

# Research on the Influencing Factors of User Acceptance of Blockchain Application in Government Services under TOE Framework

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**Abstract.** With the enhancement of information technology, the traditional government service model is also facing transformation and upgrading. Blockchain technology can help government services achieve digital transformation due to its advantages of centralization, traceability, and non-tamperability. Based on the TOE framework, this paper constructs a model of factors influencing the user acceptance of blockchain applications in government services. Through regression analysis of sample data, the results show that relative advantage, information quality, trend pressure, and individual innovativeness all have significant effects on user acceptance. Finally, the limitations of the study and future research development are pointed out in order to provide guidelines for the construction of government services.

**Keywords:** Block chain, Government service, TOE, User acceptance.

## 1. Introduction

With the popular development of modern information technology such as cloud computing, block chain and Internet of Things, the world is experiencing a revolution. <sup>[1]</sup> Blockchain as a distributed shared database is emerging as a research application in multiple fields. Specifically in the field of government governance, blockchain government services are gradually becoming one of the frontier areas of China's government reform in the context of "Internet+government services". The distributed, transparent, traceable and open characteristics of blockchain technology are in line with the concept of "Internet+" in government services, and its application can make the governance process more transparent and efficient, which will bring fundamental changes and reshaping to the original governance system and governance capacity.

Since 2018, blockchain research is no longer confined to the technical application level and financial field, but has started theoretical and empirical research on the mechanism of "blockchain governance". In the field of government services, scholars' research mainly focuses on three aspects of blockchain application to promote the sharing of government data, promote the socialization of government services, and help the precision of public services. <sup>[2]</sup> while there is a relative lack of research on user acceptance of blockchain technology in government service applications.

For government services, exploring the factors influencing the application of blockchain technology regarding users' willingness to use it and the significance of each factor generating influence can help to provide references for improving its service model and enhancing its effectiveness. Meanwhile, the TOE theoretical framework has been widely used in the influencing factors of information technology adoption during decades of development, but it is relatively lacking in the application area of block technology for government services. Based on the TOE theoretical framework, this paper systematically examines the factors influencing users' willingness to use blockchain technology applications in government services from three dimensions: technology, organization and environment, which is not only an inheritance and development of TOE theory, but also brings reference value to further improve the research on blockchain applications in government services.

## 2. Theoretical foundation

### 2.1. Connotation of blockchain

Blockchain" is an important part of the credit information communication technology system, which was first proposed in 2008 by a scholar under the pseudonym "Satoshi Nakamoto", who argued in his paper "Bitcoin: A Peer-to-Peer Electronic Cash System" that block chain technology ensures the encrypted transmission of transaction information in the application of electronic money systems. encrypted transmission, and is the underlying technology that enables bitcoin to be mined and traded. [3]

The "White Paper on the Development of Blockchain Technology and Applications in China 2016" published by the Ministry of Industry and Information Technology in 2016 defines blockchain as "in a narrow sense, a distributed ledger that combines data blocks in a sequentially linked manner into a chained data structure in chronological order and is cryptographically guaranteed to be tamper-evident and unforgeable; in a broad sense, a distributed ledger that uses block In a broader sense, it is a new distributed infrastructure and computing paradigm that utilizes a chain data structure to verify and store data, a distributed node consensus algorithm to generate and update data, a cryptographic approach to secure data transmission and access, and a smart contract composed of automated scripting code to process and manipulate data. [4] Some scholars tend to understand blockchain technology from a functional perspective as a new type of database with data storage and transaction functions. Compared to traditional databases, blockchain technology has major advantages such as decentralization, collective maintainability, traceability, tamper-evident, and anonymity. Some scholars also interpret blockchain technology from the perspective of technology as a technical collection of core technologies such as cryptography, consensus mechanisms, and timestamps.

As for the development of blockchain so far, it has undergone progressive development from the digital currency stage to the smart contract stage (2014-2016) and now to the artificial intelligence stage, and the relevant theoretical research and practical applications have been enriched and developed to a great extent. In the blockchain 3.0 stage period, blockchain technology identifies, processes and preserves valuable nodes and data in the network with the help of artificial intelligence for better value transactions. At this time, the application scenario of blockchain technology has broken through the limitation of traditional industry and expanded and applied to identity authentication, food traceability, voting and election, government approval and government openness, etc. to realize intelligent innovation. [5]

### 2.2. TOE Theory Model

TOE theory, which is the "technology-organization-environment" theory, was proposed by Tornatsky and Fleischer in 1980 on the basis of technology transfer model and innovation diffusion theory. It is used to study and synthesize the different factors influencing the adoption of innovative technologies by firms. [6]

