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Promoting Information-Resource Sharing within the Enterprise: A Perspective of Blockchain Consensus Perception

Gang Li * and Chih-Cheng Fang

International College, National Institute of Development Administration, Bangkok 10240, Thailand;
chih_cheng.fan@nida.ac.th

* Correspondence: gang.li@stu.nida.ac.th

Abstract: The prevalence of information technology (IT) and information systems (IS) provides opportunities for enterprises to sustain open innovation. However, information silos that appeared with IS use have made IS inconvenient and thus impeded enterprises' open innovation. The present study, therefore, aims to resolve this issue by helping understand how to encourage information-resource sharing within the enterprise. We first proposed a new concept—consensus perception—based on the blockchain characteristics and advantages derived from prior studies, and then developed a conceptual model based on the consensus perception and principal–agent theory. Second, we used this conceptual model to investigate whether blockchain technology (BT) can be used to promote information-resource sharing. The results showed that information security concern, perceived rewards, and openness have direct influences on information-resource sharing intention and that trust has indirect effects. The findings provide useful theoretical and practical contributions to sustain enterprises' open innovation by adopting BT to solve the information-resource sharing issues.

Keywords: blockchain; information-resource sharing; consensus perception; trust; openness; information security concern; perceived rewards; open innovation



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1. Introduction

In recent decades, information technology (IT) and information systems (IS) are catalysts that provided opportunities for enterprises to maintain their competitive edge and sustain their open innovation [? ? ?], especially for small-to-medium enterprises (SME) [? ?]. Information resources, as the fuel for sustaining IS operation, have been paid more and more attention by enterprises. For this reason, information resources are considered a strategic resource for many companies using IT and IS [? ?]. The triggers such as distrust, information security issues, and openness, make enterprise departments often unwilling to share information resources and engenders information isolation [?]. This phenomenon is called a 'silo' by Tett [?], who stated that silos block enterprises' open innovation and development.

To help enterprises overcome the disadvantages of open innovation caused by information silos and maintain their competitiveness, prior scholars have found that information-resource sharing is effective in breaking silos [? ? ?] and sustaining open innovation [?]. Due to the dual features of information resources as both the information container and information assets [?], the studies of information-resource sharing show that using intention–behavior theories (e.g., TAM and UTAUT) do not provide an effective solution to promote information-resource sharing [?]. Using principal–agent theory to explore information-resource sharing is better because principal–agent theory can be used to explain the transactional behavior between principal and agent in the presence of uncertainty [? ?], and this behavior is similar to the information-resource sharing behavior.

According to prior research, there are many uncertainties in information-resource sharing, such as distrust issues and concerns about information security [? ? ?]. These uncertain factors have impeded information-resource sharing [? ?]. Moreover, some

environmental factors such as openness, and motivational factors such as perceived rewards, also have significant influences on information-resource sharing [? ?]. On the other hand, blockchain is an emerging technology that can disrupt existing industry and enterprise strategies and capabilities [? ?]. It is a distributed ledger that stores tamper-proof records on peer-to-peer network nodes (participants). Records are maintained and tracked by network participants through a consensus mechanism without intermediaries [?], rendering them difficult to delete or modify by unauthorized individuals or groups [?]. Moreover, blockchain provides a new mechanism called smart contract to execute the rules, terms, and policies that are customized by participants, and thus allows parties to conduct transactions without intermediaries [? ?]. Due to these characteristics and advantages, blockchain technology (BT) is recognized as the “trust-free” technology to address issues about uncertainty and distrust among parties, and provides several benefits such as trust, security, openness, and rewards [? ? ?].

Therefore, whether BT can be used to promote information-resource sharing and thus sustain enterprises’ open innovation is the research objective of this study [?]. BT not only can benefit openness and rewards but also can address distrust issues and concerns about information security [?].

However, most studies of BT are theoretical expositions or literature reviews [? ?]. Studies using empirical approaches are limited, especially the research on information-resource sharing [? ? ?]. Therefore, in order to achieve the research objective, this study proposed a conceptual model based on principal-agent theory and the concept of consensus perception using Amos to explore whether BT can be used to promote information-resource sharing within an organization, thereby sustaining enterprises’ open innovation. It provides valuable contributions to the fields of BT, IM, and open innovation from the perspective of blockchain consensus perception. It contributes theoretical support for the empirical research into BT, IM, and open innovation fields through the concept of consensus perception. It also provides empirical support for enterprises to sustain open innovation by adopting BT to promote information-resource sharing.

This study includes seven sections. Section ?? introduces the research overview of this paper. Section ?? expounds the theories and concepts that support the research model proposed in this paper. Section ?? presents the research model and illustrates all hypotheses proposed by this model. Section ?? demonstrates the measurement development and sampling procedure. Section ?? explains the analysis results. Section ?? discusses the findings and implications. Additionally, Section ?? provides a conclusion for this paper’s findings and limitations.

2. Theoretical Background

2.1. Blockchain Concept and Its Characteristics

BT has four characteristics and advantages that can be used to resolve the issues of information-resource sharing. First, because of the characteristics of P2P networks, data are rarely lost due to the failure of a single node [?]. Moreover, due to the use of asymmetric cryptography algorithms, records are hardly tampered with by malicious parties or accessed by unauthorized parties [?]. Therefore, BT is considered to have strong security.

