10: Perceived usefulness has a remarkable impact on behavioral intention to adopt BCT.

These relationships are illustrated in Figure 1 below that creating the conceptual framework of this study.

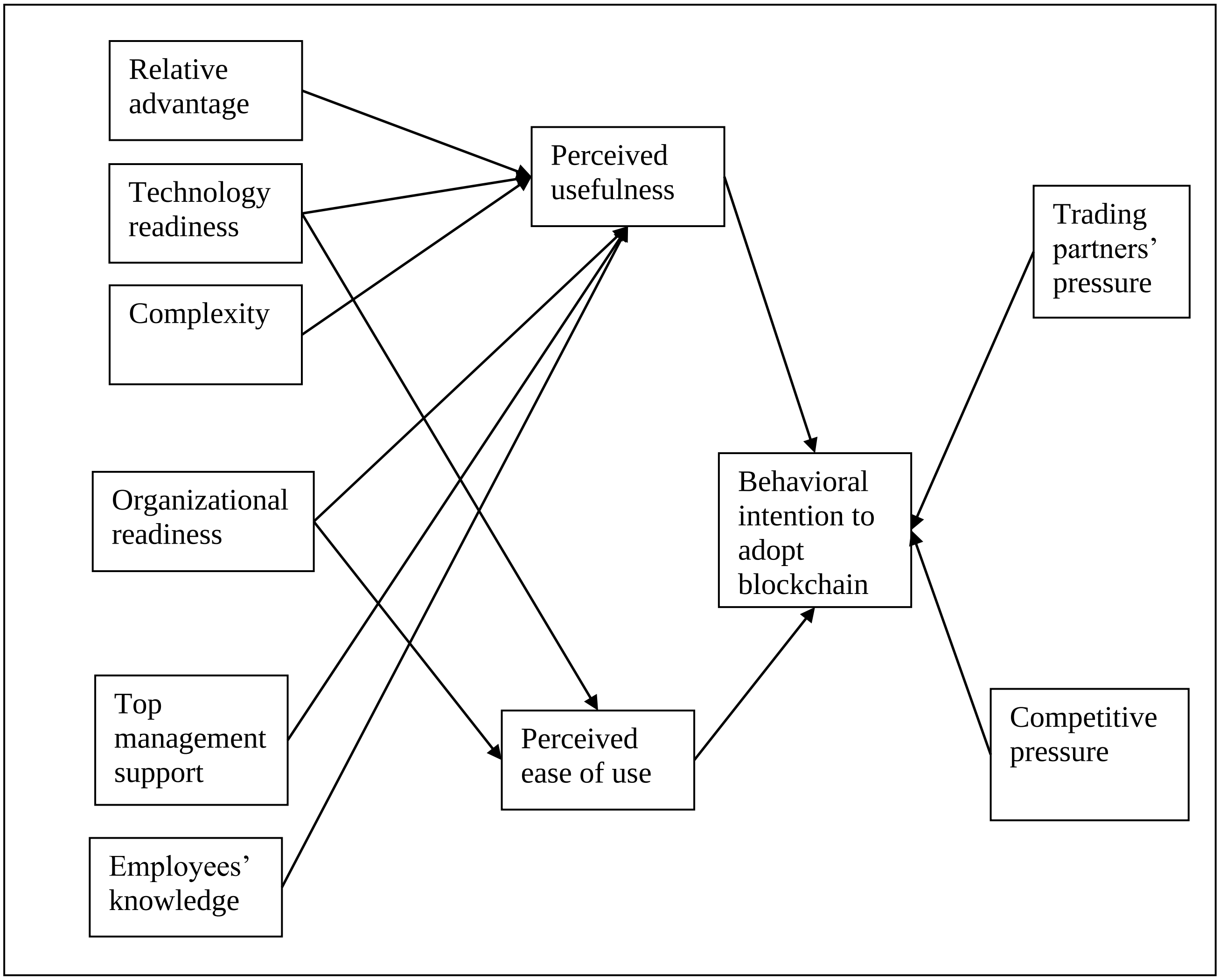

Figure 1: Conceptual model (Source: Davis, 1989; Tornatzky et al., 1990).

4. Research methodology

A questionnaire survey in the manufacturing industries of Bangladesh was applied and was sent to supply chain-related personnel to investigate the intention to adopt BCT in Bangladesh's manufacturing industry contexts. The details of the applied methodology are mentioned below.

4.1 Sampling and data collection

Primary data was used in this study which was collected by a survey from manufacturing companies in Bangladesh. Participating companies were selected from several manufacturing industry sectors like electronics, chemical, textile, food, machinery and Hardware, and pharmaceuticals. Many scholars used various techniques for sample size determination. The sample size directly correlates with the statistical analysis mechanism employed for the research (Malhotra and Dash, 2010). From the number of items in the questionnaire, the sample size can be determined. The sample size also can be determined by using ten times or five times the number of items (Hair et al., 2014).