According to TOE theory, the factors that influence organizational adoption of innovation behavior and the speed of innovation adoption can be grouped into three categories: technological, organizational, and environmental. Technology factors are mainly characteristics related to IT innovation, such as compatibility, advantages and complexity of technology, and are generally expressed in two aspects: technology management capability and technology facility construction; organizational factors refer to the characteristics of the organization, including its size, hierarchy, resources, support, leadership tenure and importance; environmental factors represent the specific environment in which the organization is located, involving economic, political, cultural and other conditions The environmental factors represent the specific environment in which the organization is located, involving economic, political, cultural and other conditions, generally manifested as economic development background, external pressure, institutional environment, competitive partnership, etc. [7,8] TOE theory has strong applicability as a model for analyzing organizational adoption of innovation projects from multiple perspectives inside and outside the comprehensive, and

the study involves the application of agricultural innovation technology<sup>[9]</sup>, e-commerce and enterprise resource planning applications,<sup>[10]</sup> open innovation in the public sector<sup>[11]</sup>, open sharing of science and technology resource platforms<sup>[12]</sup>, open government data<sup>[13]</sup>, and so on.

The TOE theoretical framework explores the adoption behavior of new technologies more fully from the organizational, environmental, and technological perspectives, and has strong flexibility and operability; therefore, the TOE theoretical framework can be considered for government digital transformation-related research.<sup>[14]</sup> Currently, TOE can be generally accepted to extend its application to the field of social governance.<sup>[15]</sup> In the case of this paper, the application of blockchain technology in the field of government services is also influenced by different factors from the technical, organizational and environmental levels. In this paper, we introduce TOE model to study users' willingness to use government services under blockchain empowerment, and take various influencing factors into consideration, so that we can provide more accurate and reasonable improvement suggestions from users' perspective.

### **3. Research Hypothesis and Model Construction**

#### **3.1. Technical level**

##### **3.1.1. Relative technological advantage**

Relative technology advantage refers to the benefits for users when a new technology is used compared to an old technology, or compared to whether or not a new technology is used.<sup>[16]</sup> For government service platforms, the relative technical advantages are more intuitively reflected in the use of technical advantages to provide benefits to users. The benefits brought to the public by the characteristics of blockchain applied to the field of government services can be broadly divided into three points: first, decentralized characteristics to improve the security of government service information; second, tamper-evident to ensure the authenticity of evidence; third, traceability to achieve open, transparent and fair government information.<sup>[17]</sup> These technical advantages drives users to use blockchain technology-enabled government service applications, thus, forming the first hypothesis:

H1: Relative technical advantages significantly affect users' willingness to use.

##### **3.1.2. Security**

After experiments, Zhaoge Yu and Peng Song pointed out that only by ensuring the security of the platform can users use the platform with a safe attitude and really put down their defensive mentality, and the security of the platform will directly affect the users' attitude of using it.<sup>[18]</sup> As the information age steps in, our surroundings are full of all kinds of information and data, and these data are also in danger of being leaked and used illegally. Regarding the application of government service data involves the private identity information of citizens and has play an important impact on daily life, therefore, this paper proposes the hypothesis that

H2: Security significantly affects users' willingness to use.

#### **3.2. Organizational level**

##### **3.2.1. Information quality**

Information quality is often used to describe the characteristics of information in terms of content, format, accuracy, timeliness, and completeness.<sup>[19]</sup> Scholars such as Delone and Mclean argue that information quality significantly affects user satisfaction.<sup>[20,21]</sup>

For users, information quality is a reflection of the high level of government services. If the blockchain government service platform can meet users' needs for information resources such as government information disclosure and food safety trace ability, users will think that the information quality of the government service platform is guaranteed, and their self-perception of the effectiveness of using the platform will be improved. Therefore, the higher the information quality of

the public library WeChat platform is perceived by the users, the higher their perception of the observability of the platform.

H3: The information quality of blockchain government services significantly affects the willingness to use.

### **3.2.2. Service quality**

Zhao and Lu found that service quality is an important condition for evaluating information systems through the study of users' usage behavior, and it has an impact on users' behavior. <sup>[22]</sup> The service quality of government services supported by blockchain technology is mainly expressed by the users in the process of using the relevant government services. Whether the users can get the corresponding help. If the information can be updated, activities can be pushed, and announcements can be made in a timely manner so that users can get useful information at the first time, then users will think that the platform can provide service guarantee, and they will be more willing to use the platform. Based on the above discussion, the following research hypothesis is proposed in this paper.

H4: The service quality of blockchain government services has a significant impact on the users' willingness to use.