Second, due to the advantages of the P2P network, characteristics of the data structure, and the features of the consensus mechanism, BT provided a trust-free platform without third-party supervision [?]. It allowed people to communicate and cooperate without concern about integrity issues and thus reduce their concerns about trust [? ?]. Therefore, trust is considered one of the BT advantages.

Third, because of the consensus mechanism and P2P network characteristics, all network participants (nodes) are involved in data maintenance. In addition, all audit trails of data are transparent for, and supervised by, all participants [? ?]. Thus, BT is considered to have high openness.

Fourth, due to the characteristics of smart contracts, reward mechanisms can be easily added into the smart contract as rules are run automatically [20]. Participants can use the smart contract to easily build any reward system that meets the consensus among participants [20,21]. Therefore, the reward is deemed as another BT advantage.

Moreover, due to the characteristics of openness and rewards that can benefit environmental and motivational factors of information-resource sharing [22], and the advantages of trust and security that can address the uncertainties of information-resource sharing [23], some scholars stated that BT can be used to promote information-resource sharing [20,21].

Therefore, this study extracted a new concept from these characteristics and advantages and called it “consensus perception” because they are considered to represent the features of BT. It includes four factors—trust, information security concern, openness, and perceived rewards. Since not only can the factors of consensus perception influence information-resource sharing behavior, but also are major features of BT [20,21], the concept of consensus perception is ideal for investigating information-resource sharing behavior based on BT, and the present study will investigate information-resource sharing based on this concept.

2.2. Principal–Agent Theory

The principal–agent theory attempts to explain the transactional agreement between principal and agent in the presence of uncertainty or with a discordant purpose [24]. Prior scholars used principal–agent theory on IM to resolve information problems caused by perceived uncertainty and information asymmetry. For example, Pavlou et al. [25] studied the influence of information asymmetry on buyers’ purchase intention through online transaction platforms from the principal–agent perspective, and found that trust and information security concerns have significant effects on perceived uncertainty and buyers’ purchase intention. Moreover, users’ concerns about information security caused by information asymmetry between users (principal) and service providers (agent) let users perceive more uncertainty and reduce their intention to use the online services provided by service providers [25].

For investigating information-resource sharing intention, the principal–agent theory is certainly better than traditional theories, because the relationship between the information-resource provider and the recipient is similar to the relationship between the principal and the agent: while sharing the information resource, the information provider perceives the uncertainty due to information asymmetry between the provider and the recipient. Therefore, the present study based on the principal–agent theory proposed a conceptual model from the perspective of the consensus perception to investigate the information-resource sharing intention.

3. Research Model and Hypotheses

The conceptual model was built based on the principal–agent theory and four factors of the consensus perception of BT. Figure 1 shows this research model. This model was used to investigate how those factors influence the intention to share information resources within an enterprise. It included six constructs: two independent variables, trust and perceived rewards; three mediators, openness, information security concern, and perceived uncertainty; and one dependent variable, information-resource sharing intention. Additionally, of the proposed nine hypotheses, four are positive, and five are negative.

All constructs and the hypotheses will be discussed in the following section.

3.1. Perceived Uncertainty

Perceived uncertainty is the degree to which future risk cannot be accurately predicted due to asymmetric information [26]. If individuals perceive the Internet to be uncertain, they will be unwilling to conduct transactions [27] or use online services [28]. Similarly, environmental risks in supply chain networks, such as supplier’s morality, affect information sharing within supply chain participants [29]. According to the principal–agent theory,

perceived uncertainty reflects people's capacity of enduring risks. It negatively connects to the buyer's intention to purchase products in e-commerce [?]. When the person perceived more uncertainty, they will have a lower willingness to conduct transactions [?], or to share information [?]. That leads to the following hypothesis:

Hypothesis 1 (H1). *Perceived uncertainty will have a negative influence on information-resource sharing intention.*

