



# Machine learning in explaining nonprofit organizations' participation : a driving factors analysis approach

Zhanxue Gong, Xiyuan Li, Jiawen Liu, Yeming Gong

## ► To cite this version:

Zhanxue Gong, Xiyuan Li, Jiawen Liu, Yeming Gong. Machine learning in explaining nonprofit organizations' participation : a driving factors analysis approach. *Neural Computing and Applications*, 2019, 31 (31 (12)), 8267-8277 p. 10.1007/s00521-018-3858-6 . hal-02880932

**HAL Id: hal-02880932**

**<https://hal.science/hal-02880932>**

Submitted on 20 Oct 2021

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/328725110>

# Machine learning in explaining nonprofit organizations' participation: a driving factors analysis approach

Article in *Neural Computing and Applications* · November 2018

DOI: 10.1007/s00521-018-3858-6

CITATION

1

READS

127

4 authors, including:



Liu Jiawen

Huazhong University of Science and Technology

7 PUBLICATIONS 17 CITATIONS

[SEE PROFILE](#)



Yeming Gong

emlyon business school

113 PUBLICATIONS 590 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Logistics Management and Decision for Online Retailers: Big Data Driven Theories and Methodologies [View project](#)



Warehousing research for online retailers [View project](#)

# Machine learning in explaining nonprofit organizations' participation: a driving factors analysis approach

**Zhanxue Gong**

**Economics and Management School, Wuhan University, Wuhan 430072, China  
gongzx@whu.edu.cn**

**Xiyuan Li**

**Economics and Management School, Wuhan University, Wuhan 430072, China  
lixiyuan@whu.edu.cn**

**Jiawen Liu**

**School of Management, Huazhong University of Science and Technology, Wuhan  
430074, China  
jiawen\_liu@hust.edu.cn**

**Yeming Gong**

**EMLYON Business School, 23 avenue Guy de Collogue, 69134 Ecully Cedex,  
France  
Gong@emlyon.com**

**Abstract :** The construction of smart cities requires the participation of non-profit organizations, but there are still some problems in the analysis of driving factors of participation. Based on this, using the structural equation model as the research method, a public satisfaction relationship model, based on the Machine learning, for non-profit organizations participating in the construction planning of smart cities was constructed in this study. At the same time, corresponding assumptions are set, and data is collected through questionnaires. Afterwards, the Likert tenth scale was used to score questionnaire questions, and Deep learning was conducted in conjunction with the model. The research shows that the model established in this study has good analytical results and has certain practical effects. It can provide suggestions for optimization and can provide theoretical references for subsequent research.

**Keywords:** Machine Learning; non-profit organization; smart city; public satisfaction

## **1 Introduction**

With the development of new information technologies and the popularity of related technologies for the Internet of Things, cloud computing, and big data, in

order to make the macro concept of "smart earth" easier for people to accept, IBM has put forward the concept of "smart city" as the cornerstone of popularizing global wisdom. It is hoped that through the construction of "smart cities", cities in the world will be guided to the development of wisdom and global smart city construction boom is set off. The commanding of the city's construction is not a government department's work and it requires the participation of multiple organizations, especially non-profit organizations (Batty, 2013).

In the study of "participation of non-profit organizations", both the American ACSI and the European Union's ECSI have always used the term "customer participation", and both believe that "non-profit organizations" are "customers" for smart city construction. Hashem et al. (2016) described the strength of non-profit organizations' participation at the three levels of false participation, symbolic participation, and substantial participation, and defined each level. The first level includes operational participation and educational participation; the second level includes informative participation, consultative participation, and restrictive participation; the third level includes cooperative participation, representative participation, and decision-making participation (Hashem et al., 2016). Girtelschmid et al. (2014) analyzed the evolution of NPO participation in decisions affecting the allocation of government resources through the study of CPR (Common-pool Resources). At the same time, they explained the impact of non-profit organization participation in the process of smart city construction and pointed out the role and significance of non-profit organization participation in the construction of public smart cities (Girtelschmid et al., 2014). Silva et al. (2017) found through studies that in the formulation of urban planning, if the right to participate and the decision-making power are given to groups representing different classes of the public, they can effectively improve the performance of urban planning. In addition, it will balance the distribution of resources among all parties in the plan by promoting the game of appeals that represent multiple interests, enhance the scientific rationality of the plan, and greatly increase the effectiveness of the plan (Silva, 2017). Rathore et al. (2017) classified the different behavioral patterns by studying the objects, modes, and frequencies of communication in the smart city construction campaign, and addressing the multiple parties involved in the construction. From the study of these patterns, it has been found that non-profit organizations have a considerable influence on the planning results, thus forming a brand-new theory of planning (Rathore et al., 2017). Zhu et al. (2017) proposed the development of characteristic and smart cities, and believed that the connotation of smart city construction was specific and there was no global universal development model (Zhu et al., 2017). Frith (2017) analyzed the information security and privacy protection issues in the construction of smart cities under the network environment, and adhered to the user-centered construction concept to achieve a sustainable, livable and comfortable smart city development vision (Frith, 2017). Liu (2017) analyzed the problems in the participation of non-profit organizations in the construction of low-carbon cities, and also provided basic countermeasures and suggestions for improving the participation of non-profit organizations in low-carbon cities (Liu, 2017). Souza et al. (2016) took the

