Journal of Open Innovation: Technology, Market, and Complexity

Article

Artificial Intelligence, Blockchain Technology, and Risk-Taking Behavior in the 4.0IR Metaverse Era: Evidence from Bangladesh-Based SMEs

Mohammad Rashed Hasan Polas [1,*], Asghar Afshar Jahanshahi [2], Ahmed Imran Kabir [3], Abu Saleh Md. Sohel-Uz-Zaman [3], Abu Rashed Osman [3] and Ridoan Karim [4]

1 Department of Computer Science and Engineering & Center for Research Training and Consultancy (CRTC), Sonargaon University (SU), Dhaka 1215, Bangladesh
2 Tecnologico de Monterrey, Business School, Mexico City 01389, Mexico
3 School of Business and Economics, United International University, Dhaka 1212, Bangladesh
4 Department of Business Law and Taxation, School of Business, Monash University, Jalan Lagoon Selatan, Subang Jaya 47500, Malaysia
* Correspondence: rashedhasanpalash@gmail.com

Abstract: This study investigates the variables affecting the adoption of blockchain technology (BT) among small and medium-sized enterprises (SMEs) with the application of artificial intelligence (AI) via the mediating lens of risk-taking behavior. As an initial sample, 150 owners/top managers from 150 SMEs (one informant from each) in Dhaka, Bangladesh, were chosen. A stratified random sample was employed for this cross-sectional study. Applying structural equation modeling, the combined influence of internal and external variables influencing the intention to adopt BT is explored. Results show that: (1) knowledge of artificial intelligence has a positive and significant effect on the adoption of blockchain technology; (2) the relevant advantage of artificial intelligence has a positive and significant effect on the adoption of blockchain technology; (3) perceived ease of use of artificial intelligence has a positive and significant effect on the adoption of blockchain technology; (4) risk-taking behavior mediates the relationship between knowledge of artificial intelligence and adoption of blockchain technology; (5) risk-taking behavior does not mediate the relationship between relevant advantage and perceived ease of use of artificial intelligence with the adoption of blockchain technology. The current study is one of the few empirical investigations relating to SMEs using artificial intelligence and blockchain technologies for business operations. The study's limitations are the small sample size and use of a single informant. However, the findings on the adoption of blockchain technology have applications for boosting the competitiveness of SMEs. This study's originality stems from two factors: the novelty of blockchain technology and its potential to upend SMEs' conventional mode of operation. It highlights the need to consider the key variables affecting SMEs' adoption of blockchain technology with artificial intelligence.

Keywords: blockchain technology; artificial intelligence; SMEs; survey; risk-taking behavior; Bangladesh

Citation: Polas, M.R.H.; Afshar Jahanshahi, A.; Kabir, A.I.; Sohel-Uz-Zaman, A.S.M.; Osman, A.R.; Karim, R. Artificial Intelligence, Blockchain Technology, and Risk-Taking Behavior in the 4.0IR Metaverse Era: Evidence from Bangladesh-Based SMEs. *J. Open Innov. Technol. Mark. Complex.* **2022**, *8*, 168. https://doi.org/10.3390/joitmc8030168

Received: 19 July 2022
Accepted: 10 September 2022
Published: 17 September 2022

1. Introduction

Nowadays, it is difficult to overlook the contributions of blockchain technology (BT) and artificial intelligence (AI) to the fourth industrial revolution (4IR) era: the former is ingrained in the mechanism of the 4IR, while AI and BT have the potential to transform the foundations of economic systems in SMEs [1,2]. The depth and breadth of the 4IR might be determined by the combined force of these two technologies. Understanding what AI and BT are in the first place is crucial when discussing the synergy between the two technologies. Understanding information in ways other than the obvious is the definition of intelligence. Individual and collective intelligence are the two forms of intelligence found in nature [3,4].

Because AI is formed by the terms artificial and intelligence, as its name suggests, intelligence is created artificially. Numerous AI approaches have been developed, such as neural networks, support vector machines, and fuzzy logic. These methods have been applied effectively in robotics, economic modeling, finite element analysis, modeling interstate conflict, and missing data estimation. In its most basic definition, blockchain technology refers to an unchangeable digital ledger system. The distributed implementation style of BT is one noteworthy aspect. It was first inspired by Bitcoin, which has now shown its potential across many industries [5,6].

Previously, Bangladesh's economy relied solely on agriculture, but as time passed, new technology entered every aspect of the economy [7]. Various sectors use automation and control technologies, such as big data, blockchain, and IoT. These technologies have become highly popular, forcing many industries to utilize AI technologies. In order to integrate AI and BT, the Bangladeshi government will need to make extensive preparations. If the technology is implemented without enough planning, numerous difficulties will occur [8]. Despite being slightly delayed, the consequences of these technologies are already being seen across the country. Several specific domains, including services, transportation, education, agriculture, health, and the environment, have been identified in Bangladesh as having the potential to efficiently use AI and BT [9]. Overall, the broad use of AI and BT have a bright possibility in Bangladesh, including ride-sharing, natural language processing (NLP) for Bengali, chatbots, hotel and ticket booking, real-time mapping, and more. Bangladesh will have a prosperous future if AI technologies are properly integrated since 34% of Bangladesh's youth are now interested in technology [7]. Before using AI technology, the Bangladeshi government needs to undertake considerable preparations. As a result, utilizing technology without enough preparation will present various challenges [8,9].

Furthermore, AI is a strategic asset for organizational performance and competitiveness in small and medium-sized businesses (SMEs) [7]. According to the study, adopting BT is accepting and using AI to provide services such as manufacturing, order reservation, and payment. In many parts of the world, SMEs make up the majority of enterprises and are vital to many economies [8]. Our knowledge of how SMEs behave concerning the adoption of AI in general and the adoption of BT in particular is lacking [9,10]. The business environment for SMEs is difficult, and they must contend with fierce rivalry from established and emerging competitors, and rising consumer expectations [11–13]. Business sustainability becomes a crucial concern in this setting. As stated in the definition of sustainable business, it is a "business that fully accounts for its present and future economic, social, and environmental implications, meeting the demands of consumers, the industry, and the environment and host communities" [14–18].

Due to the rapid development of BT and AI, it is critical to pinpoint the variables that influence knowledge, relevant advantage, and perceived ease of use concerning the adoption of BT [19–21]. The innovativeness of top management, the strategic context, the involvement of family members in management [22,23], the limitations of education and training, the absence of strategic planning, financial resources, management, and marketing skills [24], and the presence of highly centralized structures, are some of the factors that have been identified in previous studies of the factors influencing SMEs' adoption of BT [25]. However, the dearth of research on how internal and external variables affect how SMEs embrace BT was repeatedly emphasized [26]. Additionally, earlier multi-sector studies of SMEs' adoption of BT did not account for individual industry features [27], which produced inconsistent results. Consequently, this study empirically analyzes the elements influencing SMEs' propensity to adopt BT. The study's location and data collection methods were chosen because the area has a technology-friendly legal and technological infrastructure (such as high-quality Wi-Fi in SMEs), which facilitates the adoption of BT and permits the execution of an empirical investigation in appropriate settings [28].

Nevertheless, the fourth industrial revolution is thought to be greatly aided by AI and BT. In order to solve trust-related problems in the corporate world, a decentralized ecosystem is being created. Due to the distributed nature of its database and the potential for audit trails, BT is employed in many industries [29]. The traditional organizational performance is greatly improved with BT [30]. An assessment of the BT literature reveals that most research offers the potential and difficulties of using disruptive technology. The deployment of distributed ledger technology applications has received minimal attention. One of the preliminary studies looking at blockchain adoption in SMEs is [31,32]. This study's objective is to offer a thorough knowledge of the numerous elements that impact user intention to adopt blockchain with the application of AI in SMEs. The suggested model intends to assess how well research constructs fit the idea of diffusion of the innovation framework. A hypothetical model was developed by combining the key elements of knowledge, relative benefit, and perceived ease of use. The purpose of this study was to address the following research questions:

a. What factors influence the use of blockchain for artificial intelligence in the SMEs' sector in the 4.0IR metaverse era in Bangladesh?
b. What reality affects the deployment of blockchain directly in terms of artificial intelligence in the 4.0IR metaverse era?

Nuryyev et al. [33] conducted a study on BT adoption behavior and the sustainability of the business in tourism and hospitality SMEs, and explored one of the few empirical inquiries about BT adoption among SMEs. This study is based on the emerging BT and the potential for cryptocurrency payments to upend the established modes of operation for SMEs in the travel and hospitality industries. Therefore, it is crucial to consider the key variables that affect SMEs' intent to use this technology. In order to emphasize the degree of BT dissemination and investigate what influences SMEs' adoption of blockchain, Bracci et al. [34] investigated adopting a knowledge management viewpoint and drawing on the technology acceptance model. The findings indicate that although BT is commonly recognized, there is little actual understanding. In addition, the study shows that adoption rates are quite low. Knowledge, perceptions of blockchain's utility, and simplicity of use are all related to interest in the technology's potential adoption. Sciarelli et al. [35] identified the factors of users' behavioral adoption of Blockchain, studying the interactions between these variables and investigating and providing a more thorough understanding of BT adoption. The findings reveal that "efficiency and security" are major factors in organizations' decisions to use Blockchain. Furthermore, the findings reveal that perceived utility is a major predictor of the desire to employ Blockchain in corporate activities.

By providing an insight into the variables impacting Bangladeshi SMEs' intentions to embrace BT in their business operations, the research adds to the body of literature already in existence. As a result, many stakeholders, including SMEs, technology developers, suppliers, and regulatory agencies, are given a chance to consider the factors influencing their decision to use BT. The study contributed by presenting a brand-new comprehensive framework for using BT. This framework may be used to investigate the factors that influence the adoption of BT in various micro, small, and big firms in Bangladesh and overseas that operate in the manufacturing and service sectors.

This study also contributes to the field of study on how SMEs are using blockchain and AI by analyzing empirical findings based on numerous parameters. This research also develops the theoretical underpinnings of the distinctive aspects of SMEs in the acceleration of AI. Ultimately, this study is crucial because it advances knowledge of the understudied topic of blockchain and AI deployment in SMEs by integrating BT with the application of AI into business management and operations [32].

The structure of this study is as follows: Section 1 presents an introduction on the subject of BT and AI within Bangladeshi's SMEs; Section 2 shows the literature review and hypotheses development; Section 3 discusses the research methodology; Section 4 describes the findings in further detail. Finally, Section 5 discusses and concludes the study's findings.

2. Literature Review and Hypotheses Development

2.1. Blockchain Technology and Artificial Intelligence

Blockchain and AI ideas are unquestionably growing in popularity. Both technologies differ in terms of technological complexity and their potential for wide-ranging commercial effects [33]. A widespread misconception is that BT is decentralized and consequently not under any one person's authority. However, the blockchain system's basis is still ascribed to a set of key engineers. Consider a smart contract, which is essentially a collection of codes (or functions) and data (or states) created and published on a blockchain (such as Ethereum) by multiple human programmers [34]. Consequently, it is much less likely to be devoid of gaps and errors. This post assumes that BT implementation may be aided or improved by various AI approaches. A quick overview shows how AI could be utilized to produce bug-free smart contracts to reach BT's objective. The combination of AI with blockchain is anticipated to open up many opportunities for SMEs [35,36].

Moreover, innovation is a word that comes to mind when talking about BT and AI. Given the new data science, classification algorithms, and AI technologies [37,38], it is evident that rivals must pool their data to gain from a market. A new governance model built around the idea of a shared data repository is necessary to enable this sharing. A network with intense competitive pressures will not be able to support full BT and AI since it is not practical for all use cases [39]. Transparency and privacy in the service link between humans and technology is the cornerstone of the dynamic that allows people and organizations to engage in blockchain business services without fear [40]. BT saves transaction history at every node: anybody may access the history of every transaction they make [41]. Furthermore, because blockchain transactions are recorded using public and private keys (i.e., long sequences of characters that no one can read), users can opt to remain anonymous to safeguard their privacy while allowing other parties to validate their identities [42].

