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Article

Factors Affecting the Organizational Adoption of Blockchain Technology: Extending the Technology–Organization–Environment (TOE) Framework in the Australian Context

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Abstract: Blockchain technology (BCT) has been gaining popularity due to its benefits for almost every industry. However, despite its benefits, the organizational adoption of BCT is rather limited. This lack of uptake motivated us to identify the factors that influence the adoption of BCT from an organizational perspective. In doing this, we reviewed the BCT literature, interviewed BCT experts, and proposed a research model based on the TOE framework. Specifically, we theorized the role of technological (perceived benefits, compatibility, information transparency, and disintermediation), organizational (organization innovativeness, organizational learning capability, and top management support), and environmental (competition intensity, government support, trading partners readiness, and standards uncertainty) factors in the organizational adoption of BCT in Australia. We confirmed the model with a sample of adopters and potential adopter organizations in Australia. The results show a significant role of the proposed factors in the organizational adoption of BCT in Australia. Additionally, we found that the relationship between the influential factors and BCT adoption is moderated by "perceived risks". The study extends the TOE framework by adding factors that were ignored in previous studies on BCT adoption, such as perceived information transparency, perceived disintermediation, organizational innovativeness, organizational learning capability, and standards uncertainty.

Keywords: blockchain; adoption; factors; Australia; TOE; organization

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1. Introduction

Blockchain technology (BCT) is a new type of distributed and decentralized database that is managed by the participating entities called nodes. The entities manage the data without the involvement of any central controlling authority. Each node over the BCT network stores the same copy of the entire database. The network is run by the mutual consensus among the connected nodes. Initially, this novel and unique way of storing and managing data was developed to solve the double-spending problem in virtual currencies [1]. Later, many different use cases of BCT were proposed, e.g., electronic voting, network security, healthcare, human resource management (HRM), internet of things (IoT), cloud computing, music, supply chain, banking and finance, industry 4.0, and money laundering [2–4]. Recently, BCT has disrupted the global economy with the use of cryptocurrencies such as Bitcoin and Ethereum [5]. By using cryptocurrencies, organizations can transfer funds globally without the need for any formal intermediaries such as banks [6]. Many IT and digital experts suggest that BCT will reshape every industry in the future. This is also endorsed by renowned and reliable firms such as Gartner, PwC, Wintergreen, and IDC. They predicted that the BCT market would reach USD 176 billion to USD 3.1 trillion between 2025 and 2030 [7]. According to Underwood [8] and Tapscott and Tapscott [9], BCT has several operational and strategic benefits for organizations. Mohammed, Potdar and Yang [7] and Alzahrani and Daim [10] consider the adoption of BCT a great source of competitive advantage for organizations. Surprisingly, despite all the benefits, actual organizational adoption of BCT all over the globe has not reached a significantly high level [11–16]. This lack of uptake motivated us to initiate this research to investigate the factors that influence BCT adoption among Australian organizations. We chose Australian organizations due to their low adoption despite the availability of sufficient technological infrastructure and strong support for BCT from the Australian government and private associations [17,18]. To the best of our knowledge, to date, there is a lack of in-depth empirical research about the factors that influence organizations' intentions to adopt BCT in Australia [18,19]. Although some prior studies examined the organizational adoption of BCT, their focus was on non-Oceania countries such as Ireland, Malaysia, Germany, etc. [20–22]. However, the findings of a study undertaken in one context, e.g., country, cannot be generalized to any other context because every context has its unique characteristics, for instance, technology readiness, networked readiness index, and uncertainty avoidance index [23] as shown in Table 1. Technology readiness and networked readiness indexes represent the level of readiness of a country in terms of the technological infrastructure to adopt new technology whereas uncertainty avoidance refers to how individuals, groups of people, or organizations of a specific country make decisions in new and risky situations. The higher value of the technology readiness index for Australia indicates that Australia is more ready to adopt new technology compared with the other countries. At the same time, it is a more fearful country due to the higher value of uncertainty avoidance.

Table 1. Comparison of Australia with other countries for the contextual characteristics [23].

Country	Characteristics		
	Technology Readiness Index	Networked Readiness Index	Uncertainty Avoidance Index
Germany	9.15625	77.48	65
Ireland	8.03125	72.13	35
Malaysia	7.46875	61.43	36
Australia	9.71875	75.09	51

According to Chandra and Kumar [24], findings of a study conducted in one context serve as a starting point for a study in another context. They further asserted, "it is imperative to study the specific contexts aligned from a firm's perspective". Thus, this study aims to answer the key research question:

What are the key factors influencing the adoption intention of BCT among Australian organizations?

To answer this research question, we employed a quantitative research approach based on the Technology–Organization–Environment (TOE) framework. An online survey questionnaire, coined under the TOE categories, was sent to the appropriate Australian organizations. The TOE framework has been used in many past studies on BCT adoption, which reflects its suitability for this study. The past studies report various technological, organizational, and environmental factors, e.g., relative advantages, compatibility, complexity, top management support, and competitive pressure that influence BCT adoption. However, the studies provide varying results for the same factor. For example, Clohessy and Acton [22] and Orji, et al. [25] found top management support as a critical factor for the organizational adoption of BCT whereas, Wong, Leong, Hew, Tan and Ooi [21] reported an insignificant effect of the top management support for BCT adoption. Likewise, De Castro, et al. [26] reported the favorable role of government regulations towards the organizational adoption of BCT, whereas, Albrecht, et al. [27] stated that government regulations prevent BCT adoption. This inconstancy in results could be due to the presence of hidden factor(s) that moderate the cause–effect (causal) relationship between the factors [28]. This aspect has not been addressed in previous studies that used the TOE framework for BCT adoption.

Baron and Kenny [29] recommend the addition of a moderating variable(s) when the findings of different studies vary for the same variable. They asserted that the moderating variable enhances the understanding of problem and prevents any misleading conclusions. Moreover, the past BCT studies lack the impact of many factors that seem relevant to BCT adoption, for instance, disintermediation and information transparency that are considered the core features of BCT. To address the limitations of the past studies, we extend the traditional TOE framework by incorporating the following new factors:

(i) Technological factors: information transparency and disintermediation;
(ii) Organizational factors: organization innovativeness, organizational learning capability;
(iii) Environmental factors: standards uncertainty, and
(iv) Moderating factor: perceived risks.

The relevance of the above factors to the organizational adoption of BCT in Australia was found by conducting semi-structured interviews of BCT experts and decision makers from different Australian organizations that had adopted or were in the process of adopting BCT (potential adopters). These factors were further underpinned with the secondary data including the extant literature on BCT adoption, different organizations' websites, government reports, and white papers. Definitions and further explanations of the above factors are provided in Section 3 of this paper.

The rest of the paper is organized as follows. We provide a literature review on the adoption of BCT, theoretical background including research model and hypotheses, research methodology, and the empirical results followed by a discussion on the findings. The paper concludes with the key findings and their theoretical and practical contributions, presents limitations of the research, and suggests directions for future research.

2. Literature Review

2.1. Adoption of Blockchain Technology

The adoption of BCT brings a significant change to an organization's internal and external operations [18]. Therefore, the organizational adoption of BCT has gained significant interest from researchers [22]. They have taken the deterministic approach to examine the organizational adoption of BCT. This approach assumes that an organization's intention to adopt BCT is influenced by a certain number of factors. For example, De Castro, Tanner and Johnston [26] investigated the adoption of BCT in the asset and wealth management industry in South Africa. They found that the relative advantages, computability, complexity, supportive technological environment, characteristics of the industry, and regulations are the main deterministic factors that influence the organizational adoption of BCT; Orji, Kusi-Sarpong, Huang and Vazquez-Brust [25], Dobrovnik, et al. [30], Barnes III and Xiao [31], and Kühn, et al. [32] evaluated the factors that influence BCT adoption in the logistics industry. They identified that the availability of specific BCT tools, infrastructural facility, and government policy and support are the main significant factors for BCT adoption; Wong, et al. [33], Wong, Leong, Hew, Tan and Ooi [21], Bai and Sarkis [34], Kouhizadeh, et al. [35], Ghode, et al. [36], and Kalaitzi, et al. [37] investigated BCT adoption for the supply chain industry. They found relative advantages, complexity, upper management support, cost, market dynamics, competitive pressure, and regulatory support as the influencing factors; Clohessy and Acton [22] found that BCT awareness, top management support, and organization size influence BCT adoption in Ireland. Loklindt, et al. [38], Mohammed, Potdar and Yang [7], Post, et al. [39], Hoxha and Sadiku [40], and Holotiuk and Moormann [20] investigated BCT adoption for the different industries including shipping and land record management. They showed that easy verification of transactions, data accuracy and reliability, and cost reduction influence an organization's decision to adopt BCT; Kulkarni and Patil [41] and Koster and Borgman [42] mentioned that the firm scope, learning culture, top management, customer readiness, competitive pressure, and government policies influence BCT adoption in banking and the public sector. Moreover, Albrecht, Reichert, Schmid, Strüker, Neumann and Fridgen [27] studied the post-decision stage of the BCT adoption. They found that market power, regulation, transaction speed, transparency and costs, confidentiality, and interoperability were the prominent factors that influence BCT implementation in the energy sector.