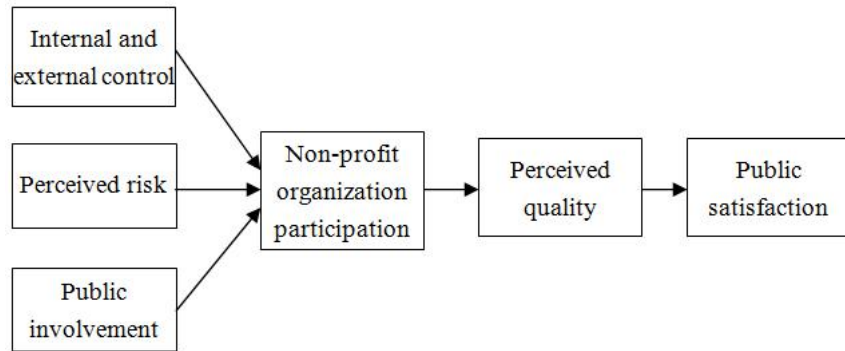
participation of non-profit organizations as the core and built a system innovation strategy to promote smart city construction planning (Souza et al., 2016). Bi (2017), through an empirical study of the Poyang Lake economic and ecological civilization construction plan, found that there are four key factors in the planning process of non-profit organization participation (Bi, 2017). Shin (2017) focused on the study of non-profit organization participation mechanisms for low-carbon urban planning and proposed construction planning requirements for public awareness, public behavior and incentive measures, and policy guarantees (Shin, 2017).

Through the above analysis, we can see that in the current research on commanding of urban construction, the analysis of non-profit organizations participating in commanding city construction is not detailed, especially in the current big data environment, the effect of driving non-profit organizations is not clear enough. Therefore, how to increase the effectiveness of non-profit organizations in the construction of smart cities through big data analysis is one of the focuses of building smart cities. Based on this, this study studies the factors that drive non-profit organizations to participate in the construction of command cities through big data, and combines the big data analysis methods to arrive at corresponding research conclusions.

## **2 Research methods**

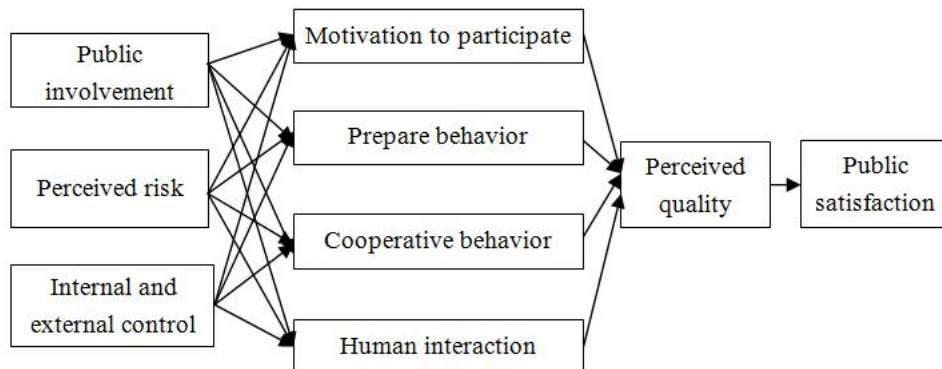
### **2.1 Conceptual Model**

In the analysis of big data-driven non-profit organizations participating in the construction of smart cities, through combining big data analysis with the status quo and characteristics of smart city construction in China, and selecting and determining relevant variables, a non-profit organization's conceptual model of participating in smart cities is constructed. The model is shown in Figure 1. This article selected the perspective of non-profit organizations in the Chinese context to conduct research, and did not consider factors such as culture and service types in the research process. The former dependent variables of non-profit organization involvement include public involvement, perceived risk, internal and external controls. Perceived quality is an antecedent variable of nonprofit organization satisfaction, and is an intermediate variable of nonprofit organization's participation in the satisfaction of nonprofit organization. Non-profit organization satisfaction is the dependent variable and outcome variable of this study. Based on this, the conceptual model contains six potential variables. The participation of non-profit organizations as the independent and core variables of this study is measured by the four dimensions of participation motivation, preparation behavior, cooperative behavior, and interpersonal interaction (Anuradha, 2017).



**Figure 1. The conceptual model of non-profit organizations participating in smart cities**

Public satisfaction in the smart city construction plan is a subjective evaluation of the public participation in non-profit organizations in the construction of smart cities. It is the cumulative effect of non-profit organizations' involvement in the process of smart city construction and the perceived level of participation process and construction planning and effectiveness. Research on the satisfaction of the public in the academia generally uses modeling from a commercial perspective of customer satisfaction (Chang, 2016). The basic model is shown in Figure 2.



**Figure 2. Research model in commercial perspective of customer satisfaction**

Public satisfaction is proposed on the basis of customer satisfaction. Its audience is changed from customers who accept goods services to social public groups. The scope of application is no longer limited to the commercial level. The plan of smart city construction aims to provide the public with a better urban social environment. The construction should be people-centered, and public satisfaction is one of the core variables to measure the level and effectiveness of smart city construction planning. The model assumptions and specific scales for this study are shown in Table 1 and Table 2 respectively (Tiwari, 2014).

**Table 1. Conditions of model assumptions**

H1-1 When the degree of public involvement	H1-11	When the degree of involvement is higher, the motivation will be higher;
--	-------	--

is higher, the level of participation of non-profit organizations will be higher.	H1-12	When the degree of involvement is higher, the preparation activity will be higher;
	H1-13	When the degree of involvement is higher, the cooperative behavior will be higher;
	H1-14	When the degree of involvement is higher, the human interaction will be higher;
H1-2: When the degree of perceived risk level is higher, the level of participation of non-profit organizations will be higher.	H1-21	When the perceived risk level is higher, the motivation will be higher;
	H1-22	When the perceived risk level is higher, the preparation activity will be higher;
	H1-23	When the perceived risk level is higher, the cooperative behavior will be higher;
	H1-24	When the perceived risk level is higher, the human interaction will be higher;
H1-2: When the degree of internal control is higher, the level of participation of non-profit organizations will be higher.	H1-31	When the degree of internal control is higher, the motivation will be higher;
	H1-32	When the degree of internal control is higher, the preparation activity will be higher;
	H1-33	When the degree of internal control is higher, the cooperative behavior will be higher;
	H1-34	When the degree of internal control is higher, the human interaction will be higher;
H2-1: When the participation level of non-profit organizations is higher, the perceived quality of service will be higher;	H2-11	When the motivation of non-profit organizations is higher, the perceived quality of service will be higher;
	H2-12	When the public preparation is higher, the perceived quality of service will be higher;
	H2-13	When the public cooperation is higher, the perceived quality of service will be higher;
	H2-14	When the public interaction is higher, the perceived quality of service will be higher
H3-1		When the public perceived quality of service is higher, public satisfaction will be higher