2.2. Knowledge

Organizations must manage knowledge carefully since it can take many forms, including tacit and explicit knowledge [43,44]. Knowledge management is described as the process of knowledge creation, knowledge acquisition, knowledge sharing (KS), and knowledge application [43,45]. Knowledge improves an activity's efficacy and quality. Academics and practitioners should explain how AI knowledge can guide SMEs [44,45]. Knowledge transfer exemplifies how employees apply their viewpoints, experience, and knowledge to solve challenges and deliver unique solutions [45]. Connelly and Kelloway [46] defined KS as a "set of actions, including exchanging information with others". Wu and Zhu [47] defined KS as "the extent to which knowledge workers share their expertise with their colleagues or peer groups". It is also known as the process of converting personal information into organizational information. Knowledge sharing makes relevant knowledge available to others inside a firm [48–50].

BT may be utilized to improve knowledge development, management, and transfer of AI [49]. It might make knowledge management more organized [49]. BT is one of the pillars of knowledge management [50]. Successful firms generate, distribute, and incorporate knowledge into their technology [51]. Thus, AI or new technologies may improve knowledge management, ultimately improving organizational performance and learning methods [52]. Blockchain may assist the enhancement of knowledge management in the direction of AI by codifying and translating tacit information into explicit knowledge inside businesses [53]. BT's decentralization and immutability have the potential to tackle problems with knowledge storage, quality, security, and information loss. Furthermore, BT's traceability, immutability, and anonymity may promote knowledge sharing and distribution by enhancing confidence between partners [54] and assisting managers in recognizing provenance and responsibility in the process of knowledge identification [54].

Because of its openness, speed, and efficiency, BT has the ability to improve the principles of knowledge management, notably incentive, reciprocity, trust, and intention [55].

As a result, it can potentially improve the knowledge management process. Another area where BT could improve knowledge management is supply chain management. In this sense, AI is critical to BT development. Akhavan and Namvar [56] use blockchain to provide a theoretical framework for supply chain knowledge management. This theoretical framework focuses on knowledge management production, sharing, storage, and application, with AI playing a crucial role in SMEs. Among the benefits mentioned by the authors are real-time access, open usage, intellectual property, user identification, trust, and the acquisition, creation, monitoring, and distribution of information [57].

Although BT is becoming more popular and important in practice and research, little is known about how it is utilized by small and medium-sized firms (SMEs) and the factors that drive their adoption [58]. From the knowledge management perspective, this paper investigates the use of BT with the application of AI in SMEs. Previous research has largely focused on technological blockchain challenges in major international enterprises including banks and insurance [59]. AI and BT are becoming increasingly important for SMEs [60]. However, SMEs, face several challenges, limiting their ability to invest in technology when compared to large firms, owing to a lack of resources and poor innovative capabilities [61]. Furthermore, few studies have looked at the consequences of BT and AI for knowledge management, particularly in SMEs [62]. They are unable to keep up with technological development and growth. Furthermore, the nature of SMEs' business is less likely to employ knowledge management methods and techniques [63].

Zareravasan et al. [64] investigate the influence of BT and AI on information sharing and management by examining the causes and benefits. Akhavan and Namvar [56] investigate the possibilities of BT in supply chain management. The authors discuss how supply chain management might leverage blockchain and AI to execute flexible networks and overcome the limitations of traditional centralized information management solutions. Blockchain applications in knowledge management may increase knowledge distribution, identification, sharing, and retention [65]. As a result, it is hypothesized that:

H1. *Knowledge of artificial intelligence has a positive and significant effect on the adoption of blockchain technology in SMEs.*

2.3. Relevant Advantage

Another important aspect in the adoption of blockchain technology for smart learning environments, according to our study, is relative advantage [66,67]. This is known as the degree to which an innovation is regarded as superior to the idea it has replaced [66]. By utilizing these attributes, it is possible to determine whether end consumers would accept BT. The literature has repeatedly demonstrated that customer intentions to embrace BT can be influenced by perceived relative benefits [68,69]. Past findings revealed that although consumers could enjoy larger proportional advantages, they might also think BT is more useful [70]. Relative advantage considerably affected the adoption of BT in past studies [71,72]. Studies have consistently shown that consumers' intentions to use BT were favorably impacted by their perceptions of relative advantages [73]. The only study that found that users reported a higher level of usefulness of the technology when they felt higher relative advantages was conducted on the links between relative advantages and the adoption of BT [74,75].

All supply chain procedures can be readily integrated using blockchain [76]. Making a more precise demand prediction, managing inventories, and creating backups as the market scenario changes are all made possible by blockchain [77]. Firms may quickly change suppliers, designs, and other benefits due to their blockchain implementation. Additionally, all quality papers may be standardized and sent to all supply chain participants, which enhances decision-making [78]. All design-related documents may be shared and used with BT [79]. Several companies have already begun integrating BT into production [80]. Similarly, blockchain can help handle logistics more effectively. There are GPS-enabled car tracking systems that can be connected with blockchain. They can supply blockchain with input data that cannot be altered [81].

The literature emphasizes how AI and BT affect business performance [82–84]. AI makes it possible to collaborate and share data, which aids in identifying market trends and implementing corrective measures including outsourcing, switching suppliers, and changing facilities [85]. The supply chain is made agile by AI [86]. However, AI has its constraints and cannot produce strategic value on its own. AI cannot provide value unless and until it is combined with organizational and human resources [87]. The importance of AI is widely acknowledged, yet much remains unknown [88]. One of the most important issues for researchers will always be how AI fits into the supply chain [89]. The results discussed above show the potential of IT. Blockchain is a cutting-edge internet-based AI program that allows supply chain participants to share documents and trade quickly, accurately, and reliably [90]. Advanced AI applications such as IoT, big data, and AI may be integrated into blockchain to analyze the data produced by corporate processes [91]. Therefore, it is hypothesized that:

H2. *The relevant advantage of artificial intelligence has a positive and significant effect on the adoption of blockchain technology in SMEs.*

2.4. Perceived Ease of Use

The perceived ease of use is a crucial component of the technology adoption paradigm. It serves as a stepping stone in our quest to understand how people see having simple access to technology [92]. In the technology acceptance paradigm, the impression of ease of use is a key component since it indicates how readily someone plans to use new technology and how much of an improvement it will make to people's lives [92,93].

There are several reasons firms desire to adopt BT [94,95]. In the context of this study, the choice to use BT is straightforward, based on the crucial role of AI [96]. TAM is one of the most extensively used models for examining how technology is utilized and spread, as well as predicting how people will react to BT acceptance or rejection [97,98]. It has been proven in both large and small organizations [98]. It has been used in a wide range of businesses and technologies, including AI [99], social media use, digital technology in education, mobile banking, and BT [100]. TAM is applied in this study to analyze SMEs' aspiration for future blockchain adoption. In terms of perceptions of blockchain's usability, the desire to adopt the technology is a dependent variable.

The degree to which technology requires the least effort to use, understand, operate, and comprehend is known as perceived ease of use [101]. We used the following factors to determine perceived ease of use: lack of knowledge, cyber security, high volatility, initial costs, lack of privacy, and immutability. The literature shows that these factors can prevent the use of technology or give the impression that it is difficult to understand, learn, and use [102–104]. Past studies depicted that perceived simplicity of use affects potential consumers' acceptance of BT [105,106]. Contrary to some of the other technical qualities, there has been relatively little study on how complexity affects consumers' adoption of BT [107]. One explanation is that perceived ease of use is typically not operationalized in isolation. Nuryyev et al. [108] asserted that the likelihood that technology or innovation would be accepted decreases with complexity [109], as do potential users' confidence in their ability to utilize it. Therefore, it was hypothesized that:

H3. *Perceived ease of use of artificial intelligence has a positive and significant effect on the adoption of blockchain technology in SMEs.*

2.5. Risk-Taking Behavior

Risk-taking behavior refers to a company's readiness to utilize blockchain technology in an uncertain business environment [109]. It is the degree to which people take risks and is determined by how much they anticipate losing wealth by employing BT [110]. Risk-taking behavior is anticipated to affect behavioral intention (BI) to employ BT. People naturally oppose change and dislike stepping outside of their comfort zone [111,112]. Among other difficulties, privacy invasion or security concerns might prohibit businesses from seizing new chances. Furthermore, because BT is still in its infancy, there are a lot of challenges to overcome, such as threats to security and privacy and a lack of understanding of what blockchain is [113,114]. The concept of risk-taking is distinct from recklessness, characterized by a lack of risk awareness. Risk-taking behavior depends on risk awareness and the decision to follow through with a choice in R&D, cash holding, and diversification strategy during AI application. It is a behavior associated with knowledge exchange [115,116].

According to the conventional notion of risk-taking behavior, an entrepreneur must be a risk-taker to use BT, which implies higher performance [117]. Entrepreneurs expect to gain more from their business decision by investing in technology for their small enterprises, which translates into a willingness to bear the risks associated with employing AI [118,119]. The outcome is related to the self-interest assumption's regular features, such as cost, return, and risk [119]. SMEs are high-risk businesses, but larger companies may be able to access more resources while simultaneously lowering risk [120]. It is only possible if SMEs have access to technology. AI plays the most significant function in this regard. Due to minor economies of scale, SMEs with basic organizational structures will be less profitable but more adaptable to the changing environment [121]. By utilizing their managerial competencies more efficiently and adopting BT, the long-term orientation approach encourages SMEs to take risks [122].

The usual diffusion strategy assumes that individual interest in BT and willingness to take risks are related [123,124]. Understanding risk-taking behavior impacts difficult information technology decisions critical for successful deployments [125]. Their findings show the need to consider risk-taking behavior while attempting to halt the growing trend of costly technology installation failures [126]. The social system learns about the invention's presence and characteristics and qualities, which leads to risk-taking behavior [127]. Certain BT properties have been discovered to be key drivers of readiness to join the system by modifying essential user risk-taking behavior [128,129].

The possible issue with ideas on technological paradoxes is that they only incorporate situational elements as mediating factors, leaving out any individual characteristics. Users may pick a different coping method even if they are using the same technology version due to differences in how they view the contradictions [130,131]. Therefore, specific variables should be considered as ones that affect how much stress people experience due to seeing paradoxes. In a commercial context, ideas addressing risk-taking behavior are strongly tied to theories addressing the acceptance of new technologies. As a result, this study identifies risk-taking behavior as a variable that may affect the adoption of BT [132,133]. The drive to take the risk associated with a certain choice dilemma is referred to as risk-taking behavior. It has been stated that a firm has a natural predisposition to take risks in a particular industry and that this tendency is difficult to modify [28,38]. In the field of AI, this tendency is not unusual. It should be explored while analyzing user behavior concerning the adoption of BT [133,134].

When SMEs embrace AI and BT, their reluctance to participate in knowledge-building activities may help mitigate the dangers connected with such information [135]. Owner–managers are concerned that the volatile business environment would jeopardize their future income [136–138]. They tend to postpone hiring new employees or deploying new technology, resulting in a "wait and see" attitude [139,140]. The "wait and see" posture implies that choices were postponed but made at the right time considering BT. Therefore, it is hypothesized that:

H4. *Risk-taking behavior mediates the relationship between knowledge of artificial intelligence and adoption of blockchain technology.*

H5. *Risk-taking behavior mediates the relationship between relevant advantage and adoption of blockchain technology.*

H6. *Risk-taking behavior mediates the relationship between perceived ease of use of artificial intelligence and adoption of blockchain technology.*

Figure 1 depicts the study's framework. In this study, six hypotheses were developed. The relationships between knowledge, relevant advantage, and perceived ease of use with adopting BT indicate hypotheses 1, 2, and 3. Furthermore, hypotheses 4, 5, and 6 show that risk-taking behavior mediates the relationship between knowledge, relevant advantage, and perceived ease of use with adopting BT.