During this literature review process, we noted that the factors that influence BCT adoption can be grouped into the TOE categories, namely, technological, organizational, and environmental contexts. Table 2 provides a summary of the factors reported in the published literature on BCT adoption.

Table 2. Factors affecting the organizational adoption of BCT.

TOE Contexts	Factors	Sources
Technological factors	Complexity, compatibility, cost, relative advantages, security, privacy, scalability, availability of specific BCT tools, trialability, observability, immutability, transactions speed, perceived novelty, disintermediation, perceived benefits, computability, infrastructural facility, increase in data availability, reduction of information asymmetry, easy verification of transactions, comprehensibility of the transactions, data accuracy and reliability, exclusion of false information from contractual information, hacking attempts system denials, high-security encryption, contract conclusion with a reasonable fee, transparency, integrity, confidentiality, interoperability, perceived challenges, hype, trust, storage capacity, decentralization, inclusiveness, territoriality, maturity	[7,18,21,25–27,30,37,38,40–45]
Organizational factors	Top management support, top management knowledge/awareness, firm size, capability of human resources, financial resources, presence of training facilities, organizational culture, supportive technological environment, perceived risk of vendor lock-in, perceived efforts in collaboration, organization learning capability, organization innovativeness, IT governance, huge resources (energy, infrastructure), high need for process harmonization, firm scope, existing infrastructure, learning culture	[22,25,26,32,37,41–44,46]
Environmental factors	Regulations, competitive pressure, government policy/support, stakeholder pressure, customer pressure, trading partner readiness, legal/standards uncertainties, institutional-based trust, technology progress in the industry, support from the community, professional consultation and assistance, perceived constraint of infrastructure, market turbulence, market power, market dynamics, customer readiness, consensus among trading partners, characteristics of industry	[21,25–27,32,37,41–44,46,47]

2.2. *Research Gaps Found in the Published Literature*

The following research gaps were observed in the past studies:

(i) Most of the research on BCT adoption has been conducted in non-Oceania countries and there is little research in the context of the Oceania region, particularly in Australia. Since the countries differ from each other in terms of their contextual and demographic characteristics such as GDP, union density, trade laws, and gender, therefore the findings of studies conducted in other countries cannot be applied in the Australian context.

(ii) There is an identified inconsistency in the results of the past studies. The studies report a linear relationship between the influencing factors and BCT adoption and ignore the impact of any intervening factor causing that inconsistency in findings.

To overcome these gaps of the past studies, the current study aims to investigate the factors affecting the adoption of BCT among Australian organizations. Moreover, the study inspects the impact of a moderating variable on the relationship between the factors and an organization's intention to adopt BCT.

2.3. Blockchain Technology in Australia

Australia is a BCT-friendly country where both government and private associations promote the adoption of BCT [43]. Australia started working with BCT when the Standards Australia submitted a proposal to the International Organization for Standardization (ISO) to develop BCT standards in 2016 [44]. Afterward, the Australian government put significant efforts to foster BCT adoption within the country. The most recent initiative of the Australian government is the issuance of the national roadmap for BCT [45]. The CSIRO's Data61, an Australian research agency, has been working to develop a national BCT network to enhance coordination among the public organizations [46]. The ASX, Australia's biggest stock exchange, partnered with "Digital Asset Holdings" to develop a private blockchain for the Australian equity market [47]. Blockchain Australia, a private association, has actively been working to encourage the use of BCT among Australian organizations [48]. Australia has all the technological infrastructure that organizations require to embrace innovation such as BCT [49,50]. Gunasekera and Valenzuela [18] and Maroun and Daniel [19] found in their study that the adoption of BCT could enhance the productivity of Australian industries such as finance, grain, and supply chain by 8–10%, resulting in a 2.6% rise in GDP. Garrard and Fielke [51] and Cao, et al. [52] mentioned that the beef sold under an Australian label in different countries is not Australian. To protect Australia's reputation, they suggested using shipment tracking with BCT to overcome this meat fraud. Monroe, et al. [53] recommended the use of BCT to empower consumers for peer-to-peer energy trading. They asserted that the BCT-enabled energy trading system could enhance the sharing economy in Australia. According to Foth and McQueenie [54], BCT can create many unexpected jobs in regional Australia. Australia is a land of innovators, early adopters, and avid users of innovation [55].

Considering this strong support and potential of BCT, it appears essential for Australian organizations to consider adopting BCT to enhance their business value and performance. However, recent documents issued by the Australian government and renowned firms indicate that Australian organizations have not adopted BCT heavily [49,56,57]. Therefore, the identification of the factors influencing the organizational adoption of BCT in Australia seems important.

3. Research Model and Hypotheses

3.1. TOE Framework

From the various options available in the IS literature, we chose the Technology–Organization–Environment (TOE) framework [58] as an underpinning theory to investigate BCT adoption. The TOE framework proposes that an organization's intention to adopt new technology is influenced by three contextual factors, namely, technology, organization, and the environment as depicted in Figure 1.

The technology context refers to the characteristics of technology that influence its adoption process. The organizational context describes the influence of an organization's features and resources on innovation adoption decisions. Environmental context states the influence of the external and inter-organizational environment in which an organization operates its business.

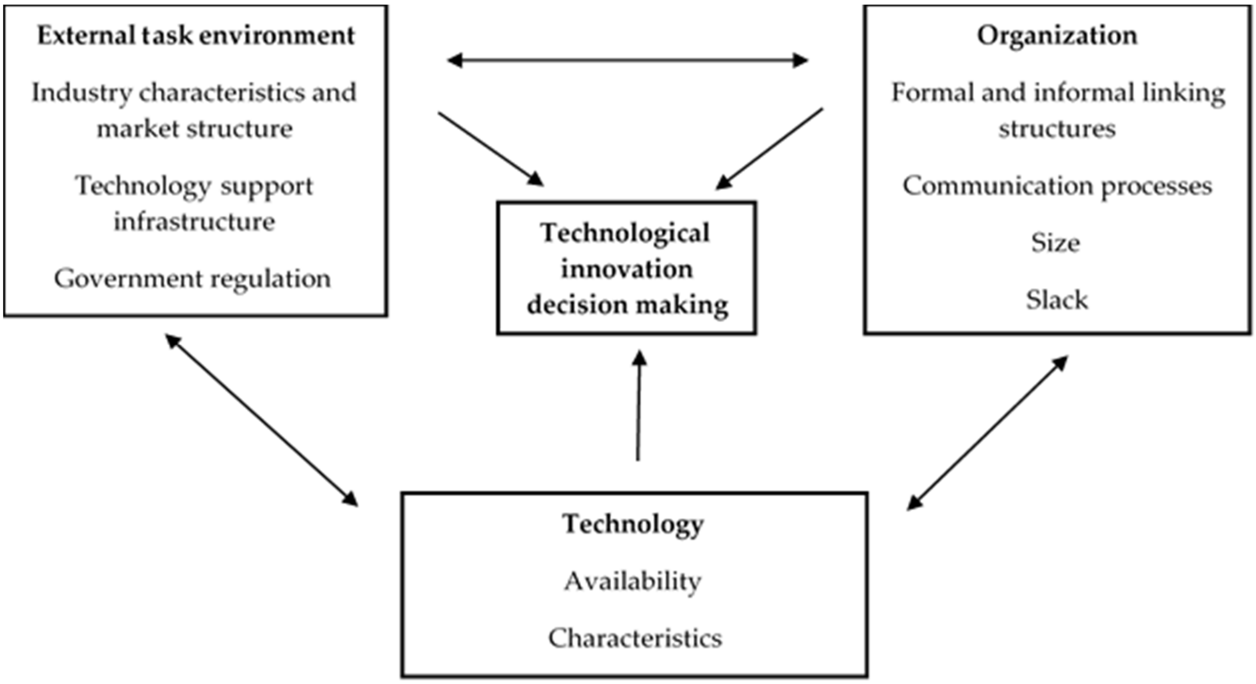

Figure 1. The TOE framework [58].

Rationale for Choosing the TOE Framework

Although other theories exist that have extensively been used to examine the adoption of different technological innovations at the organizational level [59], such as Diffusion of Innovation (DoI) [60] and Institutional Theory [61], the TOE framework has more explanatory power as explained below:

- Most of the available IT adoption theories at the organizational level are variants of the TOE framework that either divide or extend its dimensions. For example, the Institutional Theory [61] describes the influence of the environmental perspective on technology adoption that is already part of the TOE framework. Similarly, the DoI theory [60] contains technology and organizational aspects, which are also part of the TOE framework.
- Since the context is an important aspect of technology adoption, the TOE provides a useful starting point to examine the adoption process where it takes place [62].
- The TOE is the most validated theory to examine the adoption of new technologies at the organization level [59].

Due to these advantages of the TOE framework, many studies have used it to investigate the organizational adoption of different technologies such as electronic data interchange (EDI), enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM) systems, cloud computing, and e-commerce [59,62]. Thus, the TOE framework was an appropriate choice for this study. The extended version of the TOE framework prepared for this study is presented in Figure 2.