**Table 2. Specific scale and measure items**

The importance of construction X1	It is very important to actively participate in the construction of a smart city. X11
	It willing to learn information on the development of smart cities.X12
	Participate in the construction of smart cities can reflect organizational capabilities and responsibilities. X13
The pleasure of construction X2	The organization likes to participate in the smart city construction. X21
	Smart city construction can improve organizational structure. X22
	Participating in the smart city construction process is a delightful.X23
Building	It is very knowledgeable about the knowledge of smart city construction. X31

Iconic X3	Participating in the construction of smart cities can show the characteristics of the organization .X32
	Participating in the construction of smart cities can reflect the organization's public welfare .X33
Time pressure X4	Participating in smart city construction will take a lot of time to organize. X41
	The time schedule is very tight, so participating in the construction of a smart city will bring time pressure. X42
Financial risk X5	Participating in the construction of a smart city requires a certain cost. X51
	The funds for the construction of smart cities are not effectively guaranteed. X52
	The funds for smart city construction are not operating effectively. X53
Functional Risk X6	Existing conditions cannot support the effective construction of smart cities.
	The smart city's built-up effect is less than expected. X62
Participation motivation X9	Participating in the construction of smart city can improve the efficiency of the organization. X91
	Participating in the construction of smart city can exert its own social value. X92
	Participating in the construction of a smart city is conducive to the construction of a harmonious society. X93
Prepare behavior X10	Relevant knowledge, information are collected. X101
	The specific content of the construction and the operation process and other matters were consulted with the staff. X102.
	Time of participation, method of participation, participation in the media, etc are determined with staff. X103
Cooperation behavior X11	The construction of smart cities is not a unilateral work of the constructors, and it requires multiple units to cooperate. X111
	It cooperates with project that needs organization to participate in urban construction. X112
	The cooperation channel of third parties participating in the construction of smart cities is smooth. X113
Interpersonal interaction X12	Smart city construction staff can communicate friendly.X121
	The perception of smart city construction is feedback to staff. X122
	Comments and suggestions on the construction of smart cities were proposed. X123
Infrastructure intelligence Y1	Pilot infrastructure can support smart city construction. Y11
	The required broadband, next-generation information infrastructure is basically built. Y12
	The level of intelligence in public infrastructure has been improved, and operational management has been refined and coordinated. Y13
Public Service Facilitation Y2	In smart cities, accessing to urban public services is very convenient. Y21
	Smart city can provide timely public services through information service system. Y22
	Smart city improves efficiency of public service staff. Y23



Social management refinement Y3	Urban infrastructure management is highly digitized. Y31
	Urban infrastructure and city accuracy are higher. Y32
	The administrative efficiency of government under smart cities has increased dramatically Y33
Living environment livable Y4	Digitalization of residents' lives will increase under the construction of smart cities. Y41
	Smart monitoring system for water, air, and vegetation in smart cities has basically been built. Y42
	Real-time prevention and control system for pollutant discharge, energy consumption, etc. is basically completed Y43
Long-term network security Y5	The information of government, enterprises and residents can be effectively protected Y51
	Network security system and management system basically established. Y52

## 2.2 Data Selection

The empirical analysis of this study is based on the above six potential variable scales to formulate questionnaires and using the Likert scale to score questions on questionnaires. One point indicates that they are very dissatisfied and seven points indicate that they are very satisfied. Questionnaires are mainly distributed to college students, non-profit organization personnel, non-profit education organization personnel, and non-profit information construction unit staff. These groups have a high degree of concern for the construction of smart cities due to work, academic research, etc., and they have a certain level of participation. A total of 220 questionnaires were distributed, 198 questionnaires were returned, excluding questionnaires that did not focus on the construction of smart cities, and a total of valid questionnaires are 158. Questionnaire recovery, efficiency meet the structural equation model analysis requirements. At the same time, the analysis and test of the characteristics, reliability and validity of the questionnaire samples were conducted, that is, the stability and consistency of the questionnaire survey results were judged.

The reliability test of the questionnaire design consists of two aspects of the reliability and validity of the questionnaire, in order to test the validity of the questionnaire and the consistency of the questions. The reliability test of this study is measured by the Cronbach's coefficient. The Cronbach's coefficient range is [0,1]. The closer the coefficient is to 1, the higher the questionnaire reliability is, and conversely, the lower the reliability is. The validity test is to measure the variance of each question value in the proportion of the total variance, the higher the proportion, the higher the validity of the questionnaire, and the validity range is still in [0,1]. After measuring, the overall questionnaire has a Cronbach's coefficient of 0.930. The intrinsic reliability of the questionnaire is very high, and the reliability coefficient of each scale is greater than 0.700. The maximum value of validity is 0.873, and each validity value is greater than 0.5. It can be concluded that the questionnaire design problem is reasonable and has certain reliability and validity.