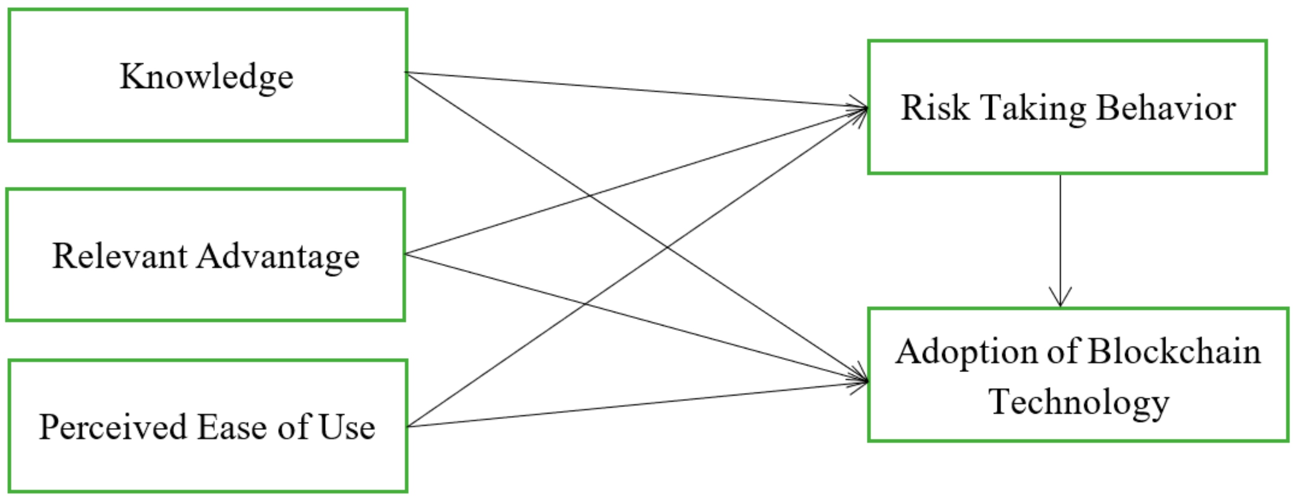

Figure 1. The framework of the study.

3. Methodology of the Study

3.1. Sample and Data

The study data were collected from SME owners/top managers (one informant from each) in Dhaka, Bangladesh. A stratified random sample was employed for this cross-sectional study. In this study, sample SMEs that operate in the era of digital transformation 4.0IR and employ smart technology were chosen. The splitting of a population into smaller subgroups known as strata is a key component of the sampling technique known as stratified random sampling. The strata are created based on the common traits or features of the members, such as income or level of education. We have used firm size (number of full-time employees) as criteria for defining the strata. This categorization assists the authors to obtain an acceptable balance between both small-sized companies and medium-sized companies in our final sample. The sampling aim is to choose a sample that is representative of the population [141]. In-country-trained research assistants collected the data. Professional academic interpreters translated the original survey items into Bengali, the official language of Bangladesh. We disseminated this questionnaire to eight academics and academic experts before conducting the final survey to assess its readability and reliability. On the basis of input from the survey's pre-test, small adjustments were made to several items at this point [142]. Five top managers reviewed the survey to ensure that no questions were unanswerable. Twenty items, four for each one, were used to measure the constructs, which were modified from earlier literature. A five-point Likert scale was used to evaluate each item (1 = "strongly disagree" and 5 = "strongly agree"). We added two screening questions (*Do you know that blockchain is a decentralized distributed database of immutable records?; Do you know that the blockchain technology was discovered with the invention of bitcoins—the first cryptocurrency?*) on the first page of the survey to ensure that the participants were familiar with BT. Furthermore, seven demographic-related items of information for survey respondents were provided in section A of the questionnaire (namely, gender, age, marital status, education level, working experience, firm age, and monthly income). The survey was provided with instructions and a statement describing the study's objectives, the gathering of data, and the assurance of the respondents' privacy [141,143].

Initially, 200 firms in total satisfied the criteria for our sample. Firms that fitted the accepted criteria of SMEs [142,143] as having less than 250 employees were chosen. The survey was conducted in February and March 2022. The survey consists of several variables influencing how SMEs use BT. Each SME manager was contacted personally during the data collection and was questioned about his or her knowledge or experience with BT. Participants who were unfamiliar with BT were not allowed to participate. Following this procedure, the authors obtained responses from 160 owners or managers; 10 of these responses had to be discarded since some of the questions had not been answered. As a result, 150 valid questionnaires were obtained from the respondents (an 80% response rate). We performed a time-trend extrapolation test (Armstrong and Overton, 1977) in order to detect non-response bias as well as predict how non-responsive late respondents would be in comparison to early late respondents (first 25%) and late respondents (last 25%). Our results demonstrated that both tests were resistant to non-response bias [144].

3.2. Measurement

The data were gathered using a questionnaire developed using scales that had already been validated and adopted in the relevant literature. A total of five variables were used in the final survey that accommodated 20 questions. Our 20-item questionnaire satisfies the minimum criteria for a rigorous instrument for Hair et al. [145]. Four items were adopted from [146] to measure the knowledge construct. Four items were adopted to measure relevant advantage from [147]. Furthermore, four items were adopted from [148] to measure the perceived ease-of-use construct. Four items were adopted from [147] to measure risk-taking behavior. Finally, four items were also adopted from [146] to measure BT adoption.

3.3. Data Analysis Technique

Due to having a “small sample size”, “non-normal data”, and “complex models”, the PLS-SEM approach with Smart PLS 3.2.9 software (created by Christian M. Ringle, Sven Wende, Jan-Michael in 2005) was used to analyze the survey data. PLS-SEM is often employed for quantitative data analysis, despite additional data analysis techniques such as correlation, regression, and analysis of variance [144,145,148].

Unlike traditional methodologies, which can only examine measured variables, PLS-SEM enables researchers to analyze the link between observed (measured) and unobserved variables (latent constructs) [145]. Additionally, PLS-SEM [145] may compute and directly include the mediator effects in the model. Data are analyzed using a two-stage model of measurement model and structural model. The measurement model measures latent variables, while the structural model measures the hypotheses based on the path analysis.

4. Findings and Discussion

4.1. Respondents’ Profile

Bangladesh is presently one of the most technologically advanced countries in the world [149]. In light of their technology management strategies and dedication to sustainable innovation, the leading certified SMEs in this research hope to learn how they perceive sustainable development. It may be useful to comprehend the specific situation of technology practices and provide policy implications in the Bangladesh-based context to other uncertified SMEs because the primary source of technology usage is the acquisition of AI, which ultimately leads to sustainable performance in SMEs [149]. The researchers asked permission from the top managers so that they may participate in our study as research subjects. A representative sample of the companies responded to the survey. In this regard, the research model and results were validated using data from owners/top managers of 150 small and medium-sized businesses in Dhaka (the capital city of Bangladesh). An original data-gathering method was applied in this investigation.

The demographic breakdown of the respondents is shown in Table 1. According to Table 1, 74 per cent of respondents were male, 40.67 per cent were between the ages of 36 and 40, 82 per cent were married, 50 per cent had postgraduate degrees, 36.67 per cent had 5 to 9 years of work experience, 40 per cent of firms had 6–8 years age of foundation after establishment, and 50 per cent reported monthly incomes below USD 500.

Table 1. Respondents' demographic profile.

Characteristics	Frequency	Percentage	Characteristics	Frequency	Percentage
Gender			*Working Experience*		
Male	111	74	Less than 5 Years	81	54
Female	39	26	5–9 Years	55	36.67
Age			10–13 Years	12	8
30 Years or below	9	6	14 Years or above	2	1
31–35 Years	33	22			
36–40 Years	61	40.67	*Firm Age*		
41–45 Years	44	29	Less than 5 Years	45	30
46 Years or above	3	2	6–8 Years	60	40
Marital Status			9–11 Years	35	23
Single	22	14.67	12–14 Years	5	3
Married	123	82	15 Years or above	5	3
Divorced	5	3	*Monthly Income (USD)*		
Education Level			Below 500	75	50
Diploma	13	8.67	501–1000	45	30
Under Graduate	75	50	1001–1500	8	5
Post Graduate	60	40	1501–2000	15	10
Others	2	1	2001 or above	7	4.67
Total–150					

4.2. Measurement, Validity, and Reliability

A two-step methodology was used in the current study to test the suggested model. We started by examining the notions' validity and reliability. To assess the importance of the structural path, bootstrapping was used in the second phase.

Our sample size of 150 surpasses the 100–200 sample observations recommended by Sroufe and Gopalakrishna-Remani [150] for undertaking path modeling. The validity and reliability of the data were originally examined before factor analysis. By determining Cronbach's alpha and the R-squared ($\mathbf{R^2}$) measure, the data's internal consistency, discriminant validity, and coefficient of determination were examined. The internal consistency is indicated by Cronbach's alpha values, which exceed 0.7 (see Table 2) [151–153].

Table 2. Measurement model assessment.

Constructs	Items	Loading	AVE	CR	Alpha	R-Square	NFI	SRMR
Knowledge	Employees are responsible for knowledge sharing regarding blockchain technology (K1).	0.847						
	Employees are committed to knowledge sharing regarding blockchain technology (K2).	0.847	0.720	0.911	0.871			
	Employees feel more belonging in the organization by knowledge sharing (K3).	0.859						
	There are organizational technological infrastructures to facilitate knowledge sharing regarding blockchain technology (K4).	0.841						

Table 2. *Cont.*

Constructs	Items	Loading	AVE	CR	Alpha	R-Square	NFI	SRMR
Relative Advantage	Blockchain reduces overhead expenses (RA1).	0.916						
	Blockchain reduces transaction costs while transferring funds (RA2).	0.770	0.759	0.926	0.893			
	Blockchain saves time while accomplishing business tasks (RA3).	0.885						
	Blockchain increases the organization's overall productivity (RA4).	0.905						
Perceived Ease of Use	It is easy to operate blockchain (PEU1).	0.906						
	Blockchain is simple to operate (PEU2).	0.803	0.704	0.904	0.858			
	It is easy to study blockchain (PEU3).	0.863						
	It is easy to comprehend blockchain (PEU4).	0.777						
Risk-Taking Behavior	Blockchain is not secured (RTB1).	0.918						
	Blockchain may increase data error rates (RTB2).	0.826	0.777	0.933	0.904	0.872		
	Their transactions' information will be compromised while using blockchain (RTB3).	0.908						
	Blockchain will not provide its expected benefits (RTB4).	0.871						
ABT	I believe our company should implement blockchain technologies in the NEAR future (ABT1).	0.895						
	We are working out/already have an implementing plan with budget for blockchain technologies (ABT2).	0.951	0.76	0.926	0.893	0.920	0.07	0.910
	Blockchain Technology is a reliable way to maintain privacy of employees like me (ABT3).	0.778						
	Blockchain technology will help stakeholders in browsing information specific to their requirements for taking decision-making (ABT4).	0.852						

AVE: Average Variance Extracted; CR: Composite Reliability; NFI: Normed Fit Index; SRMR: Standardized Root Mean Square Residual; ABT: Adoption of Blockchain Technology.

The factor loadings should be 0.50 or above, according to the rule of thumb suggested by Vinzi et al. [154]. The factor loadings of this study exceed 0.50, as shown in Table 2. Figure 2 displays the factor loading of the measurement items. Additionally, it was discovered that the composite reliability and the AVE test values were greater than the typical values of 0.7 and 0.5, respectively, which is a reliable sign. The value of Cronbach's alpha should be 0.70 or above [155]. Confusion among respondents might lead to their responding incorrectly to a certain item. In this instance, the construct item with the lowest factor loading must be removed and the AVE recalculated [155]. Table 2 shows that Cronbach's alpha is greater than 0.70. In this approach, the value of each construct's Cronbach's alpha illuminates the requirement [155]. Table 2 displays the construct reliability and AVE outcomes. It demonstrates that it would have an impact on the adoption of BT on exogenous variables (0.920 or 92 per cent). A large impact on exogenous variables may also be shown in risk-taking behavior (0.872 or 87.2 per cent). Table 2 demonstrates that the NFI value is close to 1, indicating that the model satisfies the study's objectives [155]. The model fit is good as indicated by the SRMR score of 0.08 [155].

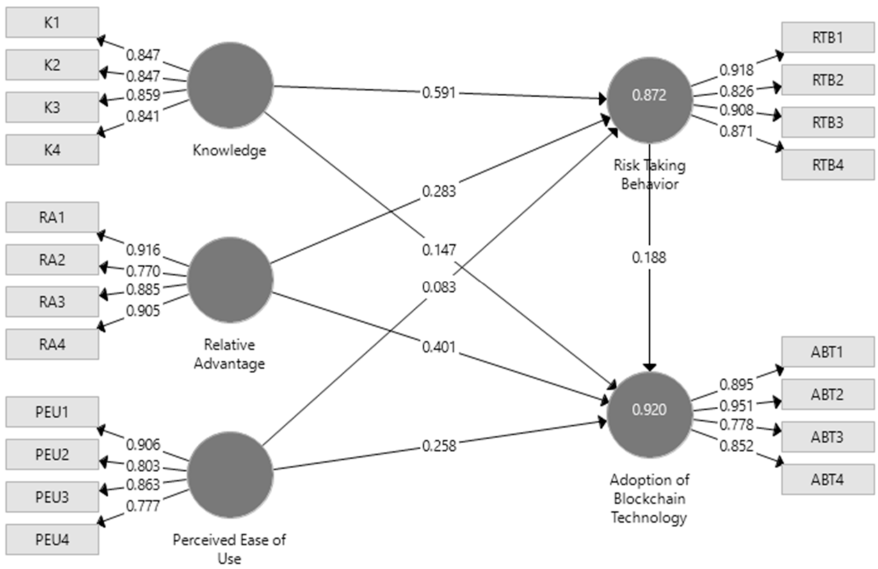

Figure 2. Standardized results of the SEM calculations.