Grouped into the technological, organizational, and environmental contexts of the TOE framework, the following sections explain the factors and their relevant hypotheses developed for this study.

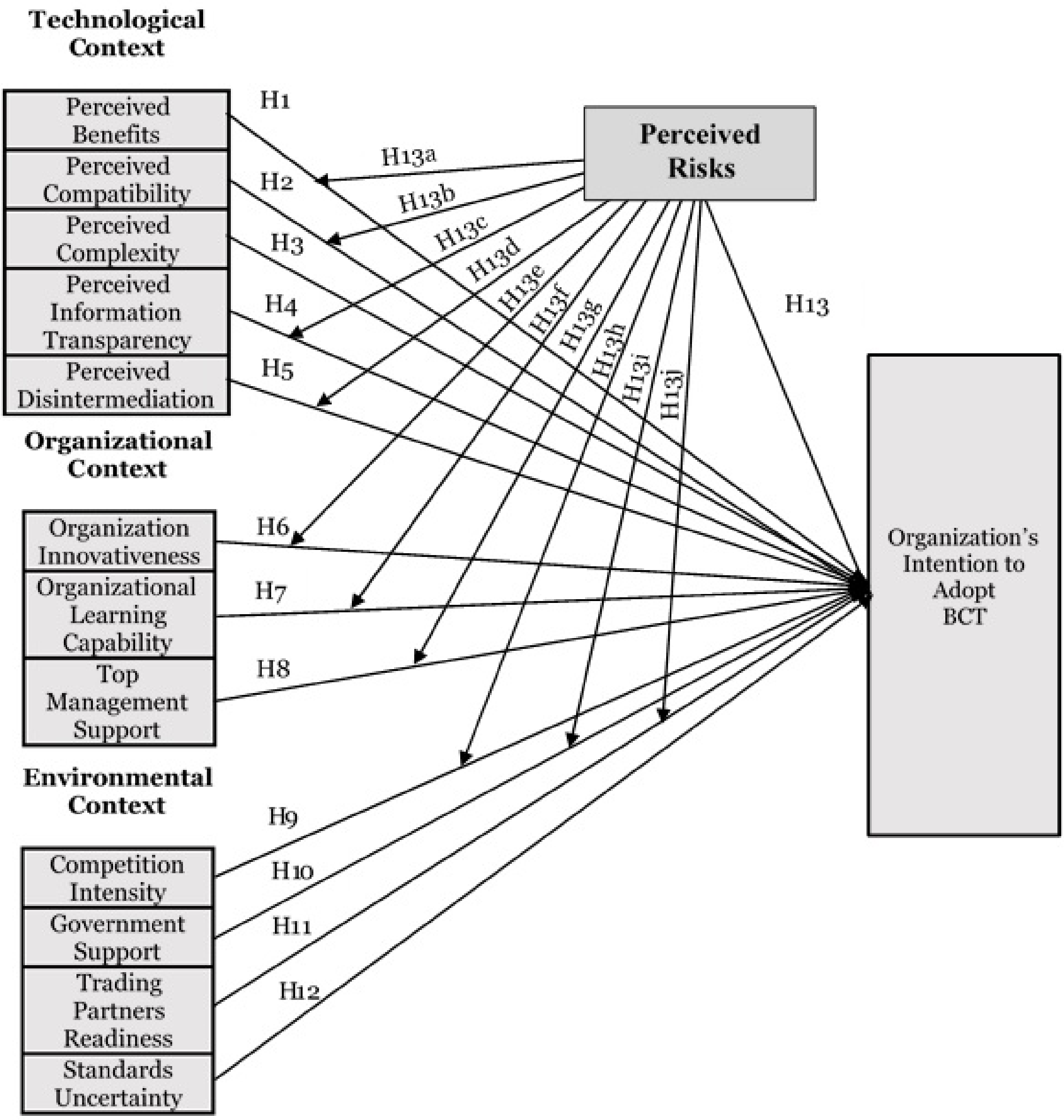

Figure 2. Extended TOE framework for the organizational adoption of BCT in the Australian context.

3.2. *Technology Context*

3.2.1. Perceived Benefits (PB)

Perceived benefits refer to the extent to which organizations perceive an innovation would be beneficial for their business [60]. BCT has many benefits such as improved auditing, cost reduction, enhanced data provenance, and trust that encourage organizations to its adoption [25]. De Castro, Tanner and Johnston [26] stated a positive role of perceived benefits in the adoption of BCT among organizations working in the wealth management industry. Therefore, it can be hypothesized that:

Hypothesis 1 (H1). *Perceived benefits positively influence an organization's intention to adopt BCT.*

3.2.2. Perceived Compatibility (PC)

Perceived compatibility refers to an organization's perception of how technology would be aligned with its business objectives [60]. De Castro, Tanner and Johnston [26] stated organizations become more inclined to adopt BCT when they perceive it as compatible with their IT infrastructure. On the other hand, organizations feel anxious about

BCT adoption when they do not find it compatible with their business operations [21]. Therefore, it can be hypothesized that:

Hypothesis 2 (H2). *Perceived compatibility positively influences an organization's intention to adopt BCT.*

3.2.3. Perceived Complexity (PCM)

Perceived complexity can be defined as the degree to which organizations perceive BCT as difficult to understand and use [26]. Wong, Leong, Hew, Tan and Ooi [21] reported complexity as a barrier for BCT adoption. Technicalities involved in BCT such as the use of public and private keys and hashing of blocks are complex processes that make organizations reluctant to its adoption [63]. Clohessy and Acton [22] reported that the perceived complexity of BCT hinders organizations from its adoption. Therefore, it can be hypothesized that:

Hypothesis 3 (H3). *Perceived complexity negatively influences an organization's intention to adopt BCT.*

3.2.4. Perceived Information Transparency (PIT)

Information transparency refers to the easy availability and verification of information for everyone [64]. Resultantly, it reduces information asymmetry and increases the traceability of information [40]. The organizations that value information transparency are more inclined to adopt technology that brings transparency within their business operations [64]. In BCT, every participant holds the same copy of data, and all the transactions are validated through a mutual consensus among the participants. This creates a transparent environment wherein the business stakeholders feel more confident while taking any decision [65]. BCT maintains an unchangeable history of the information (money, documents, and so on) that enhances trust among the stakeholders. Wamba, et al. [66] stated that information transparency plays a significant role in organizational intention to adopt BCT. Therefore, it can be hypothesized that:

Hypothesis 4 (H4). *Perceived information transparency positively influences an organization's intention to adopt BCT.*

3.2.5. Perceived Disintermediation (PD)

Disintermediation refers to the removal of an intermediary to run business operations [67]. Disintermediation is a core feature of BCT that enables organizations to have peer–peer transactions without the need for intermediaries, which saves economic costs, removes risks associated with the intermediaries, and improves business performance [68]. Organizations could readily interact, send approvals, and trace records when there is no third party involved. The disintermediation helps organizations to directly reach out to their customers. Consequently, they save overhead expenses, time, and earn customer loyalty. O'Dair [69] reported a positive impact of disintermediation of BCT in the music industry. Therefore, it can be hypothesized that:

Hypothesis 5 (H5). *Perceived disintermediation positively influences an organization's intention to adopt BCT.*

3.3. Organizational Context

3.3.1. Organization Innovativeness (OI)

Organization innovativeness can be defined as the willingness and openness of an organization to adopt new and novel ideas regardless of the risks associated with them [70]. Considering the newness and novelty of BCT, organization innovativeness seems vital for its adoption. Thong and Yap [71] reported organizational innovativeness as an essential factor towards the adoption of new technology. Similarly, Lin, et al. [72] mentioned that innovativeness is extensively linked to an organization's decision to adopt and implement innovations. They claimed that higher organizational innovativeness leads to a greater organizational transformation, which results in the adoption of new technology. Since BCT is an innovative technology, it can be expected that an organization open to new ideas which considers BCT a source of opportunities is more likely to adopt BCT. Nuryyev, et al. [73] found a statistically significant effect of innovativeness on the organizational adoption of BCT. Therefore, it can be hypothesized that:

Hypothesis 6 (H6). *Organization innovativeness positively influences an organization's intention to adopt BCT.*

3.3.2. Organizational Learning Capability (OLC)

Organization learning capability refers to an organization's ability to acquire, store, share, and implement new knowledge in its business decisions. We adapted this concept from the organizational learning theory proposed by Argyris and Schon [74]. To sustain in a turbulent business world, organizations are highly necessitated to capture new knowledge about the contemporary technological trends happening in the world and apply this knowledge to their business decisions. Organizational learning brings novelty that could motivate organizations to adopt an innovation such as BCT. Woiceshyn [75] stated that when organizations acquire new knowledge from their environment, it leads them to adopt new ideas. Organizational change and innovation come through organizational learning. Kulkarni and Patil [41] stated that the organization's learning significantly influences BCT adoption. Therefore, it can be hypothesized that:

Hypothesis 7 (H7). *Organizational learning capability positively influences an organization's intention to adopt BCT.*