## 2.3 Structural Equation Model

This paper uses LISREL to estimate the public satisfaction model of non-profit organizations participating in the construction of smart cities, and validates the research hypotheses proposed in the research. LISREL derives the sample covariance S and the observed variable covariance  $\Sigma(\theta)$  from the designed model to determine the parameters in the model. The structural equation model contains a structural equation and two measurement equations.

$$\eta = \beta\eta + \gamma\xi + \zeta(1)$$

$$X = \eta\xi + \delta(2)$$

$$Y = \lambda\eta + \varepsilon(3)$$

In the structural equation,  $\beta$  is a coefficient parameter matrix of  $\eta$ ,  $\lambda$  is a coefficient parameter matrix of  $\xi$ , and  $\zeta$  is an error term. In the measurement equations, the relationship between the exogenous measurable variable X and the exogenous potential variable  $\xi$ , the endogenous measurable variable Y, and the endogenous potential variable  $\eta$  is defined separately.  $\lambda_x$  and  $\lambda_y$  represent the regression coefficients or load matrices of  $\xi$  and  $\eta$ , respectively, and  $\delta$  and  $\varepsilon$  are the error terms of the corresponding measured variables. The matrix expression of the latent variable relationship of the structural equation model is as follows:

$$\begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \\ \eta_5 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ \beta_{21} & 0 & 0 & 0 & 0 \\ \beta_{31} & \beta_{31} & 0 & 0 & 0 \\ 0 & 0 & \beta_{43} & 0 & 0 \\ 0 & 0 & \beta_{53} & \beta_{54} & 0 \end{bmatrix} \begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \\ \eta_5 \end{bmatrix} + \begin{bmatrix} \lambda_{11} \\ \lambda_{12} \\ \lambda_{13} \\ 0 \\ 0 \end{bmatrix} \xi + \begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \\ \xi_5 \end{bmatrix} (4)$$

Structural equation model fitting indicators are shown in Table 3.

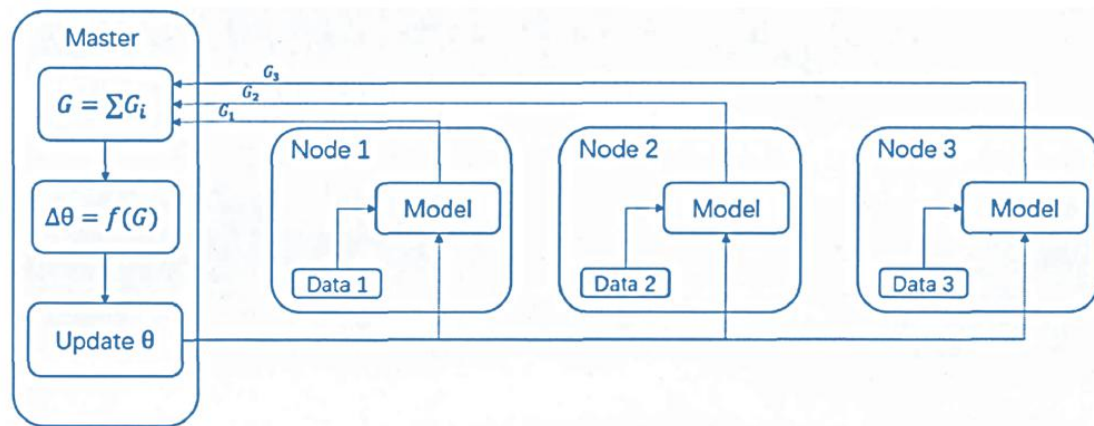
**Table 3. Structural equation model fitting index**

Alternative indicators	RMSEA	The smaller, the better	Absolute fitting effect indicator or	GFI	>0.9
	NCP	The smaller, the better		AGFI	>0.9
	PCLOSE	The smaller, the better		PGFI	>0.5
	CFI	>0.9		RMR	The smaller, the better
	PCFI	>0.5		CMNDF	<2
	HFIVE	>200		CMIN	>0.05
	FO	The smaller, the better	Relative fitting effect	NFI	>0.9
Simplicity index	AIC	The smaller, the better		IFI	>0.9

	BIC	The smaller, the better	index	RFI	>0.9
	BCC	The smaller, the better		TLI	>0.9
	CAIC	The smaller, the better		PNFI	>0.5
	ECVI	The smaller, the better			
	MECV I	The smaller, the better			

## 2.4 Machine Learning Algorithm

The biggest advantage of the big data environment compared to the stand-alone operating environment is the powerful computing power that can be scaled horizontally. In order to make the algorithm better utilize the computing power in the big data environment, it is necessary to spread the pressure of data calculation to each node in the cluster, which requires a certain degree of transformation of the algorithm. The modified algorithm conforms to the Mapreduce programming model and can run in parallel. The process of machine learning in the expected big data environment is shown in Figure 3.



**Figure 3. Schematic diagram of parallel machine learning**

The master is the core scheduler and is responsible for saving and updating of all model parameters. Node is the sample data of each computing node responsible for training the training set of the node. After obtaining the partial parameter update value  $G_i$ , it is passed to the core scheduler, and the core scheduler calculates the parameter update value  $\Delta\theta$  of the model. It can be seen from the above process that the key to the algorithm transformation is how to calculate and summarize the data set after segmentation on each computing node.