The questionnaires were sent to respondents and the researchers personally supervise this process to collect high-quality survey data. The respondents were all related to supply chain activities in their designated organizations in different departments like procurement, supply chain planning, logistics, and operations, and working as plant heads. All respondents had three or more than three years of working experience in supply chain-related activities and have some knowledge about BCT. Before sending the questionnaires, the respondents were contacted by the researcher personally over the phone, and after sending the survey questionnaire, a time-to-time follow-up was maintained by the researchers. After completing the survey questionnaires, the questionnaires were collected by the researchers. All survey companies were listed in the Dhaka Stock Exchange list. To maintain the anonymity of the respondents, a random sampling method was applied (Wong et al., 2020). Simple random sampling is preferable to use when there is an accurate sampling frame of the target population (Saunders et al., 2019). In this study, the sampling frame is available from the Dhaka Stock Exchange list and respondents are easily available as the list is available. Hence random sampling method is suitable for this study at the organizational level. A total of 275 questionnaires were disseminated and only 189 were used for the data analysis process. This sample size matches the minimum sample size requirement for analysis of partial least squares structural equation modeling (PLS-SEM) (Hair et al., 2015) and meets up the criteria of the five-times rule of sample size selection (Hair et al., 2007).

4.2 Measures

Survey instruments were adopted from previous studies which used the same constructs and measurement scales for their study (Kamble et al., 2021) to ensure construct validity and reliability. The measurement scale used here was stated in Appendix 1. The items used are relative advantage, technology readiness, complexity, perceived benefits, organizational readiness, top management support, employee knowledge, perceived usefulness, perceived ease of use, behavioral intention to adopt blockchain, trading partners' pressure, competitive pressure, regulatory support, and organizational costs. A 7- point Likert scale that ranged from "1 – Strongly disagree" to "7 – Strongly agree" was used as the measurement scale for all constructs.

4.3 Data analysis

The conceptual framework was analyzed by PLS-SEM as many studies in the SCM used PLS-SEM (Queiroz and Wamba, 2019; Wong et al., 2020; Kamble et al., 2021, Wamba et al., 2020). There are reasons behind using PLS-SEM as it can be applied for both small and large sample sizes, and can be used for exploratory research (Queiroz and Wamba, 2019). This study is using a reflective model. This is a reflective model as the arrows indicate from constructs to measure items and reflect the outcome of the intention to adopt blockchain (Akhter et al., 2016).

The demographic characteristics are shown in the following **Table 1.**

Table 1: Demographic information

Name	Types	Frequency	Percent
Gender	Male	125	66
	Female	64	34
Age (Years)	25-34	58	31
	35-44	69	37
	45-54	40	21
	55 above	22	11
Experience (years)	Less than 1 year	44	23
	1-6	86	45
	6-10	33	17
	10 years and above	26	15
Primary job scope	Junior Management	75	40
	Middle management	54	28
	Senior management	36	19
	Others	24	13
Current understanding of blockchain technology	Learning	74	40
	Testing	14	7
	Implementing	36	19
	None	65	34
6. Age of firm (years	5 or less	27	15
	More than 5 but less than 10	84	34
	At least 10	78	41
Industry type	Electrical and electronics	12	6
	Chemical	29	15
	Textile	43	23
	Food	38	20
	Machinery and hardware	22	12
	Pharmaceuticals	45	24
Number of employees	Less than 50	48	25
	50-100	54	29
	More than 100	87	46
Job domain	Plant head	18	10
	Procurement	39	21
	Supply chain planning	27	14
	Logistics	41	22
	Operations	64	33

As mentioned in table 1, most of the respondents belong to pharmaceuticals companies (24%), textile mills (23%), and food and beverage companies (29%) in which most of the respondents (33%) have been working in operations (33%) followed by 22% in logistics, 21% in procurement, 14% in supply chain planning and only 10% as plant head. The majority of the respondents (45%) have been with the organization for 1-6 years. Regarding BCT knowledge, they were learning (40%), testing (7%), and implementing (19%) this technology. A large portion of the respondents (34%) were not involved in any blockchain-related knowledge. However, the participants of the survey were briefed about the adoption of any new technology in the SCM context as a portion of the participants previously were not aware of the new technologies such as BCT. But the respondents were aware of IR 4.0; hence it was easy for them to grasp the knowledge about new technologies such as BCT. Respondents were briefed about the application, benefits, and challenges of adopting BCT in the SCM context. After the respondents were properly briefed about the technology, they completed their survey questionnaire for the adoption of new technology such as BCT.

4.4 Findings

This study used Smart PLS 3.0 to analyze the proposed model (Queiroz and Wamba, 2019; Wong et al., 2020; Kamble et al., 2020). The findings of the study are stated by measurement and structural model.

4.4.1 Measurement model

Depending on the existing pieces of literature, the model was developed, and indicators were selected for BCT adoption (Kamble et al., 2020). First of all, the construct reliability and validity were tested. The reliability was checked by Cronbach's alpha and composite reliability. For all constructs, both values are above the threshold value of 0.7 (Wong et al., 2020; Hair et al., 2017; Nunnally, 1978).