3.3.3. Top Management Support (TMS)

Top management support is an integral part of an organization's decision to adopt new technology. The lack of leadership support reduces the chances of adopting an innovation such as BCT [42]. De Castro, Tanner and Johnston [26] found that an organization adopts BCT when its leadership provides required resources. Clohessy and Acton [22] recommended top management support essential for the adoption of BCT. Therefore, it can be hypothesized that:

Hypothesis 8 (H8). *Top management support positively influences an organization's intention to adopt BCT.*

3.4. Environment Context

3.4.1. Competition Intensity (CI)

Competition intensity, also known as competitive or external pressure, is the extent to which organizations feel a fear of losing competitive advantage. Competition intensity has been recognized as an essential factor in the organizational adoption of BCT [33]. When an organization adopts BCT, its competitors also follow suit to maintain their competitive position. Wong, Leong, Hew, Tan and Ooi [21] said that competitive pressure catalyzes an organization's decision to adopt BCT. Therefore, it can be hypothesized that:

Hypothesis 9 (H9). *Competitive intensity positively influences an organization's intention to adopt BCT.*

3.4.2. Government Support (GS)

Government support refers to a government's policies, initiatives, and incentives to foster adoption of technology. According to Koster and Borgman [42], government support works as a major driving force to speed up the adoption process of BCT. De Castro, Tanner and Johnston [26] stated that when a government does not provide proper support such as establishment of regulations, widespread adoption of BCT among organizations remains impossible. Kulkarni and Patil [41] and Wong, Leong, Hew, Tan and Ooi [21] reported government support as a critical factor for the adoption of BCT. Therefore, it can be hypothesized:

Hypothesis 10 (H10). *Government support positively influences an organization's intention to adopt BCT.*

3.4.3. Trading Partner Readiness (TPR)

Trading partner readiness refers to the preparedness of the partners of an organization to embrace new technology. Similar to any inter-organizational system, BCT requires strong collaboration and interaction among the trading partners [76]. When trading partners do not have adequate technical and financial resources, an organization alone cannot decide on the adoption of BCT [32]. Bai and Sarkis [34] claimed that the willingness of trading partners is essential for the organizational adoption of BCT. Therefore, it can be hypothesized:

Hypothesis 11 (H11). *Trading partner readiness positively influences an organization's intention to adopt BCT.*

3.4.4. Standards Uncertainty (SU)

Standards uncertainty refers to the unpredictability and unavailability of formal standards and regulations, generally enforced by government institutions, for a technology. The absence of the relevant standards creates doubts and uncertainties among organizations about the benefits of new technology [77]. On the other hand, well-developed standards guide or even force organizations to invest in innovations. This is also true for the BCT [78]. Given the nascent nature, relevant standards for BCT are still missing, causing organizations to be doubtful about its future development [79]. Therefore, it can be hypothesized that:

Hypothesis 12 (H12). *Standards uncertainty negatively influences an organization's intention to adopt BCT.*

3.5. Direct and Moderating Effect of Perceived Risks

As stated in the research conducted by Peter and Ryan [80], Bauer is the first person that proposed the concept of perceived risks. Afterward, many studies were conducted to measure the effect of perceived risks on technological innovations. According to Peter and Ryan [80], perceived risks refer to the nature and amount of risk perceived by an organization when deciding an action in an unknown situation. In the IT adoption literature, perceived risks are negatively associated with the adoption of new technologies [81–83]. The existing literature reports different facets of perceived risks such as performance risk, financial risk, time risk, physical risk, social risk, psychological risk, and privacy risk for the adoption of different technologies, e.g., e-services, mobile commerce, social robot, and smartphones [84]. In the case of BCT, it is not free from the risks such as privacy, high data storage, and "51% attack" that hinder organizations from its adoption [63]. Yoo, et al. [85] mentioned perceived risks as a barrier to the organizational adoption of BCT. The risks cause doubt among organizations towards BCT adoption [86,87]. Therefore, it can be hypothesized that:

Hypothesis 13 (H13). *Perceived risks negatively influence an organization's intention to adopt BCT.*

As stated above, the past studies report a direct negative effect of perceived risks on the adoption of technological innovations. The moderating role of perceived risks when applying the TOE framework to examine the organizational adoption of BCT has yet to receive attention in the information system research. The reasons to choose perceived risks as a moderating variable in this study are given below:

(i) As previously mentioned in Section 1 of this paper, semi-structured interviews with the BCT experts were conducted to identify the factors influencing BCT adoption in Australia. The experts highlighted the moderating role of perceived risks in BCT adoption.

(ii) The past literature reports the moderating role of perceived risks in the adoption of different technological innovations. For example, Shen and Chiou [88] found that the perceived risks moderates the relationship between perceived ease of use and intention towards using internet services. Similarly, Khaksar, Khosla, Singaraju and Slade [84] reported the moderating role of perceived risks in the adoption of social assistive technology.

(iii) Given the higher value of the "uncertainty avoidance index" for Australia in Table 1, anecdotally it can be assumed that the perceived risks would moderate the relationship between the influential factors and organizations' intention to adopt new technology such as BCT.

Therefore, the following hypotheses are proposed for the moderating effect of perceived risks on the adoption of BCT among Australian organizations.

Hypothesis 13a (H13a). *Perceived risks moderate the relationship between perceived benefits and an organization's intention to adopt BCT.*

Hypothesis 13b (H13b). *Perceived risks moderate the relationship between perceived compatibility and an organization's intention to adopt BCT.*

Hypothesis 13c (H13c). *Perceived risks moderate the relationship between perceived information transparency and an organization's intention to adopt BCT.*

Hypothesis 13d (H13d). *Perceived risks moderate the relationship between perceived disintermediation and an organization's intention to adopt BCT.*

Hypothesis 13e (H13e). *Perceived risks moderate the relationship between organization innovativeness and an organization's intention to adopt BCT.*

Hypothesis 13f (H13f). *Perceived risks moderate the relationship between organizational learning capability and an organization's intention to adopt BCT.*

Hypothesis 13g (H13g). *Perceived risks moderate the relationship between top management support and an organization's intention to adopt BCT.*

Hypothesis 13h (H13h). *Perceived risks moderate the relationship between competition intensity and an organization's intention to adopt BCT.*

Hypothesis 13i (H13i). *Perceived risks moderate the relationship between government support and an organization's intention to adopt BCT.*

Hypothesis 13j (H13j). *Perceived risks moderate the relationship between trading partner readiness and an organization's intention to adopt BCT.*

Since the perceived risks per se have a negative impact on BCT adoption, we hypothesized its moderating effects for those factors that have a positive impact on BCT adoption.

4. Research Methodology

The study uses a positivist research approach with a quantitative methodology to collect and analyze the research data.

4.1. Research Method

We employed a survey method to collect data for this study. A licensed version of the Qualtrics online survey tool was utilized. The online survey is useful to collect data from a larger population to measure and test multiple variables and hypotheses [89]. Furthermore, the survey method is cost and time-effective, requires less effort to manage, and is free from respondent prejudice [90]. Thus, it was used in this study.

4.2. Unit of Analysis and Unit of Observation

A unit of analysis refers to the entity that a researcher states their findings are about at the end of the research. It can be an individual, group, or organization depending upon the nature and context of a study [91]. On the other hand, a unit of observation is an entity, which a researcher observes while investigating something about the unit of analysis [92,93]. For this study, the unit of analysis was the Australian organizations, and the unit of observation was the individuals that should be working as CEO, or the senior IT people such as CTO, IT directors/managers, and had a minimum of three years of BCT-related knowledge and experience. This cohort of senior management and IT people were selected because they are always well informed about the organization's strategies and decisions such as adopting new technology [71].

To automatically filter out the unwanted unit of analysis and the unit of observation, screening questions were incorporated at the start of the online survey. The screening questions help to keep survey data relevant and free from respondent bias [94,95]. The screening questions used in this study are provided in Appendix B.

4.3. Target Population and Sampling

BCT adopters and potential adopter organizations in Australia were the target population for this study. To find the total population, we used multiple online sources including the Australian securities exchange directory, Blockchain Australia, Google, LinkedIn, and BCT-related websites such as "VentureRadar", "Crunchbase", and "Coindesk". According to the data collected from these online sources, the total population size obtained was 917 organizations belonging to different industries that made the target population diverse.

For the sampling, we used the proportionate stratified random sampling technique that is appropriate when the target population is heterogeneous as in our study [90]. This technique requires dividing the total population into homogeneous subgroups known as strata. We randomly selected a sample proportionate to the size of each stratum. This technique allows researchers to reduce selection bias and overall variance in the sample, which in turn increases the generalizability of research findings. For this study, an industry type was taken as a stratum. We obtained a sample size of 500, which is acceptable in social science research [89]. According to Sekaran and Bougie [89], a sample size between 30 and 500 is acceptable. Table 3 provides sampling details.

Table 3. Summary of the stratified random sampling and response rate.