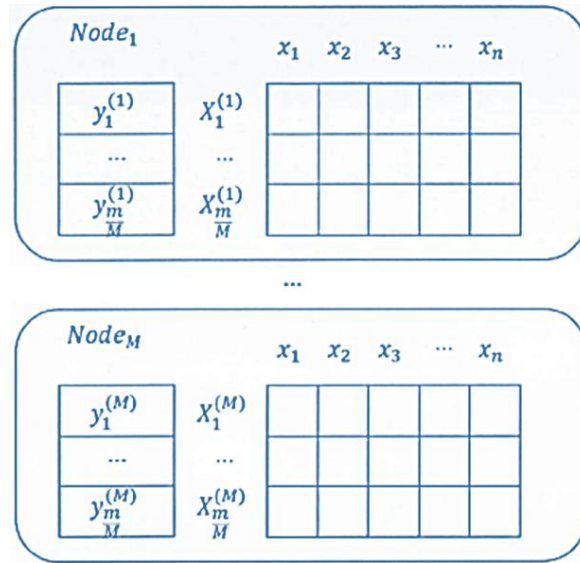
We assume a data set containing  $n$  samples in  $n$  dimensions (Figure 4). First, how to divide it into nodes on the cluster is considered, and the data can usually be segmented based on sample dimensions or segmented based on feature dimensions.

		$X_1$	$X_2$	$X_3$	$\dots$	$X_n$
$y_1$	$X_1$					
$y_2$	$X_2$					
$y_3$	$X_3$					
$\dots$	$\dots$					
$y_m$	$X_m$					

**Figure 4. Original data set**

In this study, the data segmentation method based on sample dimension is used for segmentation processing, and the original data is segmented onto  $M$  nodes based on the sample dimension. Each node contains  $m/M$  samples, and each sample contains the complete  $n$  number of features (as shown in Figure 5).

The parameter update formula of the small batch gradient descent method is modified as shown in equation (5):



**Figure 5. Schematic diagram of horizontal division of data**

$$\theta^{k+1} = \theta^k + \eta \cdot \sum_{i=1}^M \nabla J(\theta; X_{1:m/M}^{(i)}; y_{1:m/M}^{(i)}) \quad (5)$$

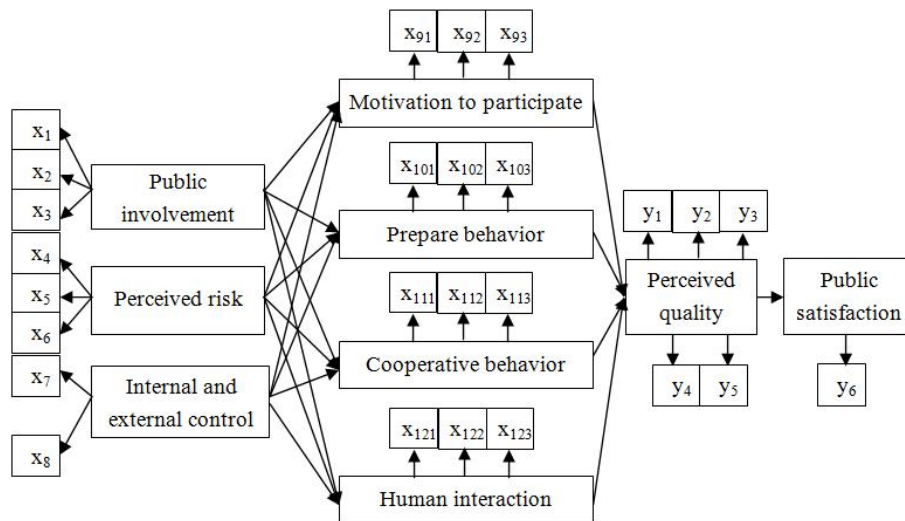
Then  $G_i$  updated on each node is equation (6), and the parameter update value is equation (7).

$$G_i = \nabla J(\theta; X_{1:m/M}^{(i)}; y_{1:m/M}^{(i)}) \quad (6)$$

$$\Delta\theta = \frac{\eta}{m} \sum_{i=1}^m G_i \quad (7)$$

### 3 Results

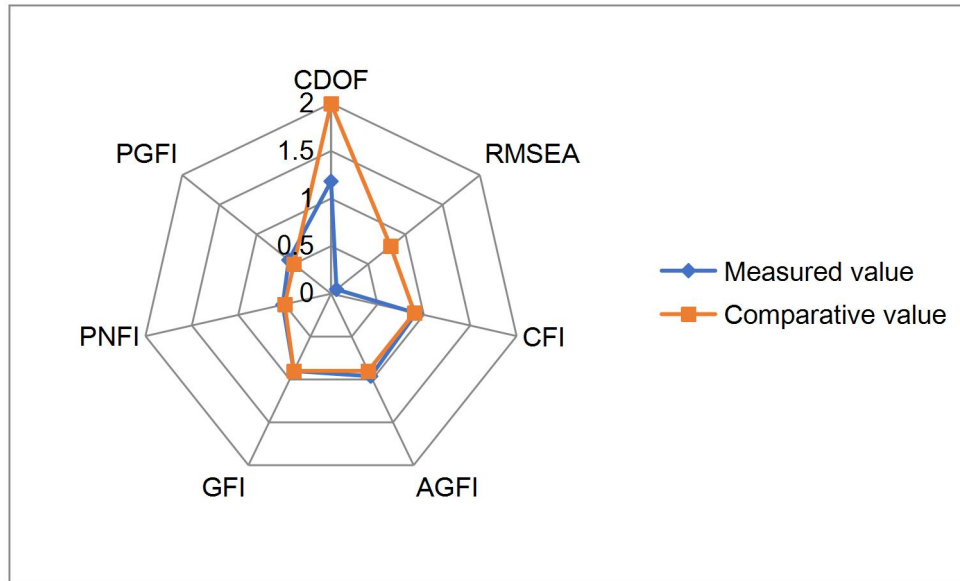
Based on the logical conceptual model, research hypothesis and latent variable scale of non-profit organizations participating in the construction of smart cities and satisfying the public about the causality of potential variables, a model of public satisfaction with the construction of smart cities in the participation of non-profit organizations in the construction of smart cities was constructed. The model, as shown in Figure 6, contains 9 latent variables and 17 research hypotheses. AMOS20.0 software was used to fit the structural equation model. The mean value of the questionnaire survey items was used as the measurement of the corresponding indicators, and the model fit statistics were within the threshold. The model passed the test, and the specific details are shown in Table 4. Among them, the chi-squared value is 551,  $df=304$ , the chi-squared degree of freedom is  $1.814 < 2$ ,  $RMSEA=0.073 < 0.08$ ,  $CFI=0.916 > 0.9$ ,  $AGFI=0.962 > 0.9$ ,  $GFI=0.901 > 0.9$ ,  $PNFI=0.520 > 0.5$ ,  $PGFI = 0.568 > 0.5$ , the indicators all meet the model's adaptation criteria.