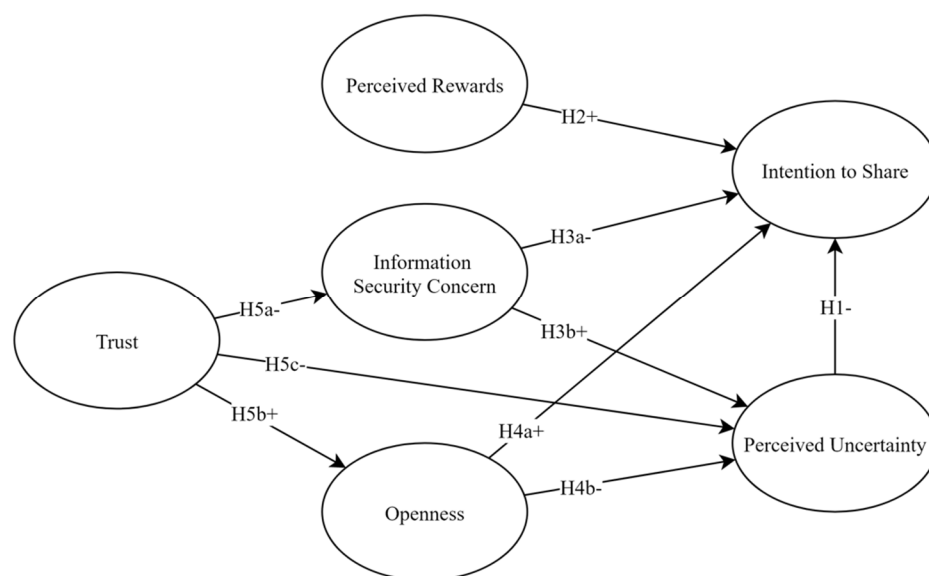


Figure 1. Research model. Note: '+' indicates a positive influence and '-' indicates a negative influence.

3.2. Perceived Rewards

Perceived rewards are the people's perception that rewards (e.g., money, reputation, and reciprocity) could promote the intention of information-resource sharing [? ?]. Rewards such as reputation motivate individuals to be involved in social interactions or contribute to the community such as sharing knowledge or information because they can enhance their reputation due to those behaviors [?]. Similarly, if people believe they can receive reciprocal benefits, they will exhibit more positive intention to share knowledge [?]. Moreover, economic rewards (e.g., money) and social rewards (e.g., reputation and reciprocity) are incentives that encourage individuals to share their genomic data by using blockchain-based platforms [?]. Therefore, in this study, the relationship between perceived rewards and information-resource sharing intention is hypothesized as follows:

Hypothesis 2 (H2). *Perceived rewards will have a positive influence on information-resource sharing intention.*

3.3. Information Security Concern

Information security is an issue that appeared with the growth of the Internet and is studied by various domains. For example, Tsai and Yeh [?] stated that information security is a major concern for online purchase intentions. In addition, Fan et al. [?] found that it is the main factor that influences local government decision-making of choosing information technology to share information across agencies and departments. Similar findings that people's concern about information security reduces their intentions to share has been shown by other scholars [? ? ? ?]. In this study, information security concern is defined as the degree of security that people feel about the Internet [?], and it is assumed that

it will reduce people's intention to share information resources. Therefore, the following hypothesis is proposed:

Hypothesis 3a (H3a). *Information security concern will exert a negative effect on the intention to share information resources.*

Moreover, people's concern about information security will lead them to produce perceived uncertainty when sharing information resources. Because when people find it difficult to assess the information recipient's capacity to safeguard their information, they cannot predict whether their information will be protected and whether they will be harmed due to information disclosures. It will cause them to perceive more uncertainty [? ?]. Thus, the following hypothesis is proposed:

Hypothesis 3b (H3b). *Information security concern will positively influence perceived uncertainty.*

3.4. Openness

Openness under the Internet context has attracted the interest of scholars. Openness not only can effectively promote communication and exchanges between employees thereby improving organizational performance [?], but can also effectively encourage communication and knowledge sharing due to disclosing information and unambiguous communication [? ?]. Moreover, it can also promote knowledge sharing through the positive effects of a community sharing culture [?]. Furthermore, openness can provide an open environment for research and innovation of institutions or enterprises [?]. Therefore, openness is defined as the extent to which information can be shared among all participants [?], and we proposed the following hypothesis:

Hypothesis 4a (H4a). *Openness has a positive relationship with the intention to share information resources.*

Moreover, it has also been found that openness can reduce uncertain factors in uncertain environments [?]. Individuals in a high degree of an open environment can more easily absorb new experiences, accept changes, and effectively use novel strategies to deal with unknowns, and thus will perceive less uncertainty when facing unknowns [? ?]. This study, therefore, hypothesizes that higher openness will lower employees' uncertainty when they communicate or share information:

Hypothesis 4b (H4b). *Openness has a negative impact on perceived uncertainty about information-resource sharing.*

3.5. Trust

Trust is a crucial concept. It has been widely studied in technology and society [?], economics [?], and IS [?]. Scholars found trust to be a social complexity-reducing mechanism that leads to a willingness of organizational dependence, used to assess whether an organization is trustworthy [? ?]. It can reduce information security concerns by reducing fears of information asymmetry [?], and can positively influence secure authentication and concerns for an attack [?].

The empirical evidence showed that trust negatively connects with concerns about information security [?], because it can increase the belief that people apply appropriate security control strategies to protect information [? ?]. The same proposal is adopted in this study; that trust can reduce concerns about information security where people share information. The following hypothesis is proposed:

Hypothesis 5a (H5a). *Higher trust will exert a negative effect on reducing the anxiety of information security.*

Not surprisingly, some scholars found that trust and openness are related but separate concepts. A higher level of trust will lead to a higher willingness to communicate thoughts and information with each other [? ?]. Moreover, scholars stated that trust is an important requisite for open communication due to it being able to promote open communication and information sharing through the reduction of opportunistic behavior [?]. Thus, this study assumed that trust facilitates openness shaping and proposed the following hypothesis:

Hypothesis 5b (H5b). *Trust will facilitate enterprise to build an environment with openness.*