Table 2: Cronbach's alpha, Composite reliability (CR), and Average variance extracted (AVE)

Construct	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
BA	0.934	0.958	0.883
COMP	0.904	0.940	0.839
CP	0.893	0.934	0.824
EK	0.901	0.938	0.834
OR	0.897	0.936	0.830
PEU	0.886	0.928	0.811
PU	0.932	0.957	0.881
RA	0.936	0.959	0.887
TMS	0.886	0.930	0.815
TPP	0.914	0.946	0.853
TR	0.916	0.947	0.856

The minimal value for Cronbach's alpha is 0.886 for PEU and top management support. The minimum composite reliability value is 0.928 for perceived ease of use (PEU). The study used the average variance extracted (AVE) for testing convergent validity. From the data, it is clear that all AVE values are higher than the suggested value of 50 percent (Tan et al. 2017). The lowest value of AVE is 0.811 for PEU. The related data of composite reliability, AVE, and Cronbach's alpha, were shown in **Table 2.** Eventually from the values, it is evident that the framework has good reliability.

For discriminant validity (Appendix 2), several approaches such as the Fornell-Larcker criterion (Fornell and Larcker, 1981) and cross-loadings were used. By observing the Fornell-Larcker criterion, it was found that the square root AVE construct is bigger compared to the correlation between the specific construct and all other constructs**.** Appendix 3 shows the outer loadings.

It is clear from Appendix 3 (Outer loading values) that all items of each construct have values more than the threshold value which is 0.7 (Queiroz and Wamba, 2019; Hair et al., 2017; Nunnally, 1978). The lowest value is observed for the construct PEU. Among the three items of PEU, the lowest value is for PEU 1 which is "Blockchain system is easy to understand", though the value is above the threshold value of 0.7. From the measurement model, it is clear that the constructs used in the model are justified.

4.4.2 Structural model

Collinearity statistics (VIF) values were checked and from the values, it is clear that all the VIF values are below the threshold values of 5 (Basbeth and Ibrahim, 2018; Kock, 2016) except for three items of three constructs. For PU1 that value is 5.133 which represents that blockchain will help to improve efficiency. BA2 has a VIF value of 5.022 which represents the firms that can use blockchain. At last, RA1 has a VIF value of 5.279 which represents that any information can be accessed from any time and place by using blockchain. But all these values slightly exceed the threshold value for VIF which is 5. So, collinearity is not a problem for this framework as all other values are within the threshold value.

For the Path coefficient, the standardized value is between -1 and +1. If the path coefficient value is close to +1 then it represents a strong positive and significant relationship (Basbeth and Ibrahim, 2018). From the values, it was found that the most important and significant driver for behavioral intention to adopt blockchain (BA) is perceived usefulness (PU) and the value for this relationship is 0.618 whereas PEU has a very low significant impact on BI as the value is very low, 0.005. But COMP hurts PU as the value is -0.146. TR hurts PEU as the value of the path coefficient for this relationship is -0.379. To evaluate the significance of the path coefficient to its standard error, bootstrapping must be done. By bootstrapping, the t values and p values can be calculated. The coefficient is statistically significant if t values are greater than 1.96 ($t > 1.96$) and the p values are less than 0.05($p < 0.05$) (Basbeth and Ibrahim, 2018; Queiroz and Wamba, 2019; Kock, 2016). **Table 3** represents the values related to the path coefficient as path coefficient, t value, p values, hypotheses, and path.

Table 3: Path coefficients

Hypothesis	Path	Path coefficient	Standard deviation	T value	P-value	Supported
H1	RA->PU	-0.146	0.048	3.071	0.002	Supported
H2a	TR->PU	0.150	0.081	1.840	**0.066**	Not supported
H2b	TR->PEU	-0.379	0.091	4.151	0.000	Supported
H3	COMP->PU	-0.146	0.048	3.071	0.002	Supported
H4a	OR->PU	0.112	0.057	1.965	**0.050**	Not Supported
H4b	OR->PEU	0.349	0.094	3.705	0.000	Supported
H5	TMS->PU	0.174	0.068	2.558	0.011	Supported
H6	EK->PU	0.157	0.061	2.566	0.011	Supported
H7	TPP->BA	0.127	0.050	2.528	0.012	Supported
H8	CP->BA	0.238	0.053	4.509	0.000	Supported
H9	PU->BA	0.618	0.049	12.641	0.000	Supported
H10	PEU->BA	0.005	0.021	0.239	**0.811**	Not supported