**Figure 6. Public satisfaction relationship model for profit organizations participating in smart city construction planning**

**Table 4. Model fitness**

$\chi^2$	df	$\chi^2$ Degree of freedom ratio	RMSEA	CFI	AGFI	GFI	PNFI	PGFI
551	304	1.814	0.073	0.916	0.962	0.901	0.520	0.568



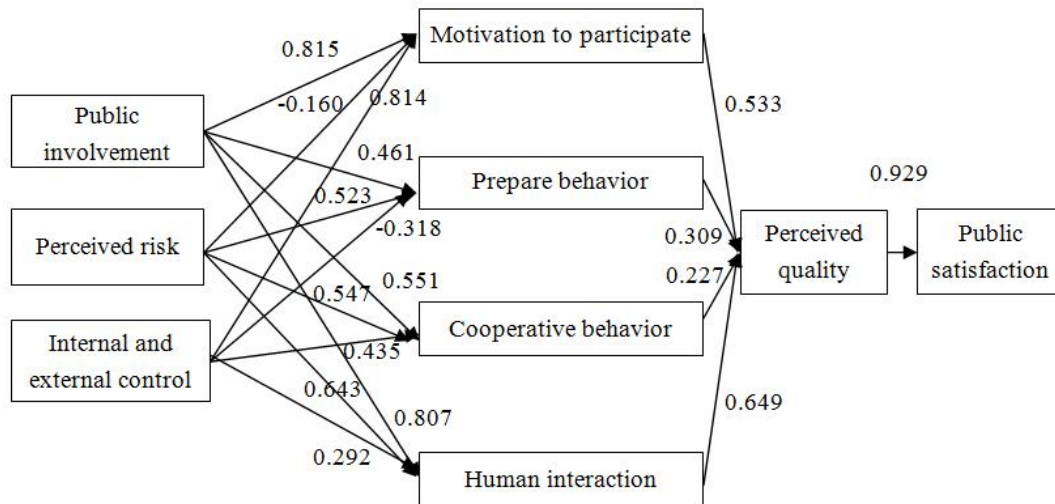
**Figure 7. Comparison of model fit**

Measurement model and structural model path coefficient are shown in Table 5 and Figure 8.

**Table 5. Measurement model path analysis**

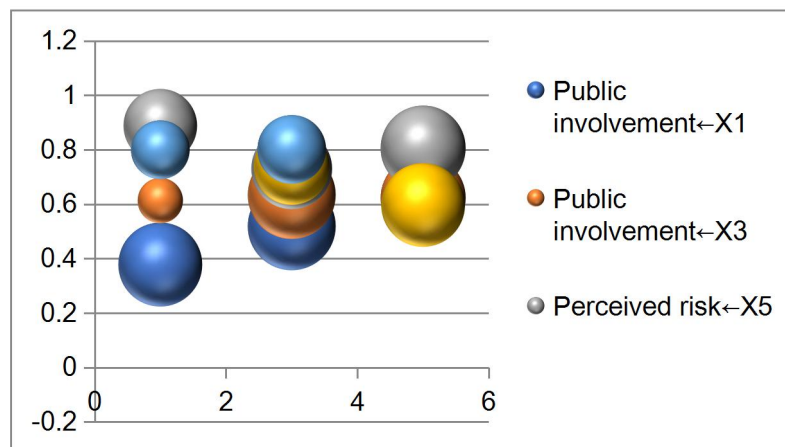
Path	Path coefficient	Path	Path coefficient	Path	Path coefficient
Public involvement←X1	0.378	Participation motivation←X93	0.519	Perceptual quality←Y1	0.675
Public involvement←X2	0.798	Preparatory behavior←X101	0.878	Perceptual quality←Y1	0.507
Public involvement←X3	0.613	Preparatory behavior←X102	0.634	Perceptual quality←Y2	0.623
Perceived risk←X4	0.233	Preparatory behavior←X103	0.877	Perceptual quality←Y3	0.823
Perceived risk←X5	0.888	Cooperative behavior←X111	0.73	Perceptual quality←Y4	0.806
Perceived risk←X6	0.614	Cooperative behavior←X112	0.74	Perceptual quality←Y5	0.821
Internal and external control←X7	0.803	Cooperative behavior←X113	0.737	Perceptual quality←Y5	0.597
Internal and external control←X8	0.33	Interpersonal interaction←X121	0.653	Non-profit organization satisfaction←Y61	0.795
Participation motivation←X91	0.8	Interpersonal interaction←X122	0.801	Non-profit organization	0.922

				satisfaction← Y62	
Participation motivation←X	0.392	Interpersonal interaction←X	0.536		



**Figure 8. Model analysis results**

Data mining bubble diagram shown in Figure 9.