Moreover, trust can reduce the perceived uncertainty through decreasing people's perception of risk, because trust can ensure people attain the desired result of events in the unknowable future as if being assured from the knowable past [?] and allow people to ignore the impact of uncertainty [?]. For example, Yang et al. [?] claimed that trust is one of the most effective factors to reduce uncertainty because trust can decrease the conscious consideration of uncertainty. Therefore, this study proposed the following hypothesis:

Hypothesis 5c (H5c). *Trust will reduce the perceived uncertainty in information-resource sharing.*

4. Research Methodology

4.1. Measurement Development

To achieve the research objective, this study employed an empirical approach. All data were collected through a questionnaire survey, and measurement items were adopted or adapted from the scales of previous studies to fit the study's context. Appendix ?? outlines the definitions of the constructs, and Appendix ?? lists the measurement items.

For the information-resource sharing intention, four measuring items were derived from Hooff and Weenen [?] and He and Wei [?]. For perceived uncertainty, four measuring items were adopted from a study by Pavlou et al. [?]. For the construct of perceived rewards, three items were derived from Hung et al. [?] and Zhang et al. [?]. For information security concern, four measuring items were adopted from a study of Flavián and Guinalú [?] and Trenz et al. [?]. For the construct of openness, five items are derived from Haesevoets et al. [?], and trust's four measurement items are from Gefen and Straub [?] and Chiu et al. [?].

All items are on a 7-point Likert scale; all items ranged from "strongly disagree" to "strongly agree". To ensure the balance and randomness of the items, two constructs use reverse items, and all were randomly arranged to reduce the potential ceiling (or floor) effect [?].

4.2. Sampling and Descriptive Statistics

The study used online surveys, and the sample was derived from three types of enterprises or institutions in the first-tier cities of China, Beijing, Shanghai, Guangzhou, and Shenzhen, which are in the IT, finance, and university sectors. The first-tier cities represent the vanguard of China's technological and economic development; IT and finance enterprises are the first enterprises to know and study blockchain, and universities are the research institutions that are interested in cutting-edge technology. Therefore, sampling from these three types of enterprises or institutions in the first-tier cities of China was representative.

The online questionnaire was developed through a survey website called "Wenjuanxing", and the URL of the questionnaire was distributed to potential participants of the institutions and enterprises. One respondent represents one institution or enterprise.

The questionnaire collection took about two months and was completed on 15 September 2020. After eliminating insincere responses through data filtering, 401 valid and usable responses were used for the final data analysis. Table ?? shows the respondents' demographics.

Table 1. Demographic of respondents.

Measure	Items	Frequency	Percent
(a) Demographic information of respondents			
Gender	Male	222	55.36
	Female	179	44.64
Age	<25	5	1.25
	25–35	263	65.59
	36–45	110	27.43
	46–55	18	4.49
	56–65	5	1.25
Highest education level	Below diploma degree	5	1.25
	Diploma degree	26	6.48
	Bachelor's degree	283	70.57
	Master's degree	79	19.70
	Doctoral degree	8	2.00
(b) Organization information			
Type of industry	IT	295	73.57
	Academic/education	38	9.48
	Finance	68	16.96
Locations	Beijing	127	31.67
	Shanghai	117	29.18
	Guangzhou	84	20.95
	Shenzhen	73	18.20
Size (number of employees)	51~100 people	71	17.71
	101~200 people	86	21.45
	201~500 people	101	25.19
	501~1000 people	65	16.21
	Above 1000 people	78	19.45

Sample size = 401.

4.3. Common Method Bias (CMB)

To minimize the influence of CMB, this study first assured the anonymity of respondents and informed them that there were no right or wrong responses during the data collection [? ?]. We then conducted Harman's single factor test after data collection, and the result shows that a single factor explains 25.79% of the total variance, which is less than 50%; there is no issue of CMB [? ?].

5. Results Analysis

To test the study's proposed model, investigate the relationships between the variables, and examine the mediation effects, structural equation modeling (SEM) with the maximum likelihood method was used in a comprehensive and combined analysis of both measurement and structural models. All constructs were measured as first-order reflective constructs using three or more indicators, and all statistical procedures and research hypotheses were tested using Amos 24.0 and SPSS 24.0. Data analysis was divided into two sections—measurement estimation and structural model analysis—which are described below.

5.1. Measurement Model Evaluation

Cronbach's alpha coefficient of all constructs ranged from 0.73 for information security concern to 0.85 for openness. All constructs were above the suggested level of 0.70 [? ?]. The CR for all constructs ranged from 0.80 for trust to 0.85 for openness, indicating that all

were over the benchmark of 0.60 recommended by Fornell and Larcker [?]. Table ?? shows the results for construct reliability.

Table 2. Construct reliability.

Construct	Cronbach's Alpha	Composite Reliability (CR)
Perceived uncertainty	0.81	0.82
Information security concern	0.73	0.80
Openness	0.85	0.85
Perceived rewards	0.74	0.82
Trust	0.76	0.80
Information-resource sharing intention	0.78	0.81

The result of the discriminant validity showed that all structures are acceptable because each indicator loads highest on the construct of intending to measure, which implies that this structure does not overlap with other constructs [?]. The results of discriminant validity are reported in Table ??.