## **3.3. Environmental factors**

### **3.3.1. Trend pressure**

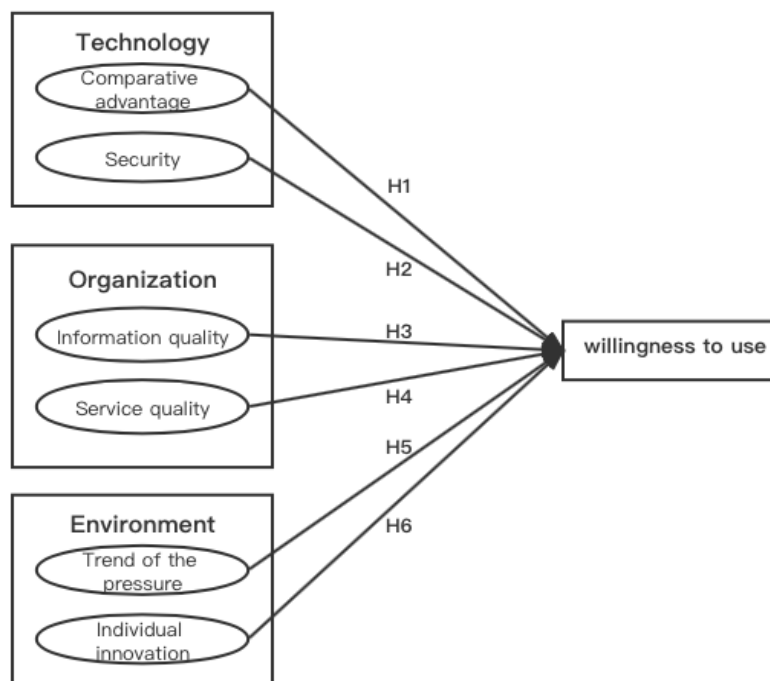
Abrahamson and Rosenkopf put forward the concept of tidal pressure in the course of their research, tidal refers to a process of innovation diffusion, that is, the acceptance of innovative technology by organizations or individuals is often not based on their own evaluation of it, but from the pressure brought by the absolute number of organizations that have accepted the innovation, and the greater the external pressure, the more it will affect the decision-making ability of individuals. <sup>[23]</sup> in their study, Schroeder et al. point out that the use of new technologies by new users is influenced by the users around them, and that an increase in the number of users around them will increase the new users' willingness to use and motivate them to follow the trend. <sup>[24]</sup> The continuous application and popularity of blockchain technology in government services will have an impact on users' willingness to use it, which in turn will promote unused users to try it out. Therefore, this paper proposes the following hypothesis.

H5: Trend pressure will significantly affect users' willingness to use.

### **3.3.2. Individual innovativeness**

Users with higher innovation tend to be more curious and receptive to new things and have a stronger willingness to use new technologies than those with lower innovation. Zhao Yuming et al. pointed out that individual innovativeness improves users' perception of ease of use of innovative technologies, which in turn influences usage behavior; <sup>[25]</sup> Song WJ et al. further pointed out through their study that individual innovativeness has a positive impact on users' behavioral intentions. <sup>[26]</sup> The government service applying blockchain technology is an emerging service method, and users with higher individual innovation are willing to experience something new, so they have higher willingness to use blockchain government service, while users with lower individual innovation tend to rely on traditional ways to get information and services, and do not have strong willingness to use the service enabled by new technology. There is no strong willingness to use new technology-enabled services. Based on this, this paper proposes the following hypothesis

H6: Individual innovativeness significantly affects users' willingness to use.



**Figure 1.** TOE Theory Research Model

## 4. Research design and data collection

### 4.1. Questionnaire design

The questionnaire of this study consists of two parts: the demographic characteristics of the survey sample and the measurement items of the variables in the theoretical model. In order to ensure the content validity of the scale, the questionnaire was designed using established scales at home and abroad, with appropriate semantic modifications according to the content of this study. The questionnaire was pre-surveyed after initial development, and 15 items were finally obtained after eliminating unreasonable question items and merging question items with no obvious differentiation. Among them, the dimensions of information quality and service quality at the organizational level were drawn from William <sup>[27]</sup>, Y. W. Yang and other scales <sup>[28]</sup>, and two scales in the technical dimension were adapted from Venkatesh and Rogers. Tidal stress draws on Yi-Wen Lee's scale <sup>[29]</sup>, both including 2 question items; willingness to use draws on Davis 's scale. <sup>[30]</sup> All scales were measured using a 5-point Likert scale, with options divided into 5 levels from strongly agree to strongly disagree.

### 4.2. Data collection

In this paper, we used questionnaires to collect data, and selected a prefecture-level city where blockchain government services were implemented, and took the citizens of the city as the sample, randomly distributed 300 questionnaires, and collected 272 valid questionnaires, with a valid recovery rate of 90.6%.

### 4.3. Data analysis

#### 4.3.1. Statistical analysis method

SPSS software is the main data processing tool used in this study. SPSS is widely used in various fields of natural science, technical science, and social science, and the software is mainly used for analyzing arithmetic, data mining, predictive analysis and other statistics-related contents, and its initial exploration and prediction application of the model is very suitable for the exploratory research

requirements of this paper on the factors influencing the willingness to use blockchain government services.