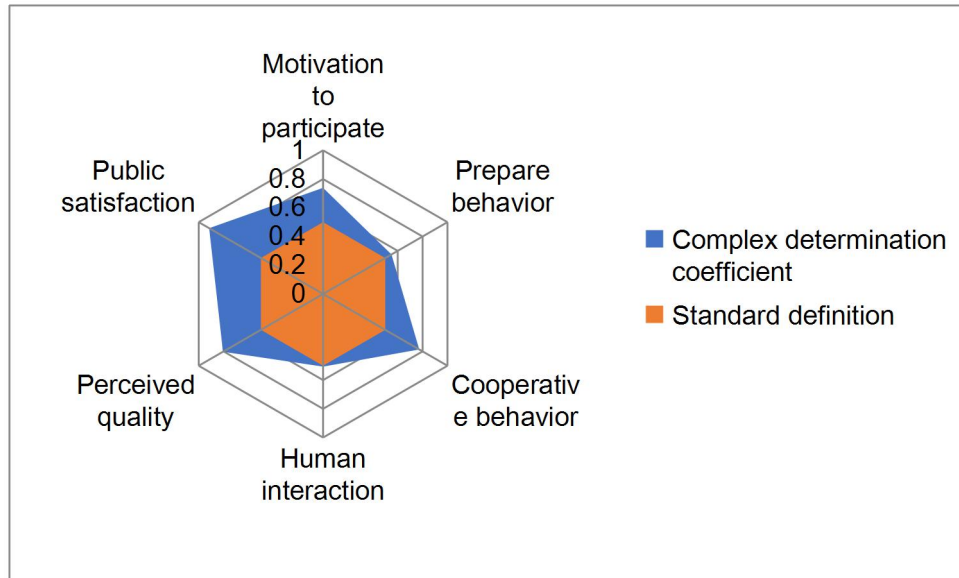
**Figure 9. Data mining bubble diagram**

The complex coefficient R<sup>2</sup> of the result variable is shown in Table 6, and the results are all greater than 0.5. Comprehensive indicators can prove that the model's fitting effect is good and the model construction is reasonable.

**Table 6. Coefficient of complex determination of result variable**

Potential variable	Coefficient of complex determination R <sup>2</sup>
Participation motivation	0.739
Preparatory behavior	0.55
Cooperative behavior	0.773

Interpersonal interaction	0.506
Perceptual quality	0.805
Public satisfaction	0.916



**Figure 10. Distribution of measurement coefficient of result variable**

#### 4 Discussion and Analysis

This study takes non-profit organization participation as the core variable to study the antecedents of non-profit organization participation and the mechanisms that non-profit organization participation affects public satisfaction through perceived quality. Through analysis of the selected potential variables, 17 research hypotheses were proposed. Based on the results of fitting the model, and combining relevant research viewpoints, the research hypothesis of this paper was verified and analyzed. The verification results are shown in Table 7.

**Table 7. Validation results of the hypothesis test**

No.	Result	No.	Result	No.	Result	No.	Result
H1-2	Support	H2-1	Nonsupport	H3-1	Support	H4-1	Support
H1-2	Support	H2-2	Support	H3-2	Nonsupport	H4-2	Support
H1-3	Support	H2-3	Support	H3-3	Support	H4-3	Support
H1-4	Support	H2-4	Support	H3-4	Support	H4-4	Support

##### 4.1 Antecedents of non-profit organization participation

Public involvement, perceived risk, and internal and external control have a certain degree of influence on the four dimensions of non-profit organization participation. Among them, the involvement of the public has a more significant positive effect on participation motivation, preparation behavior, cooperation behavior, and interpersonal interaction, that is, public involvement has a positive correlation



with non-profit organization participation; perceived risks have a significantly positive effect on preparation behavior, cooperative behavior, and interpersonal interaction, and have a weaker negative effect on participation motivation; internal and external control have a certain positive impact on participation motivation, cooperative behavior, and interpersonal interaction, and have a more significant negative impact on preparation behavior. Based on the above conclusions, the relevant government departments should increase the propaganda to build a smart city vision, stimulate the willingness of non-profit organizations to participate, and increase the level of involvement. At the same time, when guiding non-profit organizations to participate in the construction, they should provide a guaranteed participation environment and reduce the public's perceived risk.

#### **4.2 Impact of non-profit organization participation on perceived quality**

Four dimensions of non-profit organization participation have a positive impact on perceived quality, that is, non-profit organization participation can affect perceived quality and have a certain effect on public satisfaction. Among them, participation motivation, preparation behavior and interpersonal interaction have a significant positive effect with perceived quality, and cooperative behavior has a weak positive effect on perceived quality. Based on the above analysis, it can be concluded that the current non-profit organizations' participation in the construction of smart cities is mostly an independent act and there are few cooperation activities. Therefore, we should actively promote and work hard to build a cooperation platform and cooperation mechanism to promote the effectiveness and comprehensiveness of non-profit organization participation.

#### **4.3 The effect of perceived quality on public satisfaction**

Perceived quality has a strong positive effect on public satisfaction of the target variable, that is, the higher the perceived quality, the higher the degree of public satisfaction. When NPOs participate in the construction and feel the joy of participating in the experience and the effectiveness of participating in the practice, they can enhance the public's satisfaction with the construction of smart cities; similarly, when the effectiveness of smart city construction exceeds public expectations, it can also increase public satisfaction with the construction of smart cities. The smart city is the foundation for building a well-off society in an all-round way and aims to provide the public with a safer, more efficient, more convenient and greener modern urban environment. Through the model of non-profit organization participation in the smart city construction planning and the empirical analysis of the public's satisfaction, it was found that non-profit organization participation influences public satisfaction through perceived quality. The higher the degree of participation of non-profit organizations is, the more they can play their guiding role in the planning of smart city construction, build a smart city that integrates information resources and meets the needs of the public, increase public satisfaction, obtain public trust, and enhance the image of the city. Therefore, in the process of advancing the construction of smart cities, it is imperative to implement the people-oriented concept and stick to