Table 3. Discriminant validity.

	Intention	Uncertainty	Rewards	Security	Trust	Openness
Intention	0.695					
Uncertainty	−0.501	0.723				
Rewards	0.448	−0.268	0.712			
Security	−0.506	0.270	−0.472	0.649		
Trust	0.395	−0.668	0.210	−0.116	0.668	
Openness	0.510	−0.562	0.387	−0.290	0.631	0.729

Intention = information-resource sharing intention, Uncertainty = perceived uncertainty, Rewards = perceived rewards, Security = information security concern. The square root of AVE is displayed in bold style.

Convergent validity is demonstrated when different items are used to measure the same construct. The results indicate that all items had a significant factor loading with each construct, shown in Table ?? . According to the common rule of a loading value above 0.50 for acceptability [?], all items had a factor loading above 0.5. Moreover, the CR of all constructs is above their AVE. That indicated their convergent validity is acceptable.

5.2. Structural Model Estimation

A structural model is used to investigate and illustrate the relationship among variables in a proposed model. Table ?? shows the overall fit indices of the research model. Results show that the research model has good fitness levels for the indices of the CMIN/DF, AGFI, RMSEA, and acceptable levels for the indices of the SRMR, GFI, NFI, IFI, TLI, and CFI, which means the findings had achieved an acceptable level and could be used to explain the hypotheses.

5.3. Interpretation of Structural Model Testing

Path coefficients of the models are exhibited in Figure ??, and the results of the hypothesis of the structural relationships are shown in Table ?? . These results indicate that all nine causal paths of the proposed model are found to be statistically significant. Trust has a significant effect on information security concern (H5a, beta = −0.19) and openness (H5b, beta = 0.66). It explains 44% of the variance of openness and 4% of the variance of information security concern. Moreover, trust (H5c, beta = −0.55), openness (H4b, beta = −0.17), and information security concern (H3b, beta = 0.11) have significant impacts on perceived uncertainty and explain 50% of its variance. Information security concern (H3a, beta = −0.31), openness (H4a, beta = 0.24), perceived uncertainty (H1, beta = −0.25), and perceived rewards (H2, beta = 0.20) significantly influence information-resource sharing intention and explain 43% of its variance.

Table 4. Factor loadings and cross-loadings of all constructs.

	Uncertainty	Security	Openness	Rewards	Trust	Intention
PU1	0.705					
PU2	0.765					
PU3	0.721					
PU4	0.735					
S1		0.823				
S2		0.784				
S3		0.552				
S4		0.656				
O1			0.750			
O2			0.755			
O3			0.738			
O4			0.742			
O5			0.673			
PR1				0.745		
PR2				0.782		
PR3				0.795		
T1					0.719	
T2					0.745	
T3					0.693	
T4					0.653	
I1						0.621
I2						0.766
I3						0.716
I4						0.778

Intention = information-resource sharing intention, Uncertainty = perceived uncertainty, Rewards = perceived rewards, Security = information security concern.

Table 5. Summary of model fit indices.

Fit Index	Recommended Values	Model Values	Model Fit
CMIN/DF	≤ 3	1.84	Good fit
SRMR	< 0.1	0.07	Acceptable
GFI	≥ 0.9	0.92	Acceptable
AGFI	≥ 0.85	0.90	Good fit
NFI	≥ 0.8	0.88	Acceptable
IFI	≥ 0.9	0.94	Acceptable
TLI	≥ 0.9	0.93	Acceptable
CFI	≥ 0.9	0.94	Acceptable
RMSEA	≤ 0.08	0.05	Good fit

Table 6. Summary results of the structural model.

Path	Hypothesis	Path Coefficient	C.R.	Result
Uncertainty → Intention	H1	−0.25 ***	−3.58	Supported
Rewards → Intention	H2	0.20 ***	3.49	Supported
Security → Intention	H3a	−0.31 ***	−5.21	Supported
Security → Uncertainty	H3b	0.11 *	2.14	Supported
Openness → Intention	H4a	0.24 ***	3.51	Supported
Openness → Uncertainty	H4b	−0.17 *	−2.19	Supported
Trust → Security	H5a	−0.19 **	−2.98	Supported
Trust → Openness	H5b	0.66 ***	9.53	Supported
Trust → Uncertainty	H5c	−0.55 ***	−6.18	Supported