Table 3 demonstrates that the Q^2 values are larger than zero, demonstrating the model's continued predictive relevance [154]. Knowledge, perceived ease of use, and risk-taking behavior have a small impact on the adoption of BT, according to the effect sizes (f^2). Relative advantage has a medium effect on the adoption of BT. Furthermore, knowledge has a large effect on risk-taking behavior. Perceived ease of use and relative advantage have a small effect on risk-taking behavior. Overall, the model finds strong predictive significance and adequate fitness.

Table 3. Values of the Stone–Geisser indicator (Q^2) and Cohen's indicator (f^2) of the model in the SEM.

Variables	Q^2	ABT (f^2)	Risk-Taking Behavior (f^2)
Adoption of Green Energy Technology	0.594		
Knowledge	0.522	0.026	0.369
Perceived Ease of Use	0.501	0.105	0.088
Relative Advantage	0.591	0.261	0.089
Risk-Taking Behavior	0.617	0.056	

Large effect > 0.34; Medium effect > 0.14; Small effect > 0.01; Cohen [153].

4.3. Discriminant Validity

4.3.1. Fornell–Larcker Criterion Analysis

The estimated correlations between the LV (Latent Variables) and the AVE square roots in the primary diagonal of the SEM are shown in Table 4. The evaluation of the Fornell–Larcker [155] criteria reveals strong discriminant validity (the bolded square root of the AVE), which is greater than the correlations between the variables, ranging from 0.839 to 0.882. Table 5 shows the heterotrait-monotrait (HTMT) analysis for discriminant validity. Furthermore, the HTMT values are below 0.85, which was discovered when cross-validating the discriminant validity [156]. This shows there is no discriminant issue in this dataset.

Table 4. Fornell–Larcker criterion analysis for discriminant validity.

		1	2	3	4	5
1	Adoption of Green Energy Technology	0.872				
2	Knowledge	0.719	0.849			
3	Perceived Ease of Use	0.723	0.613	0.839		
4	Relative Advantage	0.736	0.603	0.509	0.871	
5	Risk-Taking Behavior	0.609	0.623	0.581	0.693	0.882

The diagonal is the square root of the AVE (in bold) of the latent variables and indicates the highest in any column or raw. Note: LV—Latent Variable.

4.3.2. Heterotrait-Monotrait (HTMT) Analysis

Table 5. The heterotrait-monotrait (HTMT) analysis for discriminant validity.

		1	2	3	4	5
1	Adoption of Green Energy Technology					
2	Knowledge	0.344				
3	Perceived Ease of Use	0.389	0.489			
4	Relative Advantage	0.278	0.378	0.232		
5	Risk-Taking Behavior	0.287	0.267	0.287	0.477	

Discriminant validity exists if HTMT < 0.85 [156]. Discriminant validity exists if HTMT < 0.90 Gold et al. [157].

4.4. Structural Model Assessment

The evaluation of the structural model is yet another crucial step in the validation process. The t-values and $\mathbf{R}^2$ values have also been calculated using the bootstrapping procedure with 4999 resamples. Figure 2 displays the results of the standardized results. All items frequently had outer loads higher than the threshold. Most variables have excellent direction coefficients.

4.5. Hypotheses Testing (Direct and Indirect Relationships)

The results of the direct impact hypotheses are displayed in Table 6. To obtain the statistical t-values, PLS bootstrapping was used. The *p*-value was calculated using a 95% confidence interval, which is an appropriate level for social science research [157,158]. Table 6 displays the findings of the hypotheses verification. It was presumptively believed that knowledge has a positive and significant impact on the adoption of BT. As anticipated, there is a strong and significant connection between knowledge and the adoption of BT ($\beta = 0.150$, t = 1.991, $p < 0.05$, see Table 6), which supports Hypothesis 1. The studies of Bracci et al. [35], Boukis [138], and Dobrovnik et al [150] support this hypothesis.

Table 6. Results of direct effect hypotheses.

Hypotheses	Relationship	Std Beta	Std Error	t-Value	*p*-Value	Decision
H1	Knowledge → Adoption of Blockchain Technology	0.15	0.074	1.991	0.047	Supported
H2	Relative Advantage → Adoption of Blockchain Technology	0.41	0.07	5.729	0	Supported
H3	Perceived Ease of Use → Adoption of Blockchain Technology	0.255	0.071	3.621	0	Supported

ABT: Adoption of Blockchain Technology.

It was presumptively assumed that relative advantage has a positive and significant impact on the adoption of BT. The findings showed that relative advantage and the adoption of BT are positively and significantly connected ($\beta = 0.410$, t = 5.729, $p < 0.001$, see Table 6), which supports Hypothesis 2. The studies of Lu et al. [70], Clohessy et al. [79], and Ullah et al. [95] support this hypothesis. It was presumptively assumed that perceived ease of use has a positive and significant impact on the adoption of BT. The findings demonstrate a positive and significant relationship between perceived ease of use and the adoption of BT (β = 0.255, t = 3.621, $p < 0.001$, see Table 6), which supports Hypothesis 3. This finding is congruent with Nuryyev et al. [34], Grover et al. [46], and Ullah et al. [95].

Table 7 shows the results of indirect hypotheses. The PROCESS MACRO program, designed by Preacher et al. [159] and Hayes [160], was used to test the hypotheses. To provide confidence intervals for these conditional direct and indirect effects, PROCESS uses a bootstrapping technique. More precisely, we used Model 4 from Hayes [160] to quantify the mediating role, which perfectly suits our study model, and we set the bootstrapping sample size to be 5000. Table 7 shows the indirect impacts among the study's variables, together with their standardized path coefficients.

Table 7. Results of indirect hypotheses.

Hypotheses	Relationship	Path Coefficient	t-Value	*p*-Value	LLCI	ULCI	Decision
H4	Relative Advantage → Risk-Taking Behavior → ABT	0.106	2.251	0.025	0.1507	0.3105	Supported
H5	Relative Advantage → Risk-Taking Behavior → ABT	0.051	1.715	0.087	0.1319	0.2794	Rejected
H6	Knowledge → Risk-Taking Behavior → ABT	0.016	0.807	0.421	0.1467	0.2345	Rejected

LLCI: Lower-Level Confidence Interval; ULCI: Upper-Level Confidence Interval. ABT: Adoption of Blockchain Technology.

It was predicted that risk-taking behavior mediates the association between knowledge and the adoption of BT. The finding that risk-taking behavior mediates the association between knowledge and the adoption of BT (β = 0.106, t = 2.251, $p < 0.05$, see Table 7), supports Hypothesis 4. It was predicted that risk-taking behavior mediates the association between relative advantage and the adoption of BT. The fifth hypothesis, that risk-taking behavior mediates the association between relative advantage and the adoption of BT, was not supported (β = 0.051, t = 1.715, $p > 0.05$, see Table 7). Thus, Hypothesis 5 is rejected. In the sixth hypothesis, it was assumed that risk-taking behavior mediates the association between perceived ease of use and the adoption of BT. Hypothesis 6 was not confirmed, because the mediation of risk-taking behavior on the relationship between perceived ease of use and the adoption of BT is not significant (β = 0.016, t = 0.807, $p > 0.05$, see Table 7).

5. Conclusions

In this paper, we sought to clarify the important factors that affect SMEs in Bangladesh in their acceptance and use of BT. In order to achieve this, we have suggested a concept that applies AI to BT. Then, using PLS-SEM, the suggested model was evaluated. The four literary contributions made by this study are as follows. Firstly, it creates a more complex and thorough model that investigates both the indirect processes that mediate the link and the direct factors for understanding each SME's specific blockchain adoption behavior [161–163]. It also provides actual evidence to support the proposed model. Thirdly, the study fills a gap in the literature by applying the conceptual model to cross-sectoral SMEs in Bangladesh. The expertise, relative advantage, and perceived ease of use, which the study indicated had a positive and significant influence on blockchain adoption in Bangladesh, are just a few of the key insights provided by the findings to managers working on blockchain adoption programs [164–166]. The findings unmistakably show that risk-taking behavior mediates the relationship between knowledge and adoption of BT. It means that risk-taking behavior is crucial for any individual to consider the risk factor when adopting any strategy for the firm. The findings also reveal that risk-taking behavior mediates the relationship between relevant advantage and perceived ease of use with the adoption of BT. It means that risk-taking behavior does not work in individuals when relevant advantages and perceived ease-of-use factors are considered for the adoption of

BT. It may happen when firms do not consider risk factors when they adopt BT in terms of relevant advantage and perceived ease of use.

In order to survive and remain ahead of the present complicated and dynamic business climate, organizations must modify their processes of activities. SMEs in Bangladesh have developed into a government-driven economic force [167,168]. The SMEs' industry in Bangladesh has been compelled to compete fiercely as a result of this intense business environment. SMEs today emphasize research and innovation in order to keep up with the rapidly evolving business environment [169–172]. BT has the potential to transform the procedures and services that SMEs provide. This industry can benefit from BT's increased transparency, improved traceability, and improved security. Many SMEs globally are utilizing these AI-enhanced BT capabilities. However, Bangladeshi SMEs are lagging behind in implementing BT. This research's goal is to discover and assess the factors (enablers or hurdles) that affect Bangladeshi SMEs' intentions to use BT [173–175].

In this study, knowledge, relative advantage, and perceived ease of use were the predictor, while adoption of BT was the dependent variable. Based on the results, four of the six developed hypotheses were accepted. Knowledge, relevant advantage, and perceived ease of use were shown to be the key determinants of Bangladeshi SMEs' intention to adopt BT. The variance that may be accounted for in the adoption of BT may increase if more external variables are incorporated into this framework. Therefore, it is advised to include additional external factors in the context of AI, organization, and environment while examining the adoption of BT. It was well observed that understanding AI plays a crucial role in discovering how external predictors would affect the uptake of BT [176]. It is advised to include elements of risk-taking behavior as mediating variables when analyzing the potential of BT adoption. Consistent with other studies, knowledge, relative advantage, and perceived ease of use all had an impact on the adoption of BT. To generalize the impact of these factors on the adoption of BT, future studies should also incorporate these variables. Since senior managers from each of the 150 Bangladesh-based SMEs were engaged in this study as informants, including more SMEs might lead to more consistent findings. While the scope of this study is confined to Bangladesh's SMEs, future studies may examine more sample nations to identify trends in blockchain adoption.

6. Implications of the Study

6.1. Theoretical Implications

The findings of this study significantly advance both theories and methods. Firstly, the authors of [170,171] made a strong case for the essential need to add empirical support to the current state of blockchain research, which is largely exploratory. This study is in response to that demand. The majority of blockchain research undertaken so far has been qualitative and has been included in literature reviews [172–174], to create a conceptual model. Although some academics have made an effort to gather empirical information, this is partly constrained by the focus on a certain industry, such as SMEs. By using the theoretical framework of adoption models and empirical data from Bangladesh's SMEs, this research aims to further the literature on the adoption of BT. Through an empirical method, it also seeks to increase the body of research on models for technological advancements.

BT is generating widespread interest and reputable publications are increasing the call for study on its many facets. The current study made two contributions to the literature. Few empirical studies have been conducted so far that link BT to significant AI metrics in SMEs. The current model links risk-taking behavior, AI, and BT. The model's overall fit is acceptable and it offers crucial information. With reference to BT, the current study developed a model and enhanced BT with it. There are other emerging technologies that SMEs may exploit, including AI, big-data analytics, and the Internet of Things (IoT). The results of this study can be used as a guide for examining how various technologies affect SMEs. Future research should examine in depth how BT might enhance certain supply networks in SMEs (such as agro-foods, downstream petroleum supply chains, etc.). For such future research, the general framework provided by the current study can act as a foundation. Future research might also look at how the use of BT affects other crucial supply chain metrics for SMEs, such knowledge, relevant advantage, and perceived ease of use.

