

# Research on the Prospects of Intelligent Transportation Market from the Perspective of Energy Conservation and Emission Reduction

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## Abstract

In the context of energy conservation and emission reduction, transportation has become a key area of attention, and intelligent transportation plays an important role in it because of its function of effectively reducing emissions and saving resources. As a new mode of transportation, intelligent transportation still has some problems and challenges. Therefore, it is of great significance to study the future market development prospect of intelligent transportation. In this regard, this study takes Hefei City, Anhui Province as the research site, and permanent residents in four municipal districts of Hefei as the research object. First, structural equation model is used to analyze the influencing factors and paths of residents' perception norms, acceptance attitudes, subjective norms, government trust and acceptance willingness about intelligent transportation. And according to the data of intelligent transportation market size from 2011 to 2021, the grey prediction model is used to forecast the market development prospect of intelligent transportation in the next five years. The results show that the perception norm has an indirect positive impact on the residents' acceptance intention, and the intelligent transportation market has a good prospect. Finally, based on the research results, this paper puts forward some countermeasures and suggestions for the development of intelligent transportation.

## Keywords

Energy Saving and Emission Reduction; Intelligent Transportation; Structural Equation Model; Grey Prediction.

## 1. Introduction

During the two sessions of the National People's Congress in 2022, China made a commitment to the international community to achieve the "dual carbon" goal of carbon peak by 2030 and carbon neutrality by 2060. The key energy conservation and emission reduction projects mentioned in the "14th Five-Year Plan" Comprehensive Work Plan for energy Conservation and emission Reduction issued by The State Council in 2021 also include intelligent transportation. Intelligent transportation refers to the integration of advanced information technology and transportation to help form a comprehensive transportation system that is safe, efficient, environmentally friendly and energy-saving. In the context of energy conservation and emission reduction, the transportation industry, which is a high-emission industry, urgently needs to shoulder the heavy responsibility of energy conservation and emission reduction and achieve green and sustainable economic development. Although intelligent transportation is developing steadily, there are still shortcomings. What problems exist in the current development of intelligent transportation and how to improve them are questions that we need

to be considered. Therefore, it is of profound practical significance to study the market prospect of intelligent transportation.

## 2. Literature Review

With regard to development prospects, Huang Kaining[1] (2022) believes that intelligent transportation systems fully coordinate the interconnections between vehicles and pedestrians, and play a substantial value in improving road traffic capacity, reducing road traffic accidents, and reducing environmental pollution. Liu Na [2](2022) believes that it is the general trend to promote the construction of urban intelligent transportation and improve the efficiency of urban traffic management. Li Jian [3](2018) believes that the application of intelligent transportation technology can not only significantly reduce the probability of highway safety accidents, but also ensure the safety and comfort of driving.

Regarding the existing problems, Yue Ping[4] (2022) believes that how to use intelligent transportation to enable the digital and intelligent development of urban road system, solve urban traffic problems, and become an important project for the modernization of urban road infrastructure. Qin Yuanyuan [5](2022) believes that the current challenges of intelligent transportation include two aspects: it is difficult to store and transfer massive data.

With regard to the development of urban intelligent transportation, Duan Peiyu[6] (2017) believes that the construction of urban intelligent transportation needs to ensure that the transportation infrastructure goes first and is adapted to local conditions. Yao Qiqi [7](2019) believes that the government should promote the development of intelligent transportation from three aspects: organizational construction, personnel training and industrialization of new technologies. Song Like [8]et al. (2023) believe that the majority of small and medium-sized towns should enhance their understanding of the Internet era and take the initiative to embrace intelligent technology.

China is a country with a large population, so the effective use of resources is particularly important, and the impact of intelligent transportation on energy conservation and emission reduction is also worthy of attention. In the past, researches on intelligent transportation under the background of energy conservation and emission reduction were mainly based on the description of the status quo and superficial reasons, and the survey group was relatively broad and lacking in focus. Hefei is the city with the largest permanent population in Anhui province. At present, the construction of intelligent transportation has achieved initial results. With the acceleration of modernization, the factors of urban people, vehicles and road traffic have increased sharply, and the traffic demand has shown a surge in quantity and quality improvement, making the promotion and popularization of intelligent transportation more urgent. Therefore, this study takes Hefei City of Anhui Province as an example to conduct in-depth research on the market prospect of intelligent transportation under the background of energy conservation and emission reduction, and then put forward targeted suggestions.

## 3. Research on the Status Quo of Residents' Cognition of Intelligent Transportation and the Constraints of Their Willingness to Accept it

### 3.1. Research Design

This questionnaire mainly includes four parts: the first part is the basic information of the interviewees; The second part mainly investigates the cognition status of the respondents on intelligent transportation; The third part is the survey of the respondents' willingness to accept intelligent transportation, setting up scale questions, mainly from the perception norms, acceptance attitude, subjective norms, government trust, acceptance willingness and other five aspects to investigate the importance of factors affecting the residents' willingness to accept

intelligent transportation. The fourth part is the survey respondents' outlook on the prospect of intelligent transportation, including the promotion and implementation measures of intelligent transportation, the need for improvement and other issues. The questionnaire was distributed offline with manual data input. A total of 806 questionnaires were collected, of which 792 were valid, with an effective questionnaire recovery rate of 98.26%. Reliability test was conducted for each item in the questionnaire. Cronbach's value was greater than 0.7 and Cronbach's Alpha of all variables was 0.798, indicating that the design of the questionnaire structure and question options was scientific and reasonable, and the overall consistency of the questionnaire was good. The KMO value of the validity test was 0.930, greater than 0.5, indicating that the questionnaire data were suitable for factor analysis; The P-value of Bartlett test is less than 0.05, indicating that the questionnaire is valid.

### 3.2. Research on the Status Quo of Residents' Cognition of Intelligent Transportation

In the survey of residents' cognition of intelligent transportation in Hefei City, the results are shown in Figure 1: 51.4% of residents have heard of intelligent transportation, accounting for the largest proportion. Most of the surveyed residents' cognition of intelligent transportation is only heard of and slightly heard of, and many residents are very familiar with intelligent transportation, but their cognition still needs to be improved.

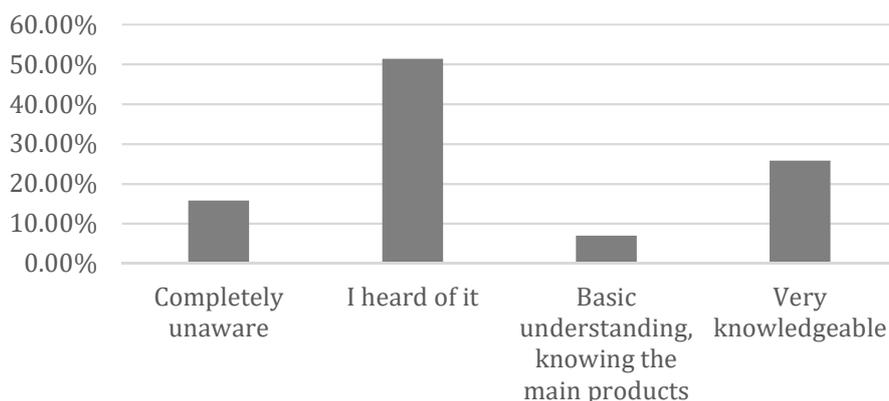


Figure 1. Distribution of respondents' cognition of intelligent transportation