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

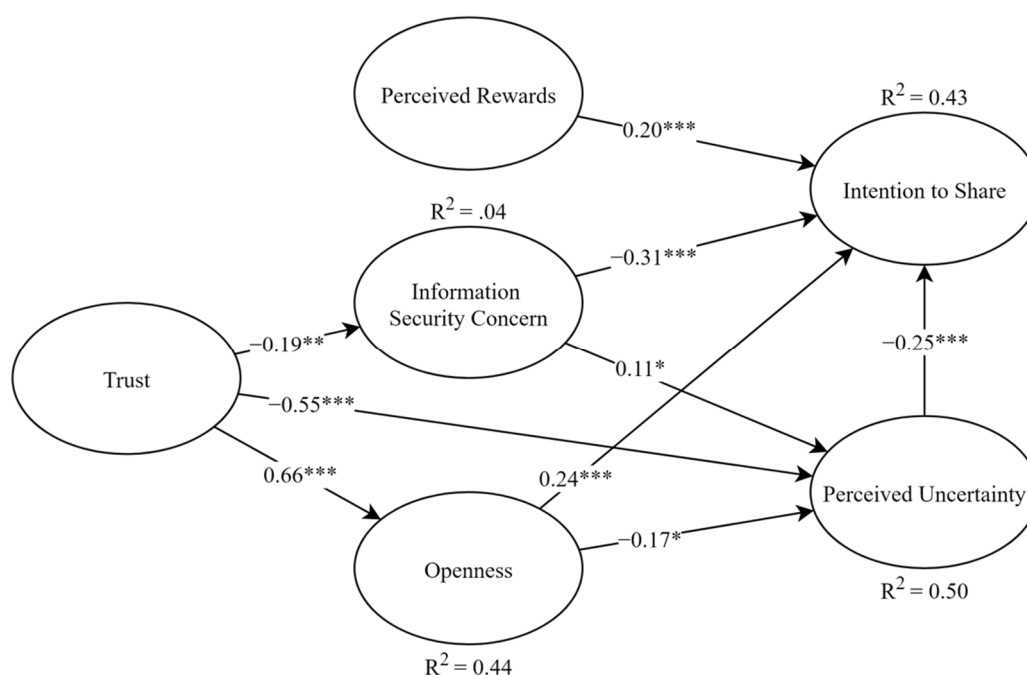


Figure 2. Path coefficients for the research model. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5.4. Interpretation of Mediating Effects

Except for the direct effects of constructs, the conceptual framework of this study also includes several implicit mediating effects on information-resource sharing intention. To investigate the mediating effects on information-resource sharing intention, the bootstrapping procedure (5000 iterations) was adopted, as scholars have said that the Baron–Kenny test and Sobel test cannot provide sufficient information of this effect [? ?]. The bootstrapping procedure is more appropriate and more powerful than either of the other tests [? ?]. The results are shown in Table ??.

The indirect effects of openness (indirect effect = 0.029, 95% bias-corrected CI [−0.003, 0.088]) on information-resource sharing intention and information security concern (indirect effect = −0.018, 95% bias-corrected CI [−0.058, 0.003]) on information-resource sharing intention, mediated by perceived uncertainty, are not significant. Moreover, the indirect effects of trust on perceived uncertainty mediated by openness (indirect effect = −0.122, 95% bias-corrected CI [−0.256, 0.043]) and mediated by information security concern (indirect effect = −0.024, 95% bias-corrected CI [−0.076, 0.004]), are also not statistically significant.

However, the indirect effects of trust on information-resource sharing intention mediated by openness (indirect effect = 0.110, 95% bias-corrected CI [0.025, 0.233]), trust on information-resource sharing intention mediated by perceived uncertainty (indirect effect = 0.123, 95% bias-corrected CI [0.014, 0.283]), and trust on information-resource sharing intention mediated by information security concern (indirect effect = 0.047, 95% bias-corrected CI [0.008, 0.117]) are statistically significant. Additionally, the direct effects of trust on information-resource sharing intention is not statistically significant (direct effect = 0.002, 95% bias-corrected CI [−0.227, 0.228]). That means openness, perceived uncertainty, and information security concern have full mediating effects on the indirect influence of trust on information-resource sharing intention.

Table 7. Mediation effects by bootstrapping procedure.

	Point Estimate	Product of Coefficients		Bias-Corrected 95% CI		Result
		SE	Z	Lower	Upper	
Indirect effects						
Openness → Uncertainty → Intention	0.029	0.023	1.261	−0.003	0.088	Not supported
Security → Uncertainty → Intention	−0.018	0.015	−1.200	−0.058	0.003	Not supported
Trust → Uncertainty → Intention	0.110	0.052	2.115	0.025	0.233	Supported
Trust → Openness → Intention	0.123	0.068	1.809	0.014	0.283	Supported
Trust → Security → Intention	0.047	0.027	1.741	0.008	0.117	Supported
Trust → Openness → Uncertainty	−0.122	0.077	−1.584	−0.265	0.043	Not supported
Trust → Security → Uncertainty	−0.024	0.019	−1.263	−0.076	0.004	Not supported
Direct effects						
Trust → Intention	0.002	0.115	0.017	−0.227	0.228	Not supported
Total effects						
Trust → Intention	0.309	0.071	4.352	0.192	0.471	Supported

Note: Standardized estimation of a 5000 bootstrap sample. Security = information security concern, Uncertainty = perceived uncertainty, Intention = information-resource sharing intention.

6. Discussion and Implications

6.1. Discussion

The present study finds several factors that can be used to understand information-resource sharing behavior and to guide whether BT can be used to promote information-resource sharing and thus sustain enterprises' open innovation.