Type of Industry	Total Population	Sample	Percentage (Out of 917)	Response	Percentage (Out of 500)
Automotive	17	11	1.2	7	1.4
Construction	11	8	0.87	3	0.6
Consultancy	56	30	3.27	14	2.8
Education	117	61	6.65	21	4.2
Electronics	28	16	1.74	7	1.4
Finance	80	44	4.8	13	2.6
Government	3	2	0.22	1	0.2
IT	219	112	12.21	43	8.6

Table 3. *Cont.*

Type of Industry	Total Population	Sample	Percentage (Out of 917)	Response	Percentage (Out of 500)
Insurance	56	30	3.27	12	2.4
Manufacturing	38	23	2.51	11	2.2
Pharmaceutical	46	26	2.84	9	1.8
Retail	29	17	1.85	8	1.6
Supply chain	145	75	8.18	29	5.8
Telecommunication	24	15	1.64	7	1.4
Transport	33	20	2.18	8	1.6
Legal	15	10	1.09	3	0.6
Total	917	500	54.53	196	39.2

4.4. Questionnaire Designing

Several measures were taken to design a reliable questionnaire for this study:

- We used validated measuring items for the perceived compatibility, perceived complexity, perceived information transparency, top management support, organization innovativeness, organizational learning capability, government support, trading partner readiness, competition intensity, standards uncertainty, and perceived risks from the existing peer-reviewed literature on information systems research. The items were adapted and modified to meet the requirement of this study. Table 4 provides detail about the measuring items for each factor and their sources. Measuring items for perceived disintermediation were not found in the existing literature, hence we developed it for this study by following the guidelines of MacKenzie, et al. [96].
- Use of duplicate and long questions, technical and specialized terms were avoided.
- Feedback from the senior academic and researchers working in the information system domain was sought to evaluate instrument relevance and content clarity in order to avoid any difficulty or non-response that the respondents might have faced while completing the survey.
- The questionnaire was sent to language experts for proofreading including review of grammatical errors and wording.

The questionnaire is provided in Appendix A.

Table 4. Factor, their measuring items, and source.

Factor	Measuring Items	Source
Perceived benefits (PB)	Blockchain reduces overhead expenses Blockchain reduces data error rates Blockchain reduces transaction costs while transferring funds Blockchain saves time while accomplishing business tasks Blockchain increases the organization's overall productivity	[97,98]
Perceived compatibility (PC)	Blockchain fits well with business processes Blockchain is compatible with technological infrastructure Blockchain fits well with technological skills	[99,100]
Perceived complexity (PCM)	Blockchain requires extra technical skills to use Blockchain is difficult to understand from a business perspective Blockchain is conceptually difficult to understand from a technical perspective	[99]
Perceived information transparency (PIT)	Access to information across the blockchain View of any activity with the data in the blockchain See the flow of the entire data in the blockchain	[101]
Perceived disintermediation (PD)	Store data without the involvement of any intermediary Access data without the involvement of any intermediary Share data without the involvement of any intermediary Audit without the involvement of any intermediary	Authors
Top management support (TMS)	Provides the necessary resources for blockchain Considers blockchain as strategically important Actively involved in IT-related decisions	[102,103]
Organizational innovativeness (OI)	Actively seek new ideas Like to do things in new ways Are open to taking risks	[104]

Table 4. *Cont.*

Factor	Measuring Items	Source
Organizational learning capability (OLC)	Have a mechanism to store new knowledge Encourage their employees to acquire new knowledge and skills Employees share their work experiences, ideas, or learning with each other Have practices to utilize new knowledge in their IT-related decisions	[105]
Government support (GS)	Policies support the adoption of blockchain Introduces economic incentives for blockchain adoption Is active in setting up the facilities to promote blockchain	[98]
Trading partner readiness (TPR)	Willing to adopt blockchain Technologically ready to adopt blockchain Financially ready to adopt blockchain	[97]
Competitive intensity (CI)	Feel pressure when competitors have adopted blockchain Feel the fear of losing a competitive advantage if they do not adopt it See competitors benefiting from adopting blockchain	[106]
Standards uncertainty (SU)	See blockchain has not reached its maturity See blockchain still requires changes to become more efficient compared with existing technologies Cannot predict that blockchain would become an industry standard in the near future	[104]
Perceived risks (PR)	It is not secured Transactions' information will be compromised while using it It will not provide its expected benefits	[107]
Intention to adopt blockchain (INT)	Adopt blockchain whenever they will have access to it in the future Adopt blockchain in the future Adopt blockchain frequently in the future	[108]

4.5. Measurement Scale

The 5- and 7-point are the two main versions of the Likert scale that are frequently used in information systems research. However, the 7-point scale outperforms the 5-point scale in terms of providing more flexibility and options to respondents, which increases the reliability and accuracy of the research findings [109,110]. Therefore, the 7-point Likert scale was considered more appropriate for the present study. We used response options from "1—strongly disagree" to "7—strongly agree".

4.6. Pilot Testing

The reliability and validity of the instrument were confirmed through a pilot study using data from 25 completed surveys. The sample for the pilot study was drawn from the same sample frame used for the main study.

4.7. Data Collection Process

The survey link along with the research objectives was emailed to the target organizations. To collect accurate information, every organization was requested to forward the survey to the CEO, or senior IT staff such as the CTO and IT directors/managers having BCT experience and knowledge. A follow-up email was sent to the non-respondent organizations. During the entire data collection period, ethical protocols were observed.

A total of 196 anonymous completed surveys were received, yielding a response rate of 39.2%, which is considered acceptable in online survey research [111].

4.8. Data Analysis Technique

To analyze the survey data, the PLS-SEM technique with SmartPLS 3 software was used. Despite the availability of other data analysis techniques such as correlation, regression, and analysis of variance, PLS-SEM is widely used for quantitative data analysis [112]. It allows researchers to analyze the relationship of the observed (measured) and unobserved variables (latent constructs) while the traditional techniques can analyze measured variables only [113]. Additionally, the moderator effects can be directly incorporated and computed into the model with the PLS-SEM [112]. Thus, the PLS-SEM was used in this study. In the PLS-SEM process, data is analyzed in the form of a measurement model and structural model. The measurement model measures latent variables whereas the structural model measures the hypotheses based on the path analysis.

5. Data Analysis and Results

5.1. Preliminary Data Analysis

Before proceeding to the SEM analysis, a preliminary data analysis confirmed the absence of missing values, selection bias, non-response bias, multicollinearity, and common method bias. Such biases in data reduce the validity of findings. Therefore, we confirmed that the data were free from these biases.

Nonresponse Bias: Nonresponse bias occurs when some respondents of the chosen sample are unable or unwilling to participate in the survey [114]. The respondents who fail to respond may be different from the rest of the population. Consequently, the true representation of the target population is not reflected in the survey data. The inferences derived from the collected data may be false and the validity of the research is compromised [115]. The nonresponse bias is introduced when the recruitment of the respondents is based on self-selection [115,116]. The participants voluntarily decide to participate in a survey. To assure that the collected data is free from self-selection bias and it truly represents the target population, we performed the comparison of the sample population and the respondents who completed the survey as shown in Table 3. From the comparison, it is clear that the actual respondents truly reflect the target and sample population, which confirms that no selection bias was present in the collected data. Furthermore, we checked the non-response bias with Levene's test for equality of variances [117] and independent-samples t-test, for all the factors. We divided the respondents between early respondents (who responded before the reminder, 45.5%) and late respondents (who responded after the reminder, 54.5%). The equal variance significance values for all the factors were found to be higher than the significance level of 0.05, which implies that both groups, early and late respondents, have the same variance. Thus, non-response bias was not found in the data.

Multicollinearity: We assessed multicollinearity for every exogenous factor through the value of variance inflation factor (VIF) as suggested by Hair Jr, et al. [118]. The VIF value of five shows high collinearity. For this study, the VIF values for all the factors were found between 1.123 and 1.953. Thus, no multicollinearity was found among the independent factors.

Common Method Bias: We performed the Harman one-factor test to confirm common bias as suggested by Podsakoff, et al. [119]. The test yielded fourteen factors. The largest factor showed 29.313% of the total variance. A value less than 50% implies that common method bias was not present in data [120].

5.2. Demographic

The demographic data indicated that most of the organizations were from the banking/finance, education, IT, and supply chain industries. These industries seem to be most appropriate for BCT. Regarding the respondents, females were 42.9% and males 57.1%. The age of most respondents was between 26 and 50 years. In the educational qualification of the respondents, postgraduate degree was highest, undergraduate second, and college certificate third. Most of the respondents were CEO (15.3%), CTO (23%), and IT directors (16.8%). Others included IT manager, technology strategy manager, database administrator, supply chain manager, and finance director/manager.

5.3. Measurement Model

The study assessed the reliability of the measurement model by calculating Cronbach's alpha, composite reliability (CR), average variance extracted (AVE); discriminant validity through the square root of the AVE, and cross-loadings. The minimum acceptable values of outer-loadings, Cronbach's alpha, and CR should be equal or greater than 0.7, and for the AVE, it should be greater than 0.5 [121]. Similarly, for the square root of the AVE of every construct, the value should exceed all the correlations among the constructs in the same block of the factor correlation matrix. Overall, the statistical results for the measurement model were above the minimum acceptable values as depicted in Tables 5 and 6. Hence, the reliability and validity criteria for this study were achieved. The values for the cross-loadings were according to the recommendations of Fornell and Larcker [122]. Each measuring item of every construct was loaded higher than the indicators of any other off-diagonal construct.