From the data, it's clear that RA has a positive significant impact on PU as the path coefficient value, t-value, and p-value are respectively 0.278, 3.915, and 0.00). Thus, H1 is supported. TR was found to have a positive non-significant impact on PU as path coefficient value, t value, and p-value are respectively 0.150, 1.840, and 0.066. That means H2a is not supported. TR had a remarkable negative impact on PEU as path coefficient value, t-value, and p-value are respectively -0.379, 4.151, and 0.00. That means H2b is supported. COMP has a negative influence on PU as the path coefficient value is -0.146. In terms of t-value and p-value are respectively 3.071 and 0.002 which meet that requirement and the relationship between COMP and PU is significant but has a negative impact. Hence, H3 is supported. OR had a positive non-significant impact on PU as path coefficient value, t-value, and p-value are respectively 0.112, 1.965, and 0.050. That means H4a is not supported. But OR had a significant positive influence on PEU as path coefficient value, t-value, and p-value are respectively 0.349, 3.705, and 0.00. That means H4b is supported. TMS had a significant positive impact on PU as path coefficient value, t-value, and p-value are respectively 0.174, 2.558, and 0.011. That means H5 is also supported. From the data, it is clear that EK has a positive significant impact on PU as the path coefficient value, t-value, and p-value are respectively 0.157, 2.566, and 0.011. Thus, H6 is supported. Also, considering the value of the path coefficient, t-value, and p-value which are 0.127, 2.528, and 0.012 respectively, TPP has a significant positive impact on BA. That means H7 is supported. Hypothesis 8 shows the relationship between CP and BA. This relationship is positive and significant as the path coefficient value, t-value, and p-value are respectively 0.238, 4.509, and 0.00. Hence Hypothesis 8 is accepted. PU was found to have a positive significant impact on BA considering the value of path coefficient, t value, and p-value which are 0.618, 1.840, and 0.066 respectively. That means H9 is supported. Finally, we can observe a non-significant positive effect of PEU on BA as the path coefficient value, t-value, and p-value are respectively 0.005, 0.239, and 0.811. This H10 is not supported.

The hypothesis can also be tested by the values of confidence intervals. The related values are given in Table 4. The rule of hypothesis testing by confidence interval is that if the confidence interval for a path coefficient does not include zero, then the path is assumed to be significant.

But if the confidence interval includes zero then the relationship is assumed to be not significant (Basbeth and Ibrahim, 2018; Kock, 2016).

Table 4: Hypothesis testing by confidence intervals

	Original Sample (O)	Sample Mean (M)	Bias	2.5%	97.5%
COMP -> PU	-0.146	-0.147	-0.001	-0.242	-0.052
CP -> BA	0.238	0.236	-0.002	0.148	0.351
EK -> PU	0.157	0.158	0.002	0.042	0.280
OR -> PEU	0.349	0.353	0.004	0.164	0.537
OR -> PU	0.112	0.109	-0.003	-0.003	0.221
PEU -> BA	0.005	0.004	-0.001	-0.034	0.048
PU -> BA	0.618	0.618	0.000	0.516	0.705
RA -> PU	0.278	0.280	0.003	0.133	0.408
TMS -> PU	0.174	0.179	0.004	0.020	0.299
TPP -> BA	0.127	0.129	0.003	0.012	0.217
TR -> PEU	-0.379	-0.386	-0.007	-0.561	-0.215
TR -> PU	0.150	0.144	-0.006	-0.014	0.302

From the values given in Table 6, it is clear that in the relationship of OR->PU, the confidence interval has a lower value of -0.003 and an upper value of 0.221. Therefore, we can conclude that the path is insignificant as zero falls within the confidence interval. Similarly, for relationships TR->PU and PEU->BA, the lower and upper bound values are -0.014, 0.302, and -0.034, 0.048. In both cases, zero falls within the interval. Thus, both relationships are proven non-significant. Similar results are found from the test using path coefficient value, p-value, and t-value. Also using the confidence interval values the relationship of COMP->PU is negative but significant as the lower and upper bound values are -0.242 and -0.052. Both the values are negative but zero does not fall within the values which proves the relationship is negative but significant. All other relationships are positive and significant considering the confidence interval values as both lower and upper bound values are positive and zero does not fall within the values.

Table 5: R-square

Dependent constructs	R Square	R Square Adjusted
BA	0.885	0.882
PEU	0.0620	0.0520
PU	0.865	0.860

Table 5 represents R-square values. The values can vary from 0 to 1. R square values of 0.75, 0.5, or 0.25 are assumed as substantial, moderate, or weak for the endogenous latent variable (Hair et al., 2017). In this study for behavioral intention to blockchain adoption (BA), the percent of the variance is 88.2%, and for perceived usefulness, the percent of the variance is 86%. Both values are above 75% which indicates a high level of predictive accuracy. For PEU, the percent of the variance is 5.2%, which represents a very weak variable (Venkatesh et al., 2003; Basbeth and Ibrahim, 2018).

5. Discussions

This study used TAM-TOE integrated model for BI to adopt BCT in the SCM for manufacturing industries in Bangladesh (shown in Figure 2). The factors used in this conceptual model were relative advantage, organizational readiness, top management support, employee' knowledge, trading partners' pressure, and competitive pressure. The results showed that relative advantage (RA) has a positive direct impact on perceived usefulness (PU) which matches with prior study findings (Kamble et al., 2020; Gangwar et al., 2015).