#### 4.3.2. Reliability analysis

The reliability analysis of the research variables using SPSS26.0 shows that: The alpha values of relative advantage, security, information quality, service quality, trend pressure and individual innovativeness are 0.66, 0.665, 0.700, 0.72, 0.71, 0.592 and 0.726 scale overall alpha value is 0.919 (greater than 0.7) (see Table 1), which passes the reliability test.

**Table 1.** Reliability analysis

Variable	Cronbach's alpha	Variable	Cronbach's alpha
Comparative advantage	0.66	Trend of the pressure	0.71
security	0.665	Individual innovation	0.592
Information quality	0.700	Willingness to use	0.726
The quality of service	0.72	All	0.919

#### 4.3.3. Validity analysis

By conducting KMO and Bartlett's sphere test on the study variables, as shown in Table 2, the KMO coefficient is 0.89 and the significance probability value of Bartlett's sphere test is infinitely close to 0 and less than 0.05. It indicates that common factors exist among the variables and there is a certain significant correlation among the variables, and the next step of factor analysis can be conducted.

**Table 2.** KMO and Bartlett's Test

KMO Measure of Sampling Adequacy		0.89
Bartlett's Test of Sphericity	Approx. Chi-square	786.798
	df	105
	Sig.	.000

#### 4.3.4. Regression analysis

The regression analysis of the study model was performed using SPSS software and the results are shown in Table 2.

As can be seen from Table 2, the F-value of the regression model is 60.447 and is significant at the 0.05 level, which indicates that the regression model is significant and meaningful and is acceptable. The regression coefficients of relative advantage, information quality, service quality, trend pressure, and personal innovativeness are 0.005, 0.000, 0.120, 0.026, and 0.001, respectively, and are significant at the 0.05 level.

**Table 3.** Regression Analysis

Dependent variable	independent variable	standardized coefficient	Sig.	R <sup>2</sup>	F(Sig)
willingness to use	Comparative advantage	0.181	0.005	0.811	65.792 (0.000 <sup>b</sup> )
	security	0.041	0.458		
	Information quality	0.314	0.000		
	The quality of service	0.124	0.120		
	Trend of the pressure	0.168	0.026		
	Individual innovation	0.263	0.001		

## 5. Conclusion and Discussion

The article explores the factors influencing the research users' willingness to use big data services and draws the following conclusions.

### 5.1. Technical aspects

The results of data analysis in the paper show that hypothesis H1 passes the significance test and the relative advantage has a positive influence on users' willingness to use. It shows that the characteristics of information security, evidence authenticity and information openness and transparency of blockchain government services compared with traditional government platforms can greatly improve users' willingness to use. Security has no significant effect on users' willingness to use, and hypothesis H2 does not pass the test. In this regard, I believe that with the development of information technology, all kinds of applications are constantly improving their security, so that security is not strongly felt by users, and user preferences and tendencies lead to deviations from the hypothesis.

### 5.2. Organizational level

Hypothesis H3 passes the significance test, and the information quality can also have a significant positive impact on the willingness to use, indicating that the stronger the willingness to use will be when users enjoy a higher level of information quality in the process of using blockchain government services. It indicates that the blockchain government service platform can strengthen users' willingness to use by providing them with rich, diverse, interesting and personalized information resources. Hypothesis H4 fails the significance test, which means that although good service quality is conducive to a better user experience, it may not have a significant effect on the actual usage effect. In contrast, the timeliness, responsiveness and reliability of the services provided by the blockchain government platform are more conducive to enhancing users' willingness to use the WeChat platform.

### 5.3. Environment level

Hypotheses H5-H6 all pass the significance test, indicating that trend pressure and individual innovativeness have a positive effect on users' willingness to use. The significant effect of trend pressure indicates that the social environment in which users live will have an impact on their perceptions. When people around them have positive attitudes toward blockchain government service applications, users will believe that this platform can help them and thus are likely to have a strong willingness to use it. In the construction of blockchain government services, the government can use social network mechanisms to strengthen the social influence of the platform on users, promote observability, and thus enhance users' willingness to use it. The significant role of individual innovativeness indicates that as a new service approach, blockchain government services are more accepted among groups with higher individual innovativeness, and if users have higher innovation spirit and are willing to try or accept new things, the more likely they are to choose to use the services empowered by blockchain technology. In the future construction of WeChat services, government services can enhance users' willingness to use through innovative service contents and means.

## 6. Shortcomings and Prospects

This paper also has its own limitations. On the one hand, the research model in the article only covers some influencing factors that affect users' willingness to use blockchain government services; other influencing factors, such as ease of use and perceived interactivity, also affect users' willingness to use, and these factors can be included in the research model in future studies. On the other hand, the research sample is limited to one place only, and different areas in different provinces can be investigated in the future so as to increase the generalization of the model.

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