Table 5. Reliability of constructs and their measuring items.

Construct with Measuring Items	Outer Loadings	CR	AVE	Cronbach's Alpha
Competitive Intensity (CI)		0.863	0.678	0.761
CI1	0.754			
CI2	0.879			
CI3	0.831			
Perceived Complexity (PCM)		0.894	0.738	0.823
CMP1	0.829			
CMP2	0.869			
CMP3	0.878			
Government Support (GS)		0.900	0.749	0.833
GS1	0.863			
GS2	0.846			
GS3	0.887			
Intention to adopt BCT (INT)		0.881	0.711	0.796
INT1	0.786			
INT2	0.858			
INT3	0.883			
Organization Innovativeness (OI)		0.887	0.724	0.810
OI1	0.829			
OI2	0.856			
OI3	0.868			
Organization Learning Capability (OLC)		0.887	0.663	0.831
OLC1	0.778			
OLC2	0.860			
OLC3	0.782			
OLC4	0.834			
Perceived Benefits (PB)		0.905	0.704	0.859
PB1	0.776			
PB2	0.871			
PB3	0.851			
PB4	0.856			
Perceived Compatibility (PC)		0.899	0.749	0.833
PC1	0.866			
PC2	0.847			
PC3	0.883			
Perceived Disintermediation (PD)		0.879	0.645	0.816
PD1	0.744			
PD2	0.847			
PD3	0.814			
PD4	0.804			
Perceived Information Transparency (PIT)		0.929	0.814	0.887
PIT1	0.889			
PIT2	0.903			
PIT3	0.914			
Perceived Risks (PR)		0.880	0.711	0.797
PR1	0.834			
PR2	0.806			
PR3	0.887			
Standards Uncertainty (SU)		0.879	0.708	0.793
SU1	0.777			
SU2	0.876			
SU3	0.867			
Top Management Support (TMS)		0.886	0.722	0.807
TMS1	0.827			
TMS2	0.875			
TMS3	0.846			
Trading Partner Readiness (TPR)		0.886	0.722	0.805
TPR1	0.773			
TPR2	0.914			
TPR3	0.857			

Table 6. Correlation of constructs compared with the square root of AVEs.

Constructs	CI	PCM	GS	INT	OI	OLC	PB	PC	PD	PIT	PR	SU	TMS	TPR
CI	0.823 *													
PCM	0.682	0.859 *												
GS	0.043	0.411	0.866 *											
INT	0.327	0.581	0.588	0.843 *										
OI	0.159	0.382	0.505	0.223	0.851 *									
OLC	0.204	0.222	0.110	0.195	0.638	0.814 *								
PB	0.410	0.500	0.225	0.589	0.435	0.270	0.839 *							
PC	0.290	0.041	0.481	0.502	0.577	0.588	0.163	0.865 *						
PD	0.565	0.490	0.195	0.323	0.067	0.484	0.244	0.568	0.803 *					
PIT	0.500	0.603	0.365	0.063	0.217	0.166	0.457	0.485	0.348	0.902 *				
PR	0.235	0.111	0.402	0.684	0.359	0.405	0.326	0.215	0.667	0.518	0.843 *			
SU	0.175	0.299	0.025	0.270	0.168	0.383	0.038	0.130	0.514	0.463	0.651	0.841 *		
TMS	0.288	0.620	0.319	0.601	0.500	0.147	0.530	0.501	0.073	0.219	0.120	0.598	0.850 *	
TPR	0.304	0.321	0.540	0.301	0.101	0.073	0.631	0.090	0.297	0.336	0.475	0.208	0.533	0.850 *

* square root of AVEs.

5.4. Structural Model

To determine the significance of path coefficients, a standard bootstrapping procedure with 500 samples and 196 cases was performed. The structural model was evaluated with the values of coefficients of determination (R^2), effect size (f^2), predictive relevance coefficient (Q^2), and the path coefficients [118,123].

The value of R^2 is the extent to which the independent constructs explain the variance in the dependent constructs [118]. The bigger value of R^2 reflects that the model has more predictive power. We found R^2 = 0.822, which implies that perceived benefits (PB), perceived compatibility (PC), perceived complexity (PCM), perceived information transparency (PIT), perceived disintermediation (PD), top management support (TMS), organization innovativeness (OI), organization learning capability (OLC), government support (GS), competition intensity (CI), trading partner readiness (TPR), standards uncertainty (SU), and perceived risks (PR) accounted for 88.2% variance of the intention to adopt blockchain (INT).

The value of f^2 represents the strength of the effect of a particular independent construct on the dependent construct in the structural model [124,125]. Cohen, et al. [126] states f^2= 0.02; f^2 = 0.15, and f^2= 0.35 as small, medium, and large effects, respectively. Our results for f^2 were found between 0.016 and 0.608. The perceived benefits (PB), perceived information transparency (PIT), perceived disintermediation (PID), and trading partner readiness (TPR) were reported to have a large effect size, whereas, perceived complexity (PC), perceived risks (PR), organization innovativeness (OI), organization learning capability (OLC), top management support (TMS), competition intensity (CI), and standards uncertainty (SU) were reported with medium effect. However, perceived complexity (PCM) and government support (GS) showed small effects. According to Chin, et al. [127], even the smallest value of f^2 for a construct is important because it reflects that the construct at least has some effect.

In addition to R^2, we performed the predictive relevance test (Stone–Geisser's Q^2) to evaluate the predictive validity of the models [128–130]. The higher value of Q^2 for a dependent construct indicates that the model has predictive relevance for that construct [131]. In our case, the dependent construct is "intention to adopt blockchain" (INT). We performed the blindfolding procedure to obtain the cross-validated redundancy value for INT, which was Q^2 = 0.526 indicating a high predictive relevance of the model for the INT.

To test the hypotheses, we performed the significance test for path coefficients. According to Chin, Marcolin and Newsted [127], the path coefficients should have a "t-value" greater than 1.645 at a significance level of 0.05 and more than 2 at a significance level of 0.01. Table 7 shows the significance test of the path coefficients.

From the obtained results, it is clear that the hypotheses H1–H13 possess more than the accepted threshold of the "t-value" [127]. The path coefficient of perceived benefits (PB), perceived compatibility (PC), perceived information transparency (PIT), perceived disintermediation (PD), organization innovativeness (OI), organization learning capability (OLC), top management support (TMS), competition intensity (CI), government support (GS), and trading partner readiness (TPR) has a positive value, which implies that they have a positive relationship with intention to adopt blockchain (INT), whereas, perceived complexity (PCM), standards uncertainty (SU), and perceived risks (PR) have a negative value, which means they have an adverse relationship with INT. In other words, the higher the complexity, risks, and uncertainty of the BCT are, the lower the organization's intention to adopt BCT in Australia.

Table 7. Path coefficient analysis.

Hypothesis	Relationship	Path Coefficient	t-Value	Decision
H1	PB→INT	0.259	3.947 *	Supported
H2	PC→INT	0.178	3.158 **	Supported
H3	CMP→INT	−0.165	3.859 **	Supported
H4	PIT→INT	0.163	3.713 *	Supported
H5	PD→INT	0.357	6.341 *	Supported
H6	OI→INT	0.273	4.770 *	Supported
H7	OLC→INT	0.056	2.371 **	Supported
H8	TMS→INT	0.124	3.102 *	Supported
H9	CI→INT	0.265	4.538 *	Supported
H10	GS→INT	0.041	2.337 *	Supported
H11	TPR→INT	0.210	3.950 *	Supported
H12	SU→INT	−0.170	3.185 *	Supported
H13	PR→INT	−0.146	2.506 *	Supported
H13a	PB→PR→INT	−0.104	0.951 **	Not Supported
H13b	PC→PR→INT	−0.163	2.204 *	Supported
H13c	PIT→PR→INT	0.087	1.995 *	Supported
H13d	PD→PR→INT	0.175	2.583 *	Supported
H13e	OI→PR→INT	−0.209	2.925 *	Supported
H13f	OLC→PR→INT	−0.102	1.252 **	Not Supported
H13g	TMS→PR→INT	0.026	0.458 **	Not Supported
H13h	CI→PR→INT	0.380	3.561 *	Supported
H13i	GS→PR→INT	0.008	0.265 **	Not Supported
H13j	TPR→PR→INT	−0.013	0.190 **	Not Supported

** $p < 0.01$, * $p < 0.05$.

5.5. Measuring the Moderating Effects

To examine the moderating effects of PR on the relationship between PB, PC, PIT, PD, OI, OLC, TMS, CI, GS, and TPR with INT, we used the product indicator approach [132]. The results showed that PR has significant moderating effects on the relationship of PC, PIT, PD, OI, CI, and INT that confirms the hypotheses H13b, H13d, H13e, and H13h. However, no moderating effects of PR were found on the relationship between PB, OLC, TMS, GS, and TRP with INT, which implies that the hypotheses H13a, H13f, H13g, H13i, and H13j are not supported.