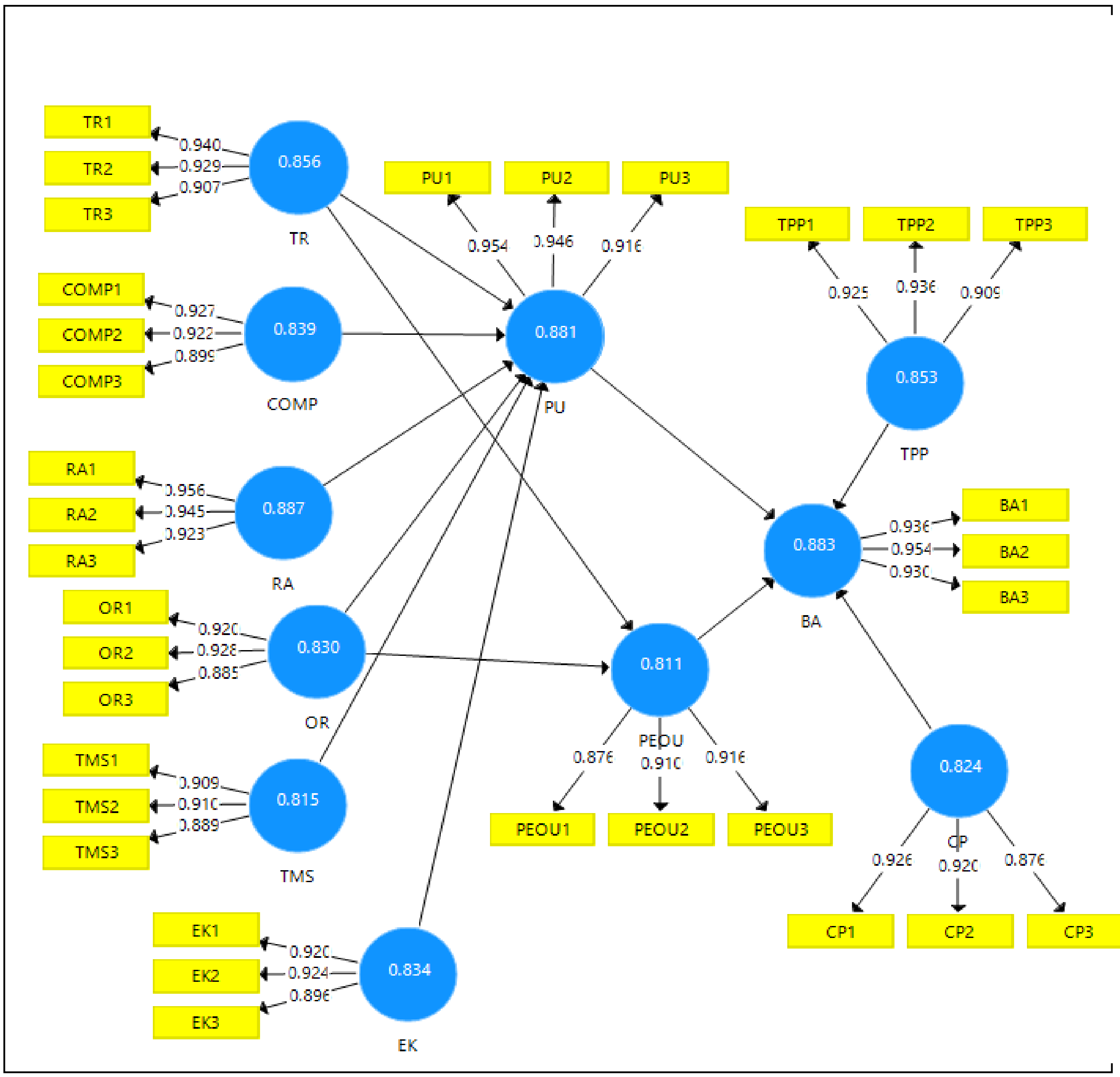

Figure 2: Structural Path model (Values of Hypothesis testing by confidence intervals and values of R square are given in Table 4 and 5 respectively)

Also, according to these study findings, PU has a positive significant impact on BA. From prior studies according to Bhattacharya and Wamba (2018), it was also found that relative advantage is considered an important criterion for technology adoption in the SCM context. Adopting technologies like blockchain offers several benefits in supply chain management including transparency, security, trust, reduced operational costs, and traceability (Kshetri, 2018; Zou et al., 2018; Rahmanzadeh et al, 2019; Reyna et al., 2018; Roeck et al., 2019).

Technology readiness was also found as a crucial factor in the adoption of technology. In this study context technology readiness has a positive non-significant impact on PU whereas technology readiness showed a negative significant impact on PEU considering p-value, t-value, and confidence interval. Kamble et al. (2020) also found that technology readiness has a non-significant impact on PU and a significant impact on PEU. An organization's technical ability, sufficient knowledge, and technical infrastructure can be a challenge to adopt any technology. A system can be useful by combining the company's resources with its technical ability (Wong et al., 2020). Therefore, for technology adoption, an organization's technical knowledge can minimize this challenge and make it useful for a company.