6.2. Managerial Implications

The verified model shows important connections between proposed variables. Given that blockchain SMEs are still in the early stages of adoption, we have created a model to provide a better understanding of individual behavior that drives the uptake of this disruptive BT in the SME sector. As a result, it is easier for businesses to decide which crucial elements to focus on to in order to develop a thorough grasp of the difficulties associated with the implementation of blockchain in SMEs. The traditional perspective of the behavioral incentive to use and adopt a certain technology is less useful than the findings of this study. The difficulties of adopting one model alone, which would mean losing the benefits of other models, are solved by this combination. Practically speaking, our findings demonstrate that the knowledge, relevant advantage, and perceived ease of use have a positive and significant impact on important aspects in the influence that directly affect the adoption of BT in SMEs' operations. We found that the association between the understanding and adoption of BT is mediated by risk-taking behavior. To cooperate, Bangladeshi SMEs' management/managers must uphold long-term bonds, increase their readiness to divulge information to supply chain partners, and enhance mutual communication.

Furthermore, the results of the current study suggest that businesses should actively collaborate with AI companies to develop blockchain-based supply chain solutions in SMEs, in addition to increasing their knowledge of BT, in order to meet top managers' expectations regarding the technology's potential to improve business performance [168–170]. Supply chain and logistics managers at AI firms should offer training sessions for staff and encourage them to learn more about BT and how it may enhance company operations. BT may be employed in logistics because it can enhance tracking and bring about greater transparency in logistics, which improves the delivery cycle. Vehicle monitoring and recording tools including GPS and RFID can be connected with BT using AI [171–173]. BT uses their location and tracking data as input, and these data are unchangeable. This will provide convenient cargo tracking and increase operational effectiveness, particularly for export logistics [174,175]. The use of BT in manufacturing is similar; all quality documentation may be standardized and distributed to all participants in the supply chain, which will enhance decision-making [169]. Because blockchain is a meta-technology, it will constantly benefit from the addition of other technologies, such as IoT and big data [176,177]. The current study will increase managers' interest in related technology. Last but not least, businesses who want to embrace and create blockchain-based AI solutions for the supply chain should begin pushing regularity actors to create a legislative framework for regulating BT. The technology will continue to be exceedingly dangerous to implement without a legal framework. There is currently no specific legislative structure to address BT in a country such as Bangladesh. Top managers, businesses, and academics should collaborate to research, create, and recommend a framework for regulating BT to policy actors [178,179].

7. Limitations and Future Directions for Research

There are several limitations to this study. Few companies are familiar with BT since it is still a relatively new concept. As an emerging economy only, Bangladesh is taken into consideration for the study context. Future cross-cultural research with other industrialized nations such as the US and UK and other crucial elements, such as local restrictions, can be considered to better comprehend the suggested model. Our findings suggest that blockchain adoption in enterprises will increase with time; a longitudinal analysis of this trend will be more interesting. The integration of BT with other technologies for security and privacy objectives was not examined. Blockchain integration with the Internet of Things can be considered in the future for greater understanding. Thirdly, researchers may think about merging additional possibilities in subsequent studies. Finally, the public's increased knowledge of BT's benefits seems to dispel the notion that they are unbreakable and safer. The design of smart contracts for additional assessment, including group-based smart contracts and self-assessment, may be the subject of future research. To establish a better organizational performance, it would be advisable to investigate the function of micropayment in organizational performance systems supported by BT with AI mechanisms.

Author Contributions: Methodology, M.R.H.P.; research study, A.A.J., A.I.K. and A.S.M.S.-U.-Z.; results, M.R.H.P.; introduction—review, R.K. and A.R.O.; conclusions, M.R.H.P.; writing—original draft preparation, M.R.H.P.; writing—review and editing, R.K. and A.R.O.; management of research project and research resources, M.R.H.P. All authors have read and agreed to the published version of the manuscript.

Funding: The authors would like to thank the Institute for Advanced Research (IAR) of United International University for supporting the research, authorship, and publication of this article (Institute for Advanced Research Publication Grant Ref. No. IAR/2021/Pub/014).

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of United International University and approved by the Institutional Review Board (or Ethics Committee) of the Institute for Advanced Research (Approval Code: IAR/2021/Pub/014).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no potential conflict of interest with respect to the research, authorship, and publication of this article.

Appendix A

Knowledge [146]:

(1) Employees are responsible for knowledge sharing regarding blockchain technology.
(2) Employees are committed to knowledge sharing regarding blockchain technology.
(3) Employees feel more belonging in the organization by knowledge sharing.
(4) There are organizational technological infrastructures to facilitate the knowledge sharing regarding blockchain technology.

Relevant Advantage [147]:

1. Blockchain reduces overhead expenses.
2. Blockchain reduces transaction costs while transferring funds.
3. Blockchain saves time while accomplishing business tasks.
4. Blockchain increases the organization's overall productivity.

Perceived Ease of Use [148]:

1. It is easy to operate blockchain.
2. Blockchain is simple to operate.
3. It is easy to study blockchain.
4. It is easy to comprehend blockchain.

Risk-Taking Behavior [147]:

(1) Blockchain is not secured.
(2) Blockchain may increase data error rates.
(3) Their transactions' information will be compromised while using blockchain.
(4) Blockchain will not provide its expected benefits.

Adoption of Blockchain Technology [146]:

(1) I believe our company should implement blockchain technologies in the NEAR future.
(2) We are working out/already have an implementing plan with budget for blockchain technologies.
(3) Blockchain Technology is a reliable way to maintain privacy of employees like me.

(4) Blockchain technology will help stakeholders in browsing information specific to their requirements for taking decision-making.

References

1. Singh, S.; Sharma, P.K.; Yoon, B.; Shojafar, M.; Cho, G.H.; Ra, I.H. Convergence of blockchain and artificial intelligence in IoT network for the sustainable smart city. *Sustain. Cities Soc.* **2020**, *63*, 102364. [CrossRef]
2. Kusuma, I.G.A.T.; Tahu, G.P.; Widyani, A.A.D.; Langgeng, M. When A New Product Innovatıon Negatıvely Impacts Marketıng Performance. *APMBA* **2022**, *11*, 41–60.
3. Novillo-Villegas, S.; Ayala-Andrade, R.; Lopez-Cox, J.P.; Salazar-Oyaneder, J.; Acosta-Vargas, P. A Roadmap for Innovation Capacity in Developing Countries. *Sustainability* **2022**, *14*, 6686. [CrossRef]
4. Smith, K.; Sepasgozar, S. Governance, Standards and Regulation: What Construction and Mining Need to Commit to Industry 4.0. *Buildings* **2022**, *12*, 1064. [CrossRef]
5. Kakani, V.; Nguyen, V.H.; Kumar, B.P.; Kim, H.; Pasupuleti, V.R. A critical review on computer vision and artificial intelligence in food industry. *J. Agric. Food Res.* **2020**, *2*, 100033. [CrossRef]
6. Zhang, Y.; Xiong, F.; Xie, Y.; Fan, X.; Gu, H. The impact of artificial intelligence and blockchain on the accounting profession. *IEEE Access* **2020**, *8*, 110461–110477. [CrossRef]
7. Islam, A.; Rahim, T.; Masuduzzaman, M.D.; Shin, S.Y. A blockchain-based artificial intelligence-empowered contagious pandemic situation supervision scheme using internet of drone things. *IEEE Wirel. Commun.* **2021**, *28*, 166–173. [CrossRef]
8. Bosri, R.; Rahman, M.S.; Bhuiyan, M.Z.A.; Al Omar, A. Integrating blockchain with artificial intelligence for privacy-preserving recommender systems. *IEEE Trans. Netw. Sci. Eng.* **2020**, *8*, 1009–1018. [CrossRef]
9. Babu, K.E.K. Artificial intelligence in Bangladesh, its applications in different sectors and relevant challenges for the government: An analysis. *Int. J. Public Law Policy* **2021**, *7*, 319–333. [CrossRef]
10. Zheng, Z.; Xie, S.; Dai, H.N.; Chen, X.; Wang, H. Blockchain challenges and opportunities: A survey. *Int. J. Web Grid Serv.* **2018**, *14*, 352–375. [CrossRef]
11. An, Y.J.; Choi, P.M.S.; Huang, S.H. Blockchain, Cryptocurrency, and Artificial Intelligence in Finance. In *Fintech with Artificial Intelligence, Big Data, and Blockchain*; Springer: Singapore, 2021; pp. 1–34.
12. Yang, H.; Fan, Y.; Liu, R. Disease Information Dissemination Prevention and Risk Management Methods in the Blockchain Environment. *Math. Probl. Eng.* **2022**, *2022*, 7617055. [CrossRef]
13. Markopoulos, E.; Kirane, I.S.; Balaj, D.; Vanharanta, H. Artificial intelligence and blockchain technology adaptation for human resources democratic ergonomization on team management. In *International Conference on Human Systems Engineering and Design: Future Trends and Applications*; Springer: Cham, Switzerland, 2019; pp. 445–455.
14. Luo, S.; Choi, T.M. Great partners: How deep learning and blockchain help improve business operations together. *Ann. Oper. Res.* **2021**, 1–26. [CrossRef]
15. Jakšič, M.; Marinč, M. Relationship banking and information technology: The role of artificial intelligence and FinTech. *Risk Manag.* **2019**, *21*, 1–18. [CrossRef]
16. Abbasi, G.A.; Tiew, L.Y.; Tang, J.; Goh, Y.N.; Thurasamy, R. The adoption of cryptocurrency as a disruptive force: Deep learning-based dual stage structural equation modelling and artificial neural network analysis. *PLoS ONE* **2021**, *16*, e0247582. [CrossRef]
17. Meghani, K. Use of Artificial Intelligence and Blockchain in Banking Sector: A Study of Scheduled Commercial Banks in India. *Meghani Indian J. Appl. Res.* **2020**, *10*. [CrossRef]
18. Fusco, A.; Dicuonzo, G.; Dell'Atti, V.; Tatullo, M. Blockchain in healthcare: Insights on COVID-19. *Int. J. Environ. Res. Public Health* **2020**, *17*, 7167. [CrossRef]
19. Gao, W.; Su, C. Analysis on block chain financial transaction under artificial neural network of deep learning. *J. Comput. Appl. Math.* **2020**, *380*, 112991. [CrossRef]
20. Wong, L.-W.; Tan, G.W.-H.; Ooi, K.-B.; Lin, B.; Dwivedi, Y.K. Artificial intelligence-driven risk management for enhancing supply chain agility: A deep-learning-based dual-stage PLS-SEM-ANN analysis. *Int. J. Prod. Res.* **2022**, 1–21. [CrossRef]
21. Deebak, B.D.; Fadi, A.T. Privacy-preserving in smart contracts using blockchain and artificial intelligence for cyber risk measurements. *J. Inf. Secur. Appl.* **2021**, *58*, 102749. [CrossRef]
22. Rodríguez-Espíndola, O.; Chowdhury, S.; Beltagui, A.; Albores, P. The potential of emergent disruptive technologies for humanitarian supply chains: The integration of blockchain, Artificial Intelligence and 3D printing. *Int. J. Prod. Res.* **2020**, *58*, 4610–4630. [CrossRef]
23. Chang, V.; Baudier, P.; Zhang, H.; Xu, Q.; Zhang, J.; Arami, M. How Blockchain can impact financial services–The overview, challenges and recommendations from expert interviewees. *Technol. Forecast. Soc. Chang.* **2020**, *158*, 120166. [CrossRef] [PubMed]
24. Baryannis, G.; Validi, S.; Dani, S.; Antoniou, G. Supply chain risk management and artificial intelligence: State of the art and future research directions. *Int. J. Prod. Res.* **2018**, *57*, 2179–2202. [CrossRef]
25. Calvaresi, D.; Mattioli, V.; Dubovitskaya, A.; Dragoni, A.F.; Schumacher, M. Reputation management in multi-agent systems using permissioned blockchain technology. In Proceedings of the 2018 IEEE/WIC/ACM International Conference on Web Intelligence (WI), Santiago, Chile, 3–6 December 2018; pp. 719–725.

26. Krittanawong, C.; Rogers, A.J.; Aydar, M.; Choi, E.; Johnson, K.W.; Wang, Z.; Narayan, S.M. Integrating blockchain technology with artificial intelligence for cardiovascular medicine. *Nat. Rev. Cardiol.* **2020**, *17*, 1–3. [CrossRef]
27. Mamoshina, P.; Ojomoko, L.; Yanovich, Y.; Ostrovski, A.; Botezatu, A.; Prikhodko, P.; Izumchenko, E.; Aliper, A.; Romantsov, K.; Zhebrak, A.; et al. Converging blockchain and next-generation artificial intelligence technologies to decentralize and accelerate biomedical research and healthcare. *Oncotarget* **2018**, *9*, 5665–5690. [CrossRef] [PubMed]
28. Etemadi, N.; Borbon-Galvez, Y.; Strozzi, F.; Etemadi, T. Supply chain disruption risk management with blockchain: A dynamic literature review. *Information* **2021**, *12*, 70. [CrossRef]
29. Jabarulla, M.Y.; Lee, H.-N. A Blockchain and Artificial Intelligence-Based, Patient-Centric Healthcare System for Combating the COVID-19 Pandemic: Opportunities and Applications. *Healthcare* **2021**, *9*, 1019. [CrossRef]
30. Bublitz, F.M.; Oetomo, A.; Sahu, K.S.; Kuang, A.; Fadrique, L.X.; Velmovitsky, P.E.; Morita, P. Disruptive technologies for environment and health research: An overview of artificial intelligence, blockchain, and internet of things. *Int. J. Environ. Res. Public Health* **2019**, *16*, 3847. [CrossRef]
31. AlShamsi, M.; Salloum, S.A.; Alshurideh, M.; Abdallah, S. Artificial intelligence and blockchain for transparency in governance. In *Artificial Intelligence for Sustainable Development: Theory, Practice and Future Applications*; Springer: Cham, Switzerland, 2021; pp. 219–230.
32. Faella, G.; Romano, V.C. Artificial intelligence and blockchain: An introduction to competition issues. *Compet. Law Policy Debate* **2019**, *5*, 19–25. [CrossRef]
33. Di Vaio, A.; Hassan, R.; Alavoine, C. Data intelligence and analytics: A bibliometric analysis of human–Artificial intelligence in public sector decision-making effectiveness. *Technol. Forecast. Soc. Chang.* **2021**, *174*, 121201. [CrossRef]
34. Nuryyev, G.; Wang, Y.-P.; Achyldurdyyeva, J.; Jaw, B.-S.; Yeh, Y.-S.; Lin, H.-T.; Wu, L.-F. Blockchain Technology Adoption Behavior and Sustainability of the Business in Tourism and Hospitality SMEs: An Empirical Study. *Sustainability* **2020**, *12*, 1256. [CrossRef]
35. Bracci, E.; Tallaki, M.; Ievoli, R.; Diplotti, S. Knowledge, diffusion and interest in blockchain technology in SMEs. *J. Knowl. Manag.* **2021**, *26*, 1386–1407. [CrossRef]
36. Sciarelli, M.; Prisco, A.; Gheith, M.H.; Muto, V. Factors affecting the adoption of blockchain technology in innovative Italian companies: An extended TAM approach. *J. Strat. Manag.* **2021**, *15*, 495–507. [CrossRef]
37. Mohanta, B.K.; Jena, D.; Satapathy, U.; Patnaik, S. Survey on IoT security: Challenges and solution using machine learning, artificial intelligence and blockchain technology. *Internet Things* **2020**, *11*, 100227. [CrossRef]
38. Wang, Z.; Li, M.; Lu, J.; Cheng, X. Business Innovation based on artificial intelligence and Blockchain technology. *Inf. Process. Manag.* **2021**, *59*, 102759. [CrossRef]
39. Chattu, V.K. A review of artificial intelligence, big data, and blockchain technology applications in medicine and global health. *Big Data Cogn. Comput.* **2021**, *5*, 41.
40. Qasim, A.; Kharbat, F.F. Blockchain technology, business data analytics, and artificial intelligence: Use in the accounting profession and ideas for inclusion into the accounting curriculum. *J. Emerg. Technol. Account.* **2020**, *17*, 107–117. [CrossRef]
41. Pablo, R.G.J.; Roberto, D.P.; Victor, S.U.; Isabel, G.R.; Paul, C.; Elizabeth, O.R. Big data in the healthcare system: A synergy with artificial intelligence and blockchain technology. *J. Integr. Bioinform.* **2022**, *19*. [CrossRef]
42. Tagde, P.; Tagde, S.; Bhattacharya, T.; Tagde, P.; Chopra, H.; Akter, R.; Rahman, M. Blockchain and artificial intelligence technology in e-Health. *Environ. Sci. Pollut. Res.* **2021**, *28*, 52810–52831. [CrossRef]
43. Fenwick, M.; Vermeulen, E.P. Technology and corporate governance: Blockchain, crypto, and artificial intelligence. *Tex. J. Bus. Law* **2019**, *48*, 1. [CrossRef]
44. Singh, S.K.; Rathore, S.; Park, J.H. Blockiotintelligence: A blockchain-enabled intelligent IoT architecture with artificial intelligence. *Future Gener. Comput. Syst.* **2020**, *110*, 721–743. [CrossRef]
45. Imron, M.A.; Munawaroh, U.I.; Farida, R.D.M.; Paramarta, V.; Sunarsi, D.; Akbar, I.R.; Masriah, I. Effect of organizational culture on innovation capability employees in the knowledge sharing perspective: Evidence from digital industries. *Ann. Rom. Soc. Cell Biol.* **2021**, *25*, 4189–4203.
46. Grover, P.; Kar, A.K.; Dwivedi, Y.K. Understanding artificial intelligence adoption in operations management: Insights from the review of academic literature and social media discussions. *Ann. Oper. Res.* **2020**, *308*, 177–213. [CrossRef]
47. Ducrée, J. Research–A blockchain of knowledge? *Blockchain Res. Appl.* **2020**, *1*, 100005. [CrossRef]
48. Connelly, C.E.; Kelloway, E.K. Predictors of employees' perceptions of knowledge sharing cultures. *Leadersh. Organ. Dev. J.* **2003**, *24*, 294–301. [CrossRef]
49. Wu, Y.; Zhu, W. An integrated theoretical model for determinants of knowledge sharing behaviours. *Kybernetes* **2012**, *41*, 1462–1482. [CrossRef]
50. Akram, S.V.; Malik, P.K.; Singh, R.; Anita, G.; Tanwar, S. Adoption of blockchain technology in various realms: Opportunities and challenges. *Secur. Priv.* **2020**, *3*, e109. [CrossRef]
51. Hijazeen, O.W.; Fadiya, S.O.; Akkaya, M.; Sari, A. Secure Fuzzy Logic to Study the Impact of Knowledge Management Enablers on Organizational Performance through Decision Making Mediator. *Int. J. Appl. Eng. Res.* **2018**, *13*, 16860–16877.
52. Chen, X.; Chua, A.Y.K.; Pee, L.G. Who sells knowledge online? An exploratory study of knowledge celebrities in China. *Internet Res.* **2022**, *32*, 916–942. [CrossRef]

53. Usmanova, K.; Wang, D.; Sumarliah, E.; Mousa, K.; Maiga, S.S. China's halal food industry: The link between knowledge management capacity, supply chain practices, and company performance. *Interdiscip. J. Inf. Knowl. Manag.* **2021**, *16*, 285. [CrossRef]
54. Mathivathanan, D.; Mathiyazhagan, K.; Rana, N.P.; Khorana, S.; Dwivedi, Y.K. Barriers to the adoption of blockchain technology in business supply chains: A total interpretive structural modelling (TISM) approach. *Int. J. Prod. Res.* **2021**, *59*, 3338–3359. [CrossRef]
55. Kopyto, M.; Lechler, S.; von der Gracht, H.A.; Hartmann, E. Potentials of blockchain technology in supply chain management: Long-term judgments of an international expert panel. *Technol. Forecast. Soc. Chang.* **2020**, *161*, 120330. [CrossRef]
56. Bamakan, S.M.H.; Moghaddam, S.G.; Manshadi, S.D. Blockchain-enabled pharmaceutical cold chain: Applications, key challenges, and future trends. *J. Clean. Prod.* **2021**, *302*, 127021. [CrossRef]
57. Philsoophian, M.; Akhavan, P.; Namvar, M. The mediating role of blockchain technology in improvement of knowledge sharing for supply chain management. *Manag. Decis.* **2021**, *60*, 784–805. [CrossRef]
58. Ruangkanjanases, A.; Hariguna, T.; Adiandari, A.M.; Alfawaz, K.M. Assessing Blockchain Adoption in Supply Chain Management, Antecedent of Technology Readiness, Knowledge Sharing and Trading Need. *Emerg. Sci. J.* **2022**, *6*, 921–937. [CrossRef]
59. Pop, C.D.; Antal, M.; Cioara, T.; Anghel, I.; Salomie, I. Blockchain and Demand Response: Zero-Knowledge Proofs for Energy Transactions Privacy. *Sensors* **2020**, *20*, 5678. [CrossRef] [PubMed]
60. Kouhizadeh, M.; Saberi, S.; Sarkis, J. Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers. *Int. J. Prod. Econ.* **2021**, *231*, 107831. [CrossRef]
61. Toufaily, E.; Zalan, T.; Dhaou, S.B. A framework of blockchain technology adoption: An investigation of challenges and expected value. *Inf. Manag.* **2021**, *58*, 103444. [CrossRef]
62. Rainero, C.; Modarelli, G. Food tracking and blockchain-induced knowledge: A corporate social responsibility tool for sustainable decision-making. *Br. Food J.* **2021**, *123*, 4284–4308. [CrossRef]
63. Ku-Mahamud, K.R.; Omar, M.; Bakar, N.A.A.; Muraina, I.D. Awareness, trust, and adoption of blockchain technology and cryptocurrency among blockchain communities in Malaysia. *Int. J. Adv. Sci. Eng. Inf. Technol.* **2019**, *9*, 1217–1222. [CrossRef]
64. Schuetz, S.; Venkatesh, V. Blockchain, adoption, and financial inclusion in India: Research opportunities. *Int. J. Inf. Manag.* **2020**, *52*, 101936. [CrossRef]
65. Zareravasan, A.; Krčál, M.; Ashrafi, A. The Implications of Blockchain for Knowledge Sharing. In Proceedings of the International Forum on Knowledge Asset Dynamics (IFKAD 2020), Matera, Italy, 9–11 September 2020.
66. Maier, R.; Hadrich, T. Knowledge management systems. In *Encyclopedia of Knowledge Management*, 2nd ed.; IGI Global: Hershey, PA, USA, 2011; pp. 779–790.
67. Roman-Belmonte, J.M.; De la Corte-Rodriguez, H.; Rodriguez-Merchan, E.C. How blockchain technology can change medicine. *Postgrad. Med.* **2018**, *130*, 420–427. [CrossRef] [PubMed]
68. Maesa, D.D.F.; Mori, P. Blockchain 3.0 applications survey. *J. Parallel Distrib. Comput.* **2020**, *138*, 99–114. [CrossRef]
69. Valeri, M.; Baggio, R. A critical reflection on the adoption of blockchain in tourism. *Inf. Technol. Tour.* **2020**, *23*, 121–132. [CrossRef]
70. Lu, L.; Liang, C.; Gu, D.; Ma, Y.; Xie, Y.; Zhao, S. What advantages of blockchain affect its adoption in the elderly care industry? A study based on the technology–organisation–environment framework. *Technol. Soc.* **2021**, *67*, 101786. [CrossRef]
71. Wong, L.-W.; Leong, L.-Y.; Hew, J.-J.; Tan, G.W.-H.; Ooi, K.-B. Time to seize the digital evolution: Adoption of blockchain in operations and supply chain management among Malaysian SMEs. *Int. J. Inf. Manag.* **2019**, *52*, 101997. [CrossRef]
72. Sheel, A.; Nath, V. Effect of blockchain technology adoption on supply chain adaptability, agility, alignment and performance. *Manag. Res. Rev.* **2019**, *42*, 1353–1374. [CrossRef]
73. Liang, T.P.; Kohli, R.; Huang, H.C.; Li, Z.L. What drives the adoption of the blockchain technology? A fit-viability perspective. *J. Manag. Inf. Syst.* **2021**, *38*, 314–337. [CrossRef]
74. Kant, N. Blockchain: A strategic resource to attain and sustain competitive advantage. *Int. J. Innov. Sci.* **2021**, *13*, 520–538. [CrossRef]
75. Mahajan, A.; Issa, T. Australian Users' Perspective of Green Blockchain Technology Adoption in Businesses. In *Sustainability Awareness and Green Information Technologies*; Springer: Cham, Switzerland, 2020; pp. 375–408.
76. Kim, J.S.; Shin, N. The impact of blockchain technology application on supply chain partnership and performance. *Sustainability* **2019**, *11*, 6181. [CrossRef]
77. Berneis, M.; Bartsch, D.; Winkler, H. Applications of Blockchain Technology in Logistics and Supply Chain Management—Insights from a Systematic Literature Review. *Logistics* **2021**, *5*, 43. [CrossRef]
78. Papathanasiou, A.; Cole, R.; Murray, P. The (non-) application of blockchain technology in the Greek shipping industry. *Eur. Manag. J.* **2020**, *38*, 927–938. [CrossRef]
79. Clohessy, T.; Acton, T.; Rogers, N. Blockchain adoption: Technological, organisational and environmental considerations. In *Business Transformation Through Blockchain*; Palgrave Macmillan: Cham, Switzerland, 2019; pp. 47–76.
80. Rashideh, W. Blockchain technology framework: Current and future perspectives for the tourism industry. *Tour. Manag.* **2020**, *80*, 104125. [CrossRef]
81. Cole, R.; Stevenson, M.; Aitken, J. Blockchain technology: Implications for operations and supply chain management. *Supply Chain. Manag.* **2019**, *24*, 469–483. [CrossRef]
82. Zheng, X.R.; Lu, Y. Blockchain technology—Recent research and future trend. *Enterp. Inf. Syst.* **2021**, 1–23. [CrossRef]

83. Ziakis, C. Blockchain and Artificial Intelligence in Real Estate. In *International Conference on Decision Support System Technology*; Springer: Cham, Switzerland, 2022; pp. 44–54.
84. Lyu, W.; Liu, J. Artificial Intelligence and emerging digital technologies in the energy sector. *Appl. Energy* **2021**, *303*, 117615. [CrossRef]
85. Chen, S.; Liu, X.; Yan, J.; Hu, G.; Shi, Y. Processes, benefits, and challenges for adoption of blockchain technologies in food supply chains: A thematic analysis. *Inf. Syst. E-Bus. Manag.* **2020**, *19*, 909–935. [CrossRef]
86. Abioye, S.O.; Oyedele, L.O.; Akanbi, L.; Ajayi, A.; Delgado, J.M.D.; Bilal, M.; Akinade, O.O.; Ahmed, A. Artificial intelligence in the construction industry: A review of present status, opportunities and future challenges. *J. Build. Eng.* **2021**, *44*, 103299. [CrossRef]
87. Ali, O.; Jaradat, A.; Kulakli, A.; Abuhalimeh, A. A Comparative Study: Blockchain Technology Utilization Benefits, Challenges and Functionalities. *IEEE Access* **2021**, *9*, 12730–12749. [CrossRef]
88. Zemánková, A. Artificial intelligence and blockchain in audit and accounting: Literature review. *WSEAS Trans. Bus. Econ.* **2019**, *16*, 568–581.
89. Dzhaparov, P. Application of blockchain and artificial intelligence in bank risk management. *Икономика Управление* **2020**, *17*, 43–57.
90. Venkatesh, V.; Davis, F.D. A model of the antecedents of perceived ease of use: Development and test. *Decis. Sci.* **1996**, *27*, 451–481. [CrossRef]
91. Sun, H.; Zhang, P. Causal relationships between perceived enjoyment and perceived ease of use: An alternative approach. *J. Assoc. Inf. Syst.* **2006**, *7*, 24. [CrossRef]
92. Grover, P.; Kar, A.K.; Janssen, M.; Ilavarasan, P.V. Perceived usefulness, ease of use and user acceptance of blockchain technology for digital transactions—Insights from user-generated content on Twitter. *Enterp. Inf. Syst.* **2019**, *13*, 771–800. [CrossRef]
93. Kamble, S.; Gunasekaran, A.; Arha, H. Understanding the Blockchain technology adoption in supply chains-Indian context. *Int. J. Prod. Res.* **2019**, *57*, 2009–2033. [CrossRef]
94. Rijanto, A. Blockchain technology adoption in supply chain finance. *J. Theor. Appl. Electron. Commer. Res.* **2021**, *16*, 3078–3098. [CrossRef]
95. Ullah, N.; Alnumay, W.S.; Al-Rahmi, W.M.; Alzahrani, A.I.; Al-Samarraie, H. Modeling Cost Saving and Innovativeness for Blockchain Technology Adoption by Energy Management. *Energies* **2020**, *13*, 4783. [CrossRef]
96. Wahyuni, A.E.; Juraida, A.; Anwar, A. Readiness factor identification Bandung city MSMEs use blockchain technology. *J. Sist. Manaj. Ind.* **2021**, *5*, 53–62. [CrossRef]
97. Kamble, S.S.; Gunasekaran, A.; Kumar, V.; Belhadi, A.; Foropon, C. A machine learning based approach for predicting blockchain adoption in supply Chain. *Technol. Forecast. Soc. Chang.* **2020**, *163*, 120465. [CrossRef]
98. Gao, S.; Li, Y. An empirical study on the adoption of blockchain-based games from users' perspectives. *Electron. Libr.* **2021**, *39*, 596–614. [CrossRef]
99. Kumar, N.; Singh, M.; Upreti, K.; Mohan, D. Blockchain Adoption Intention in Higher Education: Role of Trust, Perceived Security and Privacy in Technology Adoption Model. In Proceedings of the International Conference on Emerging Technologies and Intelligent Systems, Al Buraimi, Oman, 25–26 June 2021; Springer: Cham, Switzerland, 2021; pp. 303–313.
100. Eze, N.U.; Obichukwu, P.U.; Kesharwani, S. Perceived usefulness, perceived ease of use in ICT support and use for teachers. *IETE J. Educ.* **2021**, *62*, 12–20. [CrossRef]
101. Kabir, M.R.; Islam, M.A. Behavioural intention to adopt blockchain technology in Bangladeshi banking companies. *AIP Conf. Proc.* **2021**, *2347*, 020025.
102. Liu, N.; Ye, Z. Empirical research on the blockchain adoption—Based on TAM. *Appl. Econ.* **2021**, *53*, 4263–4275. [CrossRef]
103. Li, X.; Lai, P.-L.; Yang, C.-C.; Yuen, K.F. Determinants of blockchain adoption in the aviation industry: Empirical evidence from Korea. *J. Air Transp. Manag.* **2021**, *97*, 102139. [CrossRef]
104. Albayati, H.; Kim, S.K.; Rho, J.J. Accepting financial transactions using blockchain technology and cryptocurrency: A customer perspective approach. *Technol. Soc.* **2020**, *62*, 101320. [CrossRef]
105. Ghode, D.; Yadav, V.; Jain, R.; Soni, G. Adoption of blockchain in supply chain: An analysis of influencing factors. *J. Enterp. Inf. Manag.* **2020**, *33*, 437–456. [CrossRef]
106. Rauniyar, K.; Wu, X.; Gupta, S.; Modgil, S.; Jabbour, A.B.L.D.S. Risk management of supply chains in the digital transformation era: Contribution and challenges of blockchain technology. *Ind. Manag. Data Syst.* **2022**, *4*, 0235. [CrossRef]
107. Saberi, S.; Kouhizadeh, M.; Sarkis, J.; Shen, L. Blockchain technology and its relationships to sustainable supply chain management. *Int. J. Prod. Res.* **2019**, *57*, 2117–2135. [CrossRef]
108. Wong, L.-W.; Tan, G.W.-H.; Lee, V.-H.; Ooi, K.-B.; Sohal, A. Unearthing the determinants of Blockchain adoption in supply chain management. *Int. J. Prod. Res.* **2020**, *58*, 2100–2123. [CrossRef]
109. Bayramova, A.; Edwards, D.J.; Roberts, C. The Role of Blockchain Technology in Augmenting Supply Chain Resilience to Cybercrime. *Buildings* **2021**, *11*, 283. [CrossRef]
110. Bogucharskov, A.V.; Pokamestov, I.E.; Adamova, K.R.; Tropina, Z.N. Adoption of Blockchain Technology in Trade Finance Process. *J. Rev. Glob. Econ.* **2018**, *7*, 510–515. [CrossRef]
111. Kramer, M.P.; Bitsch, L.; Hanf, J.H. The impact of instrumental stakeholder management on blockchain technology adoption behavior in agri-food supply chains. *J. Risk Financ. Manag.* **2021**, *14*, 598. [CrossRef]