Our results show that perceived uncertainty is a negative factor that could reduce employees' intention to share information resources (H1), which is consistent with previous studies [? ? ?]. This finding suggests that decreasing uncertainties in an enterprise facilitates information-resource sharing. Perceived rewards are a positive factor that significantly influence information-resource sharing intention (H2), which is aligned with previous studies [? ? ?]. This finding suggests that adopting BT can help to promote information-resource sharing because BT can easily implement a reward mechanism through the smart contract and thus helps an enterprise to deploy reward mechanisms easier [? ? ?].

Information security concern is a significant negative factor that can directly diminish employees' intention to share information resources (H3a) and increase their perceived uncertainty (H3b). These two relations have been validated by earlier studies by Kshetri [?], Pavlou et al. [?], and Trenz et al. [?]. Moreover, the uncertainty caused by concern about information security cannot trigger employees' unwillingness to share information resources. These findings suggest that adopting BT also can promote information-resource sharing because BT can reduce information security concerns by providing a secure platform for employees [? ? ?].

Openness is an essential environmental factor that directly promotes information-resource sharing intention (H4a) and moderates perceived uncertainty (H4b). These two influences are consistent with prior studies [? ? ?]. Moreover, reduced uncertainty caused by the open environment of an enterprise cannot increase employees' willingness to share information resources. These findings suggest that adopting BT can promote information-resource sharing because BT has benefits to enterprises creating an open atmosphere [? ? ?].

Trust is the most important stimulator for the enterprise. It can decrease employees' concern for information security (H5a), facilitate open environment shaping (H5b), and reduce perceived uncertainty (H5c). These effects align with prior studies by Singh and Srivastava [?], Thusi and Maduku [?], Trenz et al. [?], and Yang et al. [?]. Moreover, except for these direct effects, trust can indirectly encourage employees to share information resources with other departments through diminishing employees' concern about information security, mitigating perceived uncertainty, and facilitating the shaping of the open environment of an enterprise [? ? ?]. These findings suggest that adopting BT can promote information-resource sharing because BT provides a new trust pattern to resolve the issues of distrust between employees and between departments, making sharing information resources in the low-trust environment possible [? ?].

Therefore, BT can help enterprises to sustain open innovation. Open innovation is the mindset that using all internal and external knowledge, sources, and resources can drive innovation [? ?]. Its core is collaboration and co-creation, and the barriers of knowledge and collaboration are the main barriers for open innovation [?]. Information-resource sharing first facilitates collaboration. Because employees can unambiguously communicate with other employees or departments through sharing information, that could reduce their opportunistic behaviors and let them more easily find right partners [? ?]. Information-resource sharing also facilitates co-creation, because through sharing information resources, employees not only efficiently develop new ideas and opinions but also can easily exchange thoughts and knowledge with each other, thereby diminishing knowledge barriers [? ?]. Therefore, adopting BT can sustain enterprises' open innovation by promoting information-resource sharing because information-resource sharing can diminish barriers of knowledge and collaboration through facilitating collaboration and co-creation.

6.2. Implications for Research

This study developed a model from the perspective of consensus perception to enable a better understanding of the influence of information-resource sharing intention and thus to support enterprises sustaining open innovation by using BT. It provides several valuable contributions to the fields of BT, IM, and open innovation. The present study first provides an empirical study to investigate information-resource sharing from the perspective of consensus perception of blockchain, which attempts to close a gap in the blockchain literature presented by Ying et al. [?], Queiroz and Wamba [?], and Wang et al. [?], who stressed that current blockchain research is chiefly conceptual and exploratory, and it has a narrow focus on the empirical evidence. Moreover, the present study's research model was derived from prior literature principal-agent models [? ?]. This model from the perspective of consensus perception of blockchain provides new insights into the research of information-resource sharing and sustaining open innovation. Furthermore, due to prior studies focusing on the direct effects of trust [? ? ?], the present study result extends previous research to indirect influence.

6.3. Implications for Practitioners

Our findings offer essential insights for practitioners of IM, IS, and open innovation. First, this study presented a model based on the classic principal-agent theory, from the perspective of consensus perception of blockchain to study information-resource sharing. The results reveal inter-relationships between the factors of consensus perception and information-resource sharing intention. These relationships give managers a new direction to practice whether BT can be used to promote information-resource sharing and thus to sustain open innovation.

Second, the environmental factors such as openness and information security are the crucial determinants for influencing information-resource sharing between departments [? ? ?]. Therefore, creating an open atmosphere and a secure information environment can help an enterprise to encourage employees to share information resources with other

departments, and adopting BT can help an enterprise to create an open atmosphere and secure information environment.

Third, trust not only directly facilitates the creation of an open environment [? ?], but reduces information security concern [? ?], and decreases perceived uncertainty [? ?]. It also indirectly increases information-resource sharing intention by the mediators of openness, information security concern, and perceived uncertainty [? ?]. Therefore, increasing trust between employees and between departments is the first choice for an enterprise to encourage information-resource sharing, and adopting BT can help an enterprise to resolve the issues of distrust between employees and between departments.

Moreover, designing some reward mechanisms can also help an enterprise to encourage information-resource sharing between departments because perceived rewards have a significant effect on information-resource sharing intention [? ?], and adopting BT can help an enterprise to deploy reward mechanisms easier.