Complexity was found to be a positive significant impact on PU for this study in terms of p-value, t-value, and confidence interval. The complexity of a system depends on a few issues like whether a system is going to be time-consuming (Kamble et al., 2020), whether learning a system requires much effort and whether it needs much experience to adopt and implement the system (Wong et al.,2020). Complexity was always a hindrance in the way of adopting new technology. From previous studies, it was found that if a system is difficult then it negatively impacts technology adoption and the reverse effect occurs if the system is simple and beneficial for a company (Alalwan et al., 2017; Dwivedi et al., 2017). However, the findings of this study deviate from the existing literature. This may occur due to several reasons such as lack of awareness and knowledge about BCT and it has impacted the belief of respondents about the usefulness of the technology. Among 189 respondents of this study, only 36 respondents (19%) mentioned that they are implementing this technology and the others are still learning and testing this technology. Also, 65 respondents (34%) mentioned that they are not aware of this technology. Therefore, there is a lack of knowledge about BCT among the portion of respondents, though the respondents were briefed thoroughly about new technologies such as BCT before participating in the survey.

Organizational readiness is an organizational factor. The findings from this study confirm that organizational readiness is an important predictor for PEU but non-significant for PU. The findings also found support from previous literature. According to Kamble et al. (2020), organizational readiness is focused on financial readiness. Wong et al. (2020) also mentioned that an organization must have financial readiness to adopt new technology. The previous studies also found that the financial benefits from the intention to adopt BCT would influence the PEU (Wong et al., 2020; Kamble et al, 2020).

Organizational factors such as top management support and employees' knowledge have a positive and significant influence on PU. The findings imply that top management support in terms of taking risks for adopting blockchain technology, providing resources, and finding this technology important for the organization enhances the feeling of perceived usefulness of this technology among employees. Also increasing employees' knowledge by providing continuous training to employees on the adoption and implementation of this technology and its benefits, will help to grow up the sense of users about the technology. The existing literature findings are also consistent with existing literature (Dubey et al., 2018; Kamble et al., 2020). Training and education influence perceived usefulness.

Competitive pressure and trading partners' pressure represents environmental factors and is found to have a positive significant impact on adoption intention. From existing literature, it was also found that competitive pressure motivates positively a company to adopt new technologies (Shi et al., 2016) and blockchain technology can help an organization gain a competitive advantage (Wong et al., 2020) and outcompete its rivals (Kamble et al., 2020). Moreover, the trading partners' willingness act as a vital factor in this regard of blockchain technology (Queiroz and Wamba, 2019), and the findings of the study are consistent with the existing literature. That means an organization can become more competitive by intention to adopt blockchain and can outcompete the competitors.

Further, both TAM constructs were tested in this study. Blockchain technology adoption is remarkably impacted by PU. The findings regarding the relationship between PU and BCT adoption intention were supported by existing literature as well (Kamble et al., 2019; Gangwar et al., 2015). The finding of the study suggested that adopting blockchain technology will improve business efficiency and business productivity as well as will enhance an organization's competitiveness. However, the findings regarding the relationship between perceived ease of use and intention to adopt blockchain were non-significant for this study and this finding deviates from the existing literature. These results suggested that blockchain technology is not easy to understand and implement compared to other advanced technologies as per respondents' responses.

5.1 Theoretical contribution

In this study, a model is developed by integrating the TAM-TOE model for the adoption intention of BCT in the SCM. There are fewer studies regarding the intention to adopt blockchain in developing country contexts (Wong et al., 2020), and hence this study was focused on the manufacturing sector of a developing country Bangladesh. Till now more studies on the intention to adopt blockchain was done based on building up a conceptual framework (Ying et al., 2018; Francisco and Swanson, 2018). This study built a conceptual framework by integrating the TAM-TOE model and also did an empirical analysis which helped to sort out relevant factors. Therefore, this study is assumed to have a valuable contribution. This study provides literature on the intention to adopt blockchain and related factors that assist academicians as well as industry practitioners to better understand the adoption intentions while adopting new technology. The constructs used in this study are derived from both the TAM model (PU, PEU and BA) and TOE model (RA, TMS, COMP, TR, OR, EK, TPP, CP) to understand the effect of the organizational, environmental, and technological factors on perceived usefulness and perceived ease of use that will eventually influence intention to adopt blockchain. The proposed model and the empirical analysis of this study have provided indispensable perceptions about the behavioral intentions when blockchain technology is adopted in the SCM context and thus can assist academics in their further research.