Additionally, we evaluated the performance of the model with and without adding PR as a moderating variable. It was noted that the significance level of the relationship between the dependent and independent variables significantly changes. For example, the TPR becomes insignificant at $p < 0.01$. However, it remains significant at $p < 0.05$.

6. Discussion

The study aims to find the factors that influence the adoption of BCT among Australian organizations. Based on the TOE framework, we found that different technological, organizational, and environmental factors affect the organizational adoption of BCT in Australia. The results support all the hypotheses, H1–H13, developed in this study. In addition to that, the results confirm that the variable perceived risks (PR) moderates the relationship between influential factors and BCT adoption. The results of this study extend the TOE framework by adding the new factors: perceived information transparency (PIT), perceived disintermediation (PD), organization innovativeness (OI), organization learning capability, competition intensity (CI), trading partner readiness (TPR), and standards uncertainty (SU) under its technological, organizational, and environmental contexts. Furthermore, the TOE framework has been extended with the inclusion of the perceived risks (PR) as a moderating variable.

In the context of the TOE framework, the results and their interpretation and comparison with the past studies are presented below. The implications of the study are also presented.

6.1. Technology Context

The technological factors are perceived benefits, compatibility, information transparency, and disintermediation positively influence the adoption of BCT, whereas the perceived complexity has a negative influence. The effect of perceived disintermediation is a new insight that was not reported in the past studies on BCT adoption. When organizations perceive that they could run their business without the involvement of any intermediary, they are attracted to adopt BCT. The disintermediation reduces the transaction cost and speedy payments [67,133], which motivates organizations to adopt BCT. However, Adams, et al. [134] pointed out that "blockchains may replace many firms across a wide number of sectors who currently (earn) profit from providing services (as an intermediary). Disintermediation may be painful for many (organizations) and have its own risks". Therefore, we suggest the BCT community create opportunities for organizations providing their services as an intermediary. The findings show that the compatibility of BCT with an organization's technological and financial needs significantly affects its adoption. This finding is consistent with Kim [135] but inconsistent with De Castro, Tanner and Johnston [26] that found BCT incompatible with the legacy infrastructure of the wealth management industry in South Africa. Therefore, we recommend organizations carefully evaluate and understand the compatibility of BCT with their business objectives before deciding on its adoption. The study found that the perceived complexity of BCT negatively impacts an organization's decision to adopt BCT. The organizations that perceive BCT as difficult to use or understand feel fear of its adoption which ultimately contributes to the low BCT adoption in Australia. De Castro, Tanner and Johnston [26] found that people from non-IT backgrounds perceive BCT as more complex compared with those having IT know-how. Therefore, we suggest organizations develop a better understanding of BCT while deciding on its adoption. In this study, perceived transparency of information through BCT has been found to be an enabler of the organizational adoption of BCT, which is consistent with the study of Al-Jabri and Roztocki [64]. Information transparency enhances trust among the organizations involved in the BCT network, consequently, organizations coordinate and share information with full of confidence.

6.2. Organizational Context

Organizational factors are innovativeness, and organization learning capability were found to be significant to the adoption of BCT, which is similar to the findings of Johnson [136], Kulkarni and Patil [41], and Newby, Nguyen and Waring [70]. We found that the organizations that are capable of acquiring new knowledge, store and apply that knowledge; hence, they are deemed to be open to new ideas, and ready to take risks, meaning they are more likely to adopt BCT. Therefore, we suggest organizations should have a learning mechanism to remain aware of developments happening in the world that could be important for their business. Regarding the top management support, our findings are consistent with those of Orji, Kusi-Sarpong, Huang and Vazquez-Brust [25], and Clohessy and Acton [22], who found that without the support of top management, the organizational adoption of BCT is less likely. This is because the top leadership is the authority to approve strategic decisions such as the adoption of new technology and allocate resources for it. This finding contrasts with Wong, Leong, Hew, Tan and Ooi [21] who found an insignificant impact of top management support on BCT adoption. Anecdotally, this could be that the top management was not convinced or was not aware of the benefits of BCT. Therefore, we suggest educating top management about BCT while initiating the idea of its adoption.

6.3. Environmental Context

The environmental factors are competition intensity, government support, and trading partner readiness positively, whereas the standards uncertainty negatively influences the adoption of BCT. The positive impact of the competition intensity on BCT adoption implies that organizations want to remain competitive at the forefront of their rivals. Competition intensity encourages organizations to find ways to grow and sustain their competitive advantage. Prior studies have also established that the adoption of BCT is important for organizations to retain their competitiveness [21,33,34]. We found a significant effect of government support on the adoption of BCT. This means organizations are satisfied with the recent initiatives of the Australian government for BCT. This finding also confirms the results of Orji, Kusi-Sarpong, Huang and Vazquez-Brust [25] who reported that when a government shows support in terms of developing policies and regulations, it enhances organizations' confidence and trust in the BCT. However, few studies reported that governments have not laid down specific regulations about BCT for different industries, so any change in regulations may adversely affect investment in BCT projects [45,137,138]. Therefore, we recommend that organizations check government regulations relevant to their industry before making any decision to adopt BCT. We found trading partner readiness has a significant influence on BCT adoption. This finding confirms the inter-organizational nature of BCT. Organizations can not adopt BCT until their trading partner are ready to adopt it. Any decision of BCT adoption without the willingness of trading partners would result in negative consequences [32,41]. We endorse the statement presented by Bai and Sarkis [34] wherein they suggested to ensure the willingness of multiple stakeholders to adopt BCT. The impact of standards uncertainty was identified as negative on the adoption of BCT, which implies that organizations are still seeking BCT-related industry standards. This finding is consistent with Guo and Liang [139] who reported that BCT adoption would be unsolved until the industry standards related to BCT are established. To accelerate the adoption of BCT, establishment of industry standards for BCT it is urgently needed [32,63,104]. This finding may help the relevant government and private industrial agencies to pay attention to the development of BCT standards.

6.4. Direct Effect of Perceived Risks

The direct impact of perceived risks is found to be negative causing organizations to be reluctant to adopt BCT. Resultantly, BCT adoption is not gaining attention among Australian organizations. This finding is aligned with the earlier study of Yoo, Bae, Park and Yang [85] that reported that the risks such as privacy disclosure, misuse of information, and un-scalability hinder organizations to adopt BCT. It suggests that organizations should carefully analyze the risks before deciding on the adoption of BCT.

6.5. Moderating Effect of Perceived Risks

We found that the perceived risks moderate the relationship between perceived compatibility (PC), perceived information transparency (PIT), perceived disintermediation (PD), organization innovativeness (OI), competition intensity (CI), and intention to adopt blockchain (INT), thereby supporting the hypotheses H13b–H13e, and H13h. These findings imply that irrespective of the compatibility of BCT with organizations' business values—their expectations for information transparency through BCT, perceiving BCT disintermediation as an opportunity, being innovative, and feeling the intensity of competitiveness—organizations become reluctant to adopt BCT because of the risks linked with BCT. The moderating role of PR was not found for PB (perceived benefits), organization learning capability (OLC), top management support (TMS), government support (GS), and trading partner readiness (TPR). Thus, the hypotheses H13a, H13f, H13g, H13i, and H13j are not supported. This is contrary to our proposed hypotheses. A possible explanation for this might be that when the organizations consider the high level of perceived benefits, top management support, trading partner readiness, and government support, they feel more comfortable and are inclined towards BCT adoption. Moreover, if organizations are more knowledgeable about BCT through their learning capability, they know how to manage the risks.

6.6. Implications

The study outlines some important implications for both theory and practice, which are given below.

6.6.1. Theoretical Implications

First, according to the best of our knowledge, this is one of the first positivist studies that provides empirical evidence about the factors influencing organizational adoption of BCT in the Australian context. Most of the research on BCT is from its technical understanding and advancement perspective. Although the technological perspective of BCT is important for its future development, understanding its adoption is also critical for maximum value creation. Thus, first, this study theoretically contributes by establishing the foundation for future research in the Australian context. Second, the prior studies on the organizational adoption of BCT establish a linear relationship between the TOE factors and the intention to adopt BCT. This is one of the first studies that extends the TOE framework by introducing a moderating variable for the organizational adoption of BCT. Researchers can use this extended TOE model shown in Figure 2 as a starting point for future research to study organizations' intentions to adopt any innovation in general and BCT in particular. With the addition of the new factors, the extended model has more explanatory power than the original TOE framework. Third, the study identifies the factors that influence the organizational adoption of BCT, particularly in Australia. Fourth, we extend the existing literature on different factors influencing BCT adoption in general. Future research can study these factors in-depth to expand the list. Fifth, the research presents a validated research model for the adoption of BCT at the organization level. This model can be used to study the adoption of other distributed inter-organizational technologies such as electronic data interchange (EDI). Finally, we have developed and validated a measuring scale for the perceived disintermediation, which would help researchers in their future studies on BCT.