Additionally, adopting BT can sustain enterprises' open innovation by promoting information-resource sharing, because BT can help an enterprise to share information resources, and information-resource sharing can help an enterprise to sustain open innovation by diminishing barriers of knowledge and collaboration through facilitating collaboration and co-creation [?].

7. Conclusions

To understand whether BT can be used to promote information-resource sharing and thus sustain enterprises' open innovation, the present study developed an integrated model based on principal-agent theory, and the results obtained supported the proposed model. This study proposed a new concept derived from blockchain, called consensus perception, and used it as the predictor of information-resource sharing intention. Openness, information security concern, and perceived rewards proved to have a direct effect on information-resource sharing intention, and trust proved to have an indirect effect on it; this was the case only in China. Information-resource sharing behavior between organizations or agencies, as well as in other countries and contexts, need to be investigated to complete our findings and enable generalization.

According to the results obtained, our proposed model was adequately explained, and all hypotheses are aligned with those from previous literature. This indicated that the factors of consensus perception can help enterprises to understand whether BT can be used to promote information-resource sharing and thus sustain enterprises' open innovation. For example, adopting BT can resolve the issues of distrust between employees and between departments and thus promote information-resource sharing [? ?]; adopting BT also can promote information-resource sharing by creating an open atmosphere [? ?] and creating a secure information environment to reduce employees' concern for information security [? ?]; moreover, adopting BT can help to implement reward mechanisms easier and thus promote information-resource sharing [? ?]. Therefore, adopting BT can be used to sustain enterprises' open innovation by promoting information-resource sharing because information-resource sharing can diminish barriers of knowledge and collaboration through facilitating collaboration and co-creation [?].

Some limitations of this study will need further investigation and additional scrutiny. First, the results explain only information-resource sharing intentions within an organization. Further studies can examine the information-resource sharing intention between organizations or agencies from the perspective of the consensus perception of blockchain. Second, the sample was collected from Chinese companies. Since cultural and national differences will impact information-resource sharing intention, further studies can examine the effects of the consensus perception on information-resource sharing intention using samples from other countries. Third, it is unclear whether the concept of consensus perception can be generalized to other circumstances; further studies can examine the effects of the consensus perception on other behavior intentions.

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Appendix A

Table A1. Definitions of the constructs.

Constructs	Definitions
Perceived uncertainty	The degree to which future risk cannot be accurately predicted due to asymmetric information [?].
Perceived rewards	The people’s perception that rewards (e.g., money, reputation, and reciprocity) could promote the intention of information-resource sharing [?].
Information security concern	The degree of security that people feel on the Internet [?].
Openness	The extent to which information can be shared among all participants [?].
Trust	A social complexity-reducing mechanism which leads to a willingness for organizational dependence [?].
Intention of sharing information resources	The probability of people sharing information resources [?].

Appendix B

Table A2. Questionnaire items.

Constructs	Items
Perceived uncertainty (reverse)	<p>PU1. The IT infrastructures used to share information resources (e.g., network framework and operating system) involve a low degree of uncertainty.</p> <p>PU2. The uncertainty associated with using IT systems or services provided by the organization or other departments to share information resources is low.</p> <p>PU3. It is not exposed to many process uncertainties when using IT systems or services provided by the organization or other departments to share information resources.</p> <p>PU4. There is a low degree of unexpected results (i.e., the provided information is stolen or abused) when using IT systems or services provided by the organization or other departments to share information resources.</p>

Table A2. Cont.

Constructs	Items
Perceived rewards	<p>PR1. I expect to receive material rewards when sharing information resources with other departments.</p> <p>PR2. I expect to improve our reputation in the organization by sharing information resources with other departments.</p> <p>PR3. I expect to improve our status in the organization by sharing information resources with other departments.</p>
Information security concern (reverse)	<p>S1. I am sure that the information resources we provide to other departments is well protected.</p> <p>S2. I am sure that other departments show great concern for the information security.</p> <p>S3. I am sure that information resources cannot be tampered with by others when we send them to other departments.</p> <p>S4. I am sure that information resources will not be intercepted by unauthorized third parties when we send them to other departments.</p>
Openness	<p>O1. The transparency of communication in the organization is high.</p> <p>O2. Departments within the organization can communicate openly with each other.</p> <p>O3. The relevant information within the organization can be shared among all leaders.</p> <p>O4. Departments within the organization can share relevant information with each other.</p> <p>O5. Departments within the organization can communicate candidly with each other.</p>
Trust	<p>T1. Promises made by other departments are likely to be reliable.</p> <p>T2. I do not doubt the honesty of other departments.</p> <p>T3. Other departments are well-meaning.</p> <p>T4. Other departments are not opportunistic.</p>
Intention of sharing information resources	<p>I1. Sharing information resources with other departments is considered a normal thing.</p> <p>I2. Sharing information resources with other departments is a good idea.</p> <p>I3. Sharing information resources with other departments is a wise move.</p> <p>I4. Sharing information resources with other departments is a positive step.</p>

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