5.2 Managerial contribution

This study provides a significant impact on industry practitioners and provides a proper guideline for the intention to adopt blockchain in the SCM context. From this study organizations seeking to adopt BCT, can sort out the related crucial factors needed to be focused on while adopting BCT. It's evident from the findings that organizations must focus on the technological readiness and relative advantage (RA) of a technology to adopt. That means if an organization has technical consultants and a sufficient technical workforce to provide support, one can get the usefulness of a technology. Also, organizations must have proper technical infrastructure and resources to support technology adoption. Though the findings of the study contradict this issue technological readiness (TR) and organizational readiness (OR) both showed a non-significant impact on perceived usefulness. Maybe this is because a large portion of respondents was not properly aware of BCT and so did not have proper knowledge about this technology. So, providing proper training and knowledge is crucial before adopting a technology. The fear of the complexity of technology can be reduced by anticipating proper training and education, and technical knowledge to the employees. If the employees are knowledgeable and are known about the know-how of technology, they would feel comfortable and easygoing with the technology. It can enhance the adoption rate as well. This further implies that the adoption of BCT requires top management support (TMS). This study also found that top management support influences the perceived usefulness (PU) that eventually influences BCT adoption positively. Top management can play a crucial role here. If they are ready to take any risks to adopt technology and are ready to provide all necessary support for technology adoption, then it would drive the organizations to adopt new technology. Moreover, trading partners' pressure (TPP) and competitive pressure (CP) can drive an organization's positive intention to adopt blockchain (BA). This study also found these factors positively impact BA. Hence organizations must address the issues of maintaining competitiveness in the market and managing a good relationship with trading partners, and industry practitioners by adopting advanced technologies like blockchain.

6. Conclusion

This study sorts out the crucial factors for BCT adoption in the SCM context for manufacturing industries in Bangladesh. For this purpose, the adoption intention of this technology was checked by creating a conceptual model by integrating TAM and TOE models. Based on the conceptual framework, the important factors necessary for the adoption intention of BCT in the SCM context were identified. The benefits of using blockchain technology in the SCM context have been discussed. The respondents were randomly selected from the manufacturing industries of Bangladesh who were working in the SCM fields assuming they had certain knowledge about BCT. From the respondents' demographic characteristics, it was evident that most of the organizations were not aware of BCT and had a knowledge deficiency about the usefulness and challenges of these technologies. From the number of respondents, it was sorted out that a large portion of respondents (34%) were not aware of this technology and a less portion (19%) were implementing this technology. Hence it was found that during the Covid-19 pandemic situation, the SCM processes in Bangladesh manufacturing industries are facing huge disruptions as most of the domestic industries are running paper-based operations and not digitalized. Also, they face a lack of resources due to collaboration problems with their trading partners (Faroque, 2019). Consequently, the business entities and governments of this country have realized the requirement of adopting more digitized SCM processes as blockchain technology (Uddin, 2020). Further empirical studies may consider focusing on specific industries in developing country contexts. This study considers a few factors of the TOE model and integrates them with the TAM model. Therefore, in the future, more empirical studies may consider the other factors of the TOE model and integrate other technology adoption theories to address technology adoption intention. Furthermore, as the BCT adoption studies are still in the infancy using other technology adoption models as the unified theory of acceptance and use of technology (UTAUT) model in developing country contexts (Wamba et al, 2020; Zelbst et al,2020; Ying et al., 2018) though there are studies in developed country contexts. Therefore, there is enough room for further research in technology adoption by using the UTAUT model in developing country contexts. Moreover, for practitioners, this study offers a significant contribution in terms of factors needed to be considered while adopting BCT in the SCM context.

6.1 Limitations and future research directions

This study has few limitations as the intention to adopt blockchain in a developing country context is still nascent and fewer studies were conducted on this ground (Queiroz and Wamba, 2019; Wamba et al., 2020). Hence before generalizing, the findings need to be analyzed carefully. In addition, the respondents were randomly chosen from different manufacturing industries, and from the respondents' demographic profiles, it was evident that a large portion of respondents (34%) were not familiar with the term blockchain technology. In addition, this study considers a few factors of the TOE model to integrate with the TAM model. For the above-mentioned limitations, there is enough scope for future studies, on adoption intention in supply chain management contexts in developing countries. To generalize the findings of this study to developing country manufacturing industry context, more similar studies are required to be conducted. Other technologies of industry 4.0 technologies such as radio frequency identification technique (RFID), internet of things (IoT), cloud computing, etc. may be adopted in similar industries and the adoption intention can be checked. The industries can be chosen in other developing country contexts. This study is based on the manufacturing industries of Bangladesh which are comprised of chemical industries, textiles, pharmaceuticals, and food and beverage companies. Hence there is a scope for future researchers to conduct more empirical studies in specific industry contexts such as fast-moving consumer goods (FMCG), the tobacco industry, and the chemical industry. Also, different types of industries belonging to the FMCG sector as toiletries, cosmetics, pharmaceuticals, food, and beverage can be separately tested empirically to verify the adoption intention of different technologies in specific industry contexts. Also, there is lacking longitudinal studies on technology adoption in the SCM context (Rogerson et al., 2020). Thus, in the future, longitudinal studies should be conducted in similar industries. Moreover, future studies should be conducted based on other technology adoption theories as the unified theory of acceptance and use of technology (UTAUT) by integrating with other constructs from similar and different settings.