the path of sustainable development. First, the enthusiasm for participation of non-profit organizations must be stimulated. Through many ways, the bright vision of smart city construction is popularized to the public, thereby gaining public recognition and stimulating enthusiasm. Second, the propaganda and education of knowledge related to smart cities must be strengthened so as to further deepen public awareness of the construction of smart cities and effectively increase the effectiveness and scientific of participation. Thirdly, a perfect platform for participation must be set up, and the effective way for non-profit organizations to participate is clear and unimpeded. At the same time, we need innovative modes of participation and actively open channels for participating in multi-subject cooperation. Fourth, we must strengthen the training of the professional quality and service level of the personnel of the intelligent city construction, and promote the prosperity and development of the construction of the intelligent city with a solid professionalism and enthusiastic service attitude. Fifth, we must strengthen the system guarantee, establish a non-profit organization to participate in the whole process, multi-directional and three-dimensional guarantee system from the entrance to the export in the intelligent city, and integrate the economic, political, cultural and social means to ensure the convenience and comfort of the non-profit organization participation. Through the implementation of the above five measures, we can realize the public's high involvement, high internal control and low risk perception in the construction of Intelligent city, can ensure the public's good experience of quality perception of the construction of intelligent cities, can meet the public's individualized needs, can full play to the positive role of the public in the construction of the intelligent city and can guide the public to become the propellant, participants and beneficiaries of smart city construction, thus laying a solid foundation for the grand goal of building a well-off society in an all-round way.

#### **4 Conclusion**

The smart city construction has already started, so it is necessary to study the relevant driving factors of non-profit organizations participating in the smart city construction process. This study takes non-profit organization participation as the core variable to study the antecedents of non-profit organization participation and the mechanism that participation of non-profit organizations affects public satisfaction through perceived quality. In the analysis of big data-driven non-profit organizations participating in the construction of smart cities, through combining big data analysis and combining the status quo and characteristics of China's smart city construction to select and determine relevant variables, a conceptual model of non-profit organizations participating in smart cities was constructed. The model was used to study the variables. At the same time, LISREL was used to estimate the impact of non-profit organizations participating in smart city construction on public satisfaction models, and was used to validate the research hypotheses proposed in the study. According to the logical concept model of non-profit organizations participating in the construction of smart cities, the causal relationship between potential variables and the research hypotheses and potential variable scales, the public satisfaction

relationship model in which non-profit organizations participated in the construction of smart cities was constructed and was analyzed comprehensively. First, questionnaires are used to collect data. Afterwards, Likert Scale 10 was used to score questions on the questionnaire. Finally, the big data analysis combined with the model is performed. The research shows that the model established in this study has good analysis results and has certain practical results. It can provide suggestions for optimization.

## References

- [1]Batty M. Big data, smart cities and city planning[J]. *Dialogues in Human Geography*, 2013, 3(3):274.
- [2]Hashem I A T, Chang V, Anuar N B, et al. The role of big data in smart city[J]. *International Journal of Information Management*, 2016, 36(5):748-758.
- [3]Girtelschmid S, Steinbauer M, Kumar V, et al. On the application of Big Data in future large-scale intelligent Smart City installations[J]. *International Journal of Pervasive Computing & Communications*, 2014, 10(2):322-8.
- [4]Silva B N, Khan M, Han K. Big Data Analytics Embedded Smart City Architecture for Performance Enhancement through Real-Time Data Processing and Decision-Making[J]. 2017, 2017(7):1-12.
- [5]Rathore M M, Paul A, Ahmad A, et al. IoT-Based Big Data: From Smart City towards Next Generation Super City Planning[J]. *International Journal on Semantic Web & Information Systems*, 2017, 13(1):28-47.
- [6]Zhu C, Shu L, Leung V C M, et al. Secure Multimedia Big Data in Trust-Assisted Sensor-Cloud for Smart City[J]. *IEEE Communications Magazine*, 2017, 55(12):24-30.
- [7]Frith J. Big Data, Technical Communication, and the Smart City[J]. *Journal of Business & Technical Communication*, 2017, 31(2):168-187.
- [8]Liu Z. Research on the Internet of Things and the development of smart city industry based on big data[J]. *Cluster Computing*, 2017(5):1-7.
- [9]Souza A, Figueredo M, Cacho N, et al. Using Big Data and Real-Time Analytics to Support Smart City Initiatives[J]. *IFAC-PapersOnLine*, 2016, 49(30):257-262.
- [10]Bi Y, Lin C, Zhou H, et al. Time-Constrained Big Data Transfer for SDN-Enabled Smart City[J]. *IEEE Communications Magazine*, 2017, 55(12):44-50.
- [11]Shin D, Song Y M. Forthcoming Big Data in Smart Cities: Experiment for Machine Learning Based Happiness Estimation in Seoul City[J]. 2017, 7(1):28-35.
- [12]Anuradha G, Babu K R. Trends and Impact of Vehicular Tailpipe Emission using Big Data Analytics under Smart City Environment[J]. *International Journal of Scientific & Engineering Research*, 2017, 8(9):269-275.
- [13]Chang H J, Kim D N. A Study on big data utilization for implementation of the resident participation type safe community planning of the smart city[J]. 2016, 9(5):478-495.
- Carpita M, Simonetto A. Big Data to Monitor Big Social Events: Analysing the mobile phone
- [14]Tiwari A. Global Journal of Multidisciplinary Studies URBAN SCIENCES, BIG DATA AND INDIA'S SMART CITY INITIATIVE[J]. 2014, 3(12):14-25.