112. Queiroz, M.M.; Wamba, S.F.; De Bourmont, M.; Telles, R. Blockchain adoption in operations and supply chain management: Empirical evidence from an emerging economy. *Int. J. Prod. Res.* **2021**, *59*, 6087–6103. [CrossRef]
113. Choi, D.; Chung, C.Y.; Seyha, T.; Young, J. Factors affecting organizations' resistance to the adoption of blockchain technology in supply networks. *Sustainability* **2020**, *12*, 8882. [CrossRef]
114. Prewett, K.W.; Prescott, G.L.; Phillips, K. Blockchain adoption is inevitable—Barriers and risks remain. *J. Corp. Account. Financ.* **2019**, *31*, 21–28. [CrossRef]
115. Cowden, B.; Tang, J. Institutional entrepreneurial orientation: Beyond setting the rules of the game for blockchain technology. *Technol. Forecast. Soc. Chang.* **2022**, *180*, 121734. [CrossRef]
116. Saurabh, S.; Dey, K. Blockchain technology adoption, architecture, and sustainable agri-food supply chains. *J. Clean. Prod.* **2020**, *284*, 124731. [CrossRef]
117. Zhang, C.; Lu, Y. Study on artificial intelligence: The state of the art and future prospects. *J. Ind. Inf. Integr.* **2021**, *23*, 100224. [CrossRef]
118. Kadilar, C.; Cingi, H. A New Ratio Estimator in Stratified Random Sampling. *Commun. Stat. Theory Methods* **2005**, *34*, 597–602. [CrossRef]
119. Brislin, R.W. Back-translation for cross-cultural research. *J. Cross-Cult. Psychol.* **1970**, *1*, 185–216. [CrossRef]
120. Kamble, S.S.; Gunasekaran, A.; Gawankar, S.A. Sustainable Industry 4.0 framework: A systematic literature review identifying the current trends and future perspectives. *Process Saf. Environ. Prot.* **2018**, *117*, 408–425. [CrossRef]
121. Armstrong, J.S.; Overton, T.S. Estimating nonresponse bias in mail surveys. *J. Mark. Res.* **1977**, *14*, 396–402. [CrossRef]
122. Classen, N.; Van Gils, A.; Bammens, Y.; Carree, M. Accessing Resources from Innovation Partners: The Search Breadth of Family SMEs. *J. Small Bus. Manag.* **2012**, *50*, 191–215. [CrossRef]
123. Campanella, F.; Serino, L. Do personal characteristics of manager a_ect Smes' Access to Bank Loan? *Int. J. Econ. Bus. Financ.* **2019**, *6*, 1–14.
124. Dash, G.; Paul, J. CB-SEM vs PLS-SEM methods for research in social sciences and technology forecasting. *Technol. Forecast. Soc. Chang.* **2021**, *173*, 121092. [CrossRef]
125. Hair, J.F., Jr.; Sarstedt, M.; Hopkins, L.; Kuppelwieser, V.G. Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *Eur. Bus. Rev.* **2014**, *26*, 106–121. [CrossRef]
126. Polas, M.R.H.; Saha, R.K.; Ahamed, B. Leveraging green IoT and blockchain technology in the era of transformative digitalization: A green energy usage perspective. In *Handbook of Research on Social Impacts of E-Payment and Blockchain Technology*; IGI Global: Hershey, PA, USA, 2022; pp. 115–135.
127. Malik, S.; Chadhar, M.; Vatanasakdakul, S.; Chetty, M. Factors affecting the organizational adoption of blockchain technology: Extending the technology–organization–environment (TOE) framework in the Australian context. *Sustainability* **2021**, *13*, 9404. [CrossRef]
128. Hamdan, I.K.A.; Aziguli, W.; Zhang, D.; Sumarliah, E.; Usmanova, K. Forecasting blockchain adoption in supply chains based on machine learning: Evidence from Palestinian food SMEs. *Br. Food J.* **2022**. [CrossRef]
129. Kano, T.; Sheikh, A.M.; Toyama, K. IT Career aspirations in Bangladesh: A Trigger for development? *Inf. Technol. Dev.* **2021**, *27*, 336–360. [CrossRef]
130. Sroufe, R.; Gopalakrishna-Remani, V. Management, social sustainability, reputation, and financial performance relationships: An empirical examination of US firms. *Organ. Environ.* **2019**, *32*, 331–362. [CrossRef]
131. Vinzi, V.E.; Trinchera, L.; Amato, S. PLS path modeling: From foundations to recent developments and open issues for model assessment and improvement. In *Handbook of Partial Least Squares*; Springer: Berlin/Heidelberg, Germany, 2010; pp. 47–82.
132. Hair, J.; Hollingsworth, C.L.; Randolph, A.B.; Chong, A.Y.L. An updated and expanded assessment of PLS-SEM in information systems research. *Ind. Manag. Data Syst.* **2017**, *117*, 442–458. [CrossRef]
133. Cohen, N.J.; Squire, L.R. Preserved Learning and Retention of Pattern-Analyzing Skill in Amnesia: Dissociation of Knowing How and Knowing That. *Science* **1980**, *210*, 207–210. [CrossRef]
134. Chin, W.W. The partial least squares approach to structural equation modeling. *Mod. Methods Bus. Res.* **1998**, *295*, 295–336.
135. Fornell, C.; Larcker, D.F. Structural equation models with unobservable variables and measurement error: Algebra and statistics. *J. Mark. Res.* **1981**, *18*, 382–388. [CrossRef]
136. Gold, A.H.; Malhotra, A.; Segars, A.H. Knowledge Management: An Organizational Capabilities Perspective. *J. Manag. Inf. Syst.* **2001**, *18*, 185–214. [CrossRef]
137. Bickel, P.J.; Götze, F.; van Zwet, W.R. Resampling fewer than n observations: Gains, losses, and remedies for losses. In *Selected Works of Willem van Zwet*; Springer: New York, NY, USA, 2012; pp. 267–297.
138. Boukis, A. Exploring the implications of blockchain technology for brand–consumer relationships: A future research agenda. *J. Prod. Brand Manag.* **2019**, *29*, 307–320. [CrossRef]
139. Wamba, S.F.; Queiroz, M.M.; Trinchera, L. Dynamics between blockchain adoption determinants and supply chain performance: An empirical investigation. *Int. J. Prod. Econ.* **2020**, *229*, 107791. [CrossRef]
140. Ullah, N.; Mugahed Al-Rahmi, W.; Alzahrani, A.I.; Alfarraj, O.; Alblehai, F.M. Blockchain Technology Adoption in Smart Learning Environments. *Sustainability* **2021**, *13*, 1801. [CrossRef]
141. Queiroz, M.M.; Wamba, S.F. Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA. *Int. J. Inf. Manag.* **2018**, *46*, 70–82. [CrossRef]

142. Cao, D.; Tao, H.; Wang, Y.; Tarhini, A.; Xia, S. Acceptance of automation manufacturing technology in China: An examination of perceived norm and organizational efficacy. *Prod. Plan. Control.* **2020**, *31*, 660–672. [CrossRef]
143. Maroun, E.A.; Daniel, J.; Zowghi, D.; Talaei-Khoei, A. Blockchain in Supply Chain Management: Australian Manufacturer Case Study. In *Service Research and Innovation*; Springer: Cham, Switzerland, 2018; pp. 93–107.
144. Oliveira, T.; Thomas, M.; Baptista, G.; Campos, F. Mobile payment: Understanding the determinants of customer adoption and intention to recommend the technology. *Comput. Hum. Behav.* **2016**, *61*, 404–414. [CrossRef]
145. Tian, F. An agri-food supply chain traceability system for China based on RFID & blockchain technology. In Proceedings of the 2016 13th International Conference on Service Systems and Service Management (ICSSSM), Kunming, China, 24–26 June 2016; pp. 1–6.
146. Apte, S.; Petrovsky, N. Will blockchain technology revolutionize excipient supply chain management? *J. Excip. Food Chem.* **2016**, *7*, 910.
147. Casino, F.; Dasaklis, T.K.; Patsakis, C. A systematic literature review of blockchain-based applications: Current status, classification and open issues. *Telemat. Inform.* **2019**, *36*, 55–81. [CrossRef]
148. Dobrovnik, M.; Herold, D.M.; Fürst, E.; Kummer, S. Blockchain for and in Logistics: What to Adopt and Where to Start. *Logistics* **2018**, *2*, 18. [CrossRef]
149. Hastig, G.M.; Sodhi, M.S. Blockchain for supply chain traceability: Business requirements and critical success factors. *Prod. Oper. Manag.* **2020**, *29*, 935–954. [CrossRef]
150. Di Vaio, A.; Varriale, L. Blockchain technology in supply chain management for sustainable performance: Evidence from the airport industry. *Int. J. Inf. Manag.* **2020**, *52*, 102014. [CrossRef]
151. Moin, S.; Karim, A.; Safdar, Z.; Safdar, K.; Ahmed, E.; Imran, M. Securing IoTs in distributed blockchain: Analysis, requirements and open issues. *Future Gener. Comput. Syst.* **2019**, *100*, 325–343. [CrossRef]
152. Leng, J.; Jiang, P.; Xu, K.; Liu, Q.; Zhao, J.L.; Bian, Y.; Shi, R. Makerchain: A blockchain with chemical signature for self-organizing process in social manufacturing. *J. Clean. Prod.* **2019**, *234*, 767–778. [CrossRef]
153. Allen, D.W.; Berg, C.; Davidson, S.; Novak, M. Potts, J. International policy coordination for blockchain supply chains. *Asia Pac. Policy Stud.* **2019**, *6*, 367–380. [CrossRef]
154. Filimonau, V.; Naumova, E. The blockchain technology and the scope of its application in hospitality operations. *Int. J. Hosp. Manag.* **2020**, *87*, 102383. [CrossRef]
155. Torky, M.; Hassanein, A.E. Integrating blockchain and the internet of things in precision agriculture: Analysis, opportunities, and challenges. *Comput. Electron. Agric.* **2020**, *178*, 105476. [CrossRef]
156. Ølnes, S.; Ubacht, J.; Janssen, M. Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. *Gov. Inf. Q.* **2017**, *34*, 355–364. [CrossRef]
157. Risius, M.; Spohrer, K. A blockchain research framework. *Bus. Inf. Syst. Eng.* **2017**, *59*, 385–409. [CrossRef]
158. Preacher, K.J.; Hayes, A.F. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behav. Res. Methods Instrum. Comput.* **2004**, *36*, 717–731. [CrossRef]
159. Kamilaris, A.; Fonts, A.; Prenafeta-Boldύ, F.X. The rise of blockchain technology in agriculture and food supply chains. *Trends Food Sci. Technol.* **2019**, *91*, 640–652. [CrossRef]
160. Hayes, A.F. Mediation, moderation, and conditional process analysis. In *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach Edn*; Guilford Publications: New York, NY, USA, 2013; Volume 1, p. 20.
161. Alazab, M.; Alhyari, S.; Awajan, A.; Abdallah, A.B. Blockchain technology in supply chain management: An empirical study of the factors affecting user adoption/acceptance. *Clust. Comput.* **2021**, *24*, 83–101. [CrossRef]
162. Dutta, P.; Choi, T.M.; Somani, S.; Butala, R. Blockchain technology in supply chain operations: Applications, challenges and research opportunities. *Transp. Res. Part E Logist. Transp. Rev.* **2020**, *142*, 102067. [CrossRef] [PubMed]
163. Lohmer, J.; Bugert, N.; Lasch, R. Analysis of resilience strategies and ripple effect in blockchain-coordinated supply chains: An agent-based simulation study. *Int. J. Prod. Econ.* **2020**, *228*, 107882. [CrossRef] [PubMed]
164. Chang, S.E.; Chen, Y. When blockchain meets supply chain: A systematic literature review on current development and potential applications. *IEEE Access.* **2020**, *8*, 62478–62494. [CrossRef]
165. Koh, L.; Dolgui, A.; Sarkis, J. Blockchain in transport and logistics–paradigms and transitions. *Int. J. Prod. Res.* **2020**, *58*, 2054–2062. [CrossRef]
166. De Giovanni, P. Blockchain and smart contracts in supply chain management: A game theoretic model. *Int. J. Prod. Econ.* **2020**, *228*, 107855. [CrossRef]
167. Lim, M.K.; Li, Y.; Wang, C.; Tseng, M.L. A literature review of blockchain technology applications in supply chains: A comprehensive analysis of themes, methodologies and industries. *Comput. Ind. Eng.* **2021**, *154*, 107133. [CrossRef]
168. Khan, S.A.R.; Razzaq, A.; Yu, Z.; Miller, S. Industry 4.0 and circular economy practices: A new era business strategies for environmental sustainability. *Bus. Strategy Environ.* **2021**, *30*, 4001–4014. [CrossRef]
169. Hughes, L.; Dwivedi, Y.K.; Misra, S.K.; Rana, N.P.; Raghavan, V.; Akella, V. Blockchain research, practice and policy: Applications, benefits, limitations, emerging research themes and research agenda. *Int. J. Inf. Manag.* **2019**, *49*, 114–129. [CrossRef]
170. Behnke, K.; Janssen, M.F.W.H.A. Boundary conditions for traceability in food supply chains using blockchain technology. *Int. J. Inf. Manag.* **2020**, *52*, 101969. [CrossRef]

171. Dolgui, A.; Ivanov, D.; Potryasaev, S.; Sokolov, B.; Ivanova, M.; Werner, F. Blockchain-oriented dynamic modelling of smart contract design and execution in the supply chain. *Int. J. Prod. Res.* **2020**, *58*, 2184–2199. [CrossRef]
172. Paliwal, V.; Chandra, S.; Sharma, S. Blockchain technology for sustainable supply chain management: A systematic literature review and a classification framework. *Sustainability* **2020**, *12*, 7638. [CrossRef]
173. Bodkhe, U.; Tanwar, S.; Parekh, K.; Khanpara, P.; Tyagi, S.; Kumar, N.; Alazab, M. Blockchain for industry 4.0: A comprehensive review. *IEEE Access.* **2020**, *8*, 79764–79800. [CrossRef]
174. Frizzo-Barker, J.; Chow-White, P.A.; Adams, P.R.; Mentanko, J.; Ha, D.; Green, S. Blockchain as a disruptive technology for business: A systematic review. *Int. J. Inf. Manag.* **2020**, *51*, 102029. [CrossRef]
175. Dubey, R.; Gunasekaran, A.; Bryde, D.J.; Dwivedi, Y.K.; Papadopoulos, T. Blockchain technology for enhancing swift-trust, collaboration and resilience within a humanitarian supply chain setting. *Int. J. Prod. Res.* **2020**, *58*, 3381–3398. [CrossRef]
176. Kurpjuweit, S.; Schmidt, C.G.; Klöckner, M.; Wagner, S.M. Blockchain in additive manufacturing and its impact on supply chains. *J. Bus. Logist.* **2021**, *42*, 46–70. [CrossRef]
177. Choi, T.M.; Ouyang, X. Initial coin offerings for blockchain based product provenance authentication platforms. *Int. J. Prod. Econ.* **2021**, *233*, 107995. [CrossRef]
178. Zhong, H.; Zhang, F.; Gu, Y. A Stackelberg game based two-stage framework to make decisions of freight rate for container shipping lines in the emerging blockchain-based market. *Transp. Res. Part E Logist. Transp. Rev.* **2021**, *149*, 102303. [CrossRef]
179. Raja Santhi, A.; Muthuswamy, P. Influence of blockchain technology in manufacturing supply chain and logistics. *Logistics* **2022**, *6*, 15. [CrossRef]