Appendix 1

Constructs	Label	Measures	Source
Technological Factors	Relative advantage (RA)	RA1: Blockchain will provide access to remote information from any time from any place better	Kamble et al. (2021)
		RA2: Blockchain requires less IT infrastructure maintenance	Kamble et al. (2021)
		RA3: Blockchain can enhance the efficiency of operations	Kamble et al. (2021)
	Technology readiness (TR)	TR1: Your organization has the availability of a technical workforce	Kamble et al. (2021)
		TR2: You have access to technical consultants	Kamble et al. (2021)
		TR3: Your organization successfully implemented similar technologies in the past	Kamble et al. (2021)
	Complexity (Comp)	Comp1: Blockchain is going to be time-consuming	Kamble et al. (2021)
		Comp2: It is not flexible to interact with blockchain applications	Kamble et al. (2021)
		Comp3: It is difficult for blockchain to integrate complex supply chain operations	Kamble et al. (2021)
Organizational Factors	Organizational readiness (OR)	OR1: Your organization has access to technical knowledge to implement blockchain	Kamble et al. (2021)
		OR2: Your organization has access to internet connectivity to implement blockchain	Kamble et al. (2021)
		OR3: Your organization has availability of funds to implement blockchain	Kamble et al. (2021)
	Top management support (TMS)	TMS1: Blockchain is seen with strategic importance by our top management	Kamble et al. (2021)
		TMS2: Top management is prepared to take the risks associated with blockchain implementation	Kamble et al. (2021)
		TMS3. Top management supports by providing a culture of transparency and information sharing	Kamble et al. (2021)
	Employees' knowledge (EK)	EK1: Training imparted on blockchain improves the level of understanding of blockchain substantially	Kamble et al. (2021)
		EK2: The organization provides complete training on blockchain	Kamble et al. (2021)
		EK3: The training programs on blockchain increased confidence	Kamble et al. (2021)
Environmental Factors	Trading partners' pressure (TPP)	TPP1: Supply chain partners are very enthusiastic about blockchain implementation	Kamble et al. (2021)
		TPP2: Supply chain partners are willing to support blockchain implementation	Kamble et al. (2021)
		TPP3: Supply chain partners have always supported us in the past in implementing ICT initiatives	Kamble et al. (2021)
	Competitive pressure (CP)	CP1: Blockchain offers competitive advantages	Kamble et al. (2021)
		CP2: Competitors are in the process of implementing blockchain	Kamble et al. (2021)
		CP3: Competitors will become more competitive with blockchain implementation	Kamble et al. (2021)
TAM Constructs	Perceived ease of use (PEU)	PEU1: The blockchain system is easy to understand	Kamble et al. (2021)
		PEU2: Blockchain is easy to use	Kamble et al. (2021)
		PEU3: Blockchain features will be easier compared to other technologies	Kamble et al. (2021)
	Perceived usefulness (PU)	PU1: Blockchain will help improve business efficiency	Kamble et al. (2021)
		PU2: Blockchain will help improve business productivity	Kamble et al. (2021)

		PU3: Blockchain develops organizational competitiveness	Kamble et al. (2021)
Intention to adopt blockchain (BA)		BA1: I predict my firm would adopt blockchain regularly in future	Kamble et al. (2021)
		BA2: Using blockchain is advantageous	Kamble et al. (2021)
		BA3: The firm is in favor of using blockchain	Kamble et al. (2021)

Appendix 2 Discriminant validity

	BA	**COMP**	**CP**	**EK**	**OR**	**PEU**	**PU**	**RA**	**TMS**	**TPP**	**TR**
BA	**0.940**										
COMP	-0.810	**0.916**									
CP	0.859	-0.726	**0.908**								
EK	0.859	-0.774	0.806	**0.913**							
OR	0.851	-0.741	0.774	0.760	**0.911**						
PEU	0.009	0.071	0.055	-0.026	0.058	**0.901**					
PU	0.926	-0.818	0.838	0.842	0.808	-0.016	**0.939**				
RA	0.852	-0.776	0.777	0.799	0.748	-0.058	0.876	**0.942**			
TMS	0.869	-0.737	0.792	0.824	0.838	0.036	0.853	0.812	**0.903**		
TPP	0.854	-0.765	0.818	0.818	0.809	0.000	0.863	0.817	0.807	**0.924**	
TR	0.876	-0.826	0.815	0.815	0.769	-0.110	0.876	0.900	0.817	0.834	**0.925**

Appendix 3 Loadings

Construct	Item	Loading
BA	BA1	0.936
	BA2	0.954
	BA3	0.930
COMP	COMP1	0.927
	COMP2	0.922
	COMP3	0.899
CP	CP1	0.926
	CP2	0.920
	CP3	0.876
EK	EK1	0.920
	EK2	0.924
	EK3	0.896
OR	OR1	0.920
	OR2	0.928
	OR3	0.885
PEU	PEU1	0.876
	PEU2	0.910
	PEU3	0.916
PU	PU1	0.954
	PU2	0.946
	PU3	0.916
RA	RA1	0.956
	RA2	0.945
	RA3	0.923

TMS	TMS1	0.909
	TMS2	0.910
	TMS3	0.889
TPP	TPP1	0.925
	TPP2	0.936
	TPP3	0.909
TR	TR1	0.940
	TR2	0.929
	TR3	0.907

Data availability statement: Data available on request

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