6.6.2. Practical Implications

In addition to having theoretical implications, the study has various important implications for practice. First, our findings would provide guidelines to the policy and decision makers working with the Australian government to develop national policies to promote BCT adoption among Australian organizations. This also applies to the private associations such as "Blockchain Australia" that have actively been working to foster BCT adoption in Australia. Second, disintermediation is found to be a significant factor in BCT adoption. This finding urges the organizations working as an intermediary to redesign their business models to sustain in the market. Third, the findings could help consulting and marketing companies to consider factors identified in this study while providing their services to the potential adopters of BCT, saving time and effort. For example, it is useless to provide services to a customer whose trading partners are not ready to adopt BCT. Fourth, we have found that organizations feel reluctant to adopt BCT due to the lack of established standards of BCT. Therefore, this finding is important for governments and private regulatory bodies to develop relevant standards to remove the uncertainties hindering BCT adoption. Fifth, the study highlights the role of an organization's top management in BCT adoption. Therefore, the organization's top management should be determined and focused on the adoption of new technology. Top management's clarity towards value creation is conducive to achieve successful adoption of BCT in their organization. Finally, the competition intensity is found positive for BCT adoption. Therefore, IT vendors develop BCT apps that provide a competitive advantage to their customers.

7. Conclusions

The BCT is an important technology that could bring several strategic and operational advantages to organizations. However, its adoption among organizations has not reached a significant level including in Australia. To examine this lack of uptake, this study aimed to find the factors influencing the adoption of BCT among Australian organizations. By following a quantitative approach, this study proposed and confirmed an extended TOE framework. In contrast to the earlier studies on the organizational adoption of BCT that establish a linear relationship between influential factors and an organization's intention to adopt BCT, this study introduced a moderating variable. A data sample was collected from the Australian organization through an online survey. The PLS-SEM technique with SmartPLS software was used for the data analysis. The results of the study highlight that technological factors: perceived benefits, compatibility, information transparency, and disintermediation; organizational factors: organization innovativeness, organization learning capability, and top management support; and environmental factors: competition intensity, government support, trading partners readiness, and standards uncertainty play an important role in the organizational adoption of BCT in Australia. The findings of this study provide direction to decision makers and policymakers, BCT vendors, technology practitioners, and researchers to develop strategies that contribute to the successful adoption and value creation of BCT.

Although this study achieved its aim, additional empirical research will further enhance its applicability and validity. For example, at the moment, the study focuses on the Australian context that reduces its external validity. Future research can be conducted in other countries, which have different regulatory and technological developments, to enhance its generalizability. Further, the study is cross-sectional. There is a high likelihood of changes in findings as time progresses. In the future, we hope to develop a dynamic model capable of predicting an organizations' intention to adopt BCT over time.

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Appendix A

Survey Questionnaire

Please respond to each statement by indicating the degree of agreement or disagreement by using the following scale.

1 = Strongly Disagree
2 = Disagree
3 = Somewhat Disagree
4 = Neutral
5 = Somewhat Agree
6 = Agree
7 = Strongly Agree

Factor	Questions
Perceived benefits (PB)	In my opinion, organizations adopt blockchain when they perceive that: Blockchain reduces overhead expenses Blockchain reduces data error rates Blockchain reduces transaction costs while transferring funds Blockchain saves time while accomplishing business tasks Blockchain increases the organization's overall productivity
Perceived compatibility (PC)	In my opinion, organizations adopt blockchain when they perceive that: Blockchain fits well with their business processes Blockchain is compatible with their technological infrastructure Blockchain fits well with their technological skills
Perceived complexity (PCM)	In my opinion, organizations do not adopt blockchain when they perceive that it: Blockchain requires extra technical skills to use Blockchain is difficult to understand from a business perspective Blockchain is conceptually difficult to understand from a technical perspective
Perceived information transparency (PIT)	In my opinion, organizations adopt blockchain when they perceive that: Blockchain enables them to have transparent access to information across the network Blockchain enables them to have a transparent view of any activity in the data Blockchain enables them to have a transparent flow of the entire data
Perceived disintermediation (PD)	In my opinion, organizations adopt blockchain when they perceive that: Blockchain enables them to store their data without the involvement of any intermediary Blockchain enables them to access their data without the involvement of any intermediary Blockchain enables them to share their data without the involvement of any intermediary Blockchain enables them to audit without the involvement of any intermediary
Top management support (TMS)	In my opinion, organizations adopt blockchain when: Their top management provides the necessary resources for blockchain Their top management considers blockchain as strategically important Their top management is actively involved in IT-related decisions
Organizational innovativeness (OI)	In my opinion, organizations adopt blockchain when: They actively seek new ideas They like to do things in new ways They are open to taking risks
Organizational learning capability (OLC)	In my opinion, organizations adopt blockchain when: They have a mechanism to store new knowledge They encourage their employees to acquire new knowledge and skills Their employees share their work experiences, ideas, or learning with each other They have practices to utilize new knowledge in their IT-related decisions
Government support (GS)	In my opinion, organizations adopt blockchain when: The Australian government supports the adoption of blockchain The Australian government introduces economic incentives for blockchain adoption The Australian government is active in setting up facilities to promote blockchain
Trading partner readiness (TPR)	In my opinion, organizations adopt blockchain when: Their trading partners are also willing to adopt blockchain Their trading partners are also technologically ready to adopt blockchain Their trading partners are also financially ready to adopt blockchain
Competitive intensity (CI)	In my opinion, organizations adopt blockchain when: They feel pressure when their competitors have adopted it They feel the fear of losing a competitive advantage if they do not adopt it They see their competitors benefiting from adopting it
Standards uncertainty (SU)	In my opinion, organizations do not adopt blockchain when: They see blockchain has not reached its maturity They see blockchain still requires changes to become more efficient compared with existing technologies They cannot predict that blockchain would become an industry standard in the near future
Perceived risks (PR)	In my opinion, organizations do not adopt blockchain when they perceive that: Blockchain is not secured Their transactions' information will be compromised while using blockchain Blockchain will not provide its expected benefits
Intention to adopt blockchain (INT)	In my opinion: Organizations would adopt blockchain whenever they will have access to it in the future Organizations would adopt blockchain in the future Organizations would adopt blockchain frequently in the future

Appendix B

Screening Questions

Q1. Which country do you belong to? Please select from the list of countries given below. (survey exits if a respondent selects a country other than Australia)

Q2. Which of the following age groups best describes you?
(survey exits if a respondent select age less than 18 years)

Q3. Please indicate which of the following technologies best describes your knowledge/experience?

- B2B-Commerce
- Blockchain Technology
- Electronic Data Interchange (EDI)
- Distributed DBMS
- Other (please type)

(survey exits if a respondent does not select "Blockchain Technology")

Q4. Please indicate which of the following technologies your organization has been involved with?

- B2B-Commerce
- Cloud Computing
- RFID
- Robotics
- Internet of Things (IoT)
- Blockchain Technology
- Electronic Data Interchange (EDI)
- Artificial Intelligence
- Distributed DBMS
- Social Media Technologies
- Gaming
- Other

(survey exits if a respondent does not select "Blockchain Technology")

Q5. Please indicate which of the following job titles best describes your role?

- Chief Executive Officer President Chairperson
- Chief Technology Officer Chief Information Officer Chief Digital Officer
- IT Manager
- Business Development Manager
- Other
- IT Director
- Technology Strategy Manager
- Finance Director Finance Manager
- Customer Service Manager
- Database Administrator
- Supply Chain Manager
- Store Manager
- Sales Manager
- Other

(survey exits if a respondent does not select IT related job)

Q6. How many years of knowledge/experience of blockchain technology do you have?

- Less than 3 years
- 3–4 years
- 5–7 years
- 8–10 years
- Above 10 years

(survey exits if a respondent selects "Less than 3 years")

Q7. How would you rate your knowledge of blockchain technology?

- Little knowledge of blockchain technology
- Good knowledge of blockchain technology
- Excellent knowledge of blockchain technology

(survey exits if a respondent selects "Little knowledge of blockchain technology")

Q8. What is/was the status of involvement of your organization with blockchain technology?

- Currently interested in blockchain technology and actively seeking related information
- Currently in the process of deciding adoption of blockchain technology
- Currently implemented blockchain technology
- Previously implemented blockchain technology, but currently not using

Q9. What is/was the size of your organization in terms of the number of employees?

- Having employees between 1 and 4
- Having employees between 5 and 19
- Having employees between 20 and 199
- Having employees more than 200

Q10. What is the annual revenue of your organization?

- Less than $1 million
- Between $1–5 million
- Between $5–50 million
- Above $50 million

Q11. Which of the following industries describes your organization?

- Automotive
- Electronics
- Services
- Chemical
- Finance/Banking
- Insurance
- Construction
- Manufacturing
- Education
- Consultancy
- Pharmaceutical
- Information Technology
- Supply Chain
- Real Estate
- Government
- Telecommunication
- Retail
- Transport
- Legal
- Other

Q12. What type of blockchain technology you have knowledge/experience of?

- Public
- Private
- Hybrid
- Other (please type)

Q13. What is the highest level of your education?

- College Certificate
- Undergraduate Degree
- Postgraduate Degree or Higher
- Professional Certificate/Diploma
- Other (please type)

Q14. What is your gender?

- Male
- Female
- Not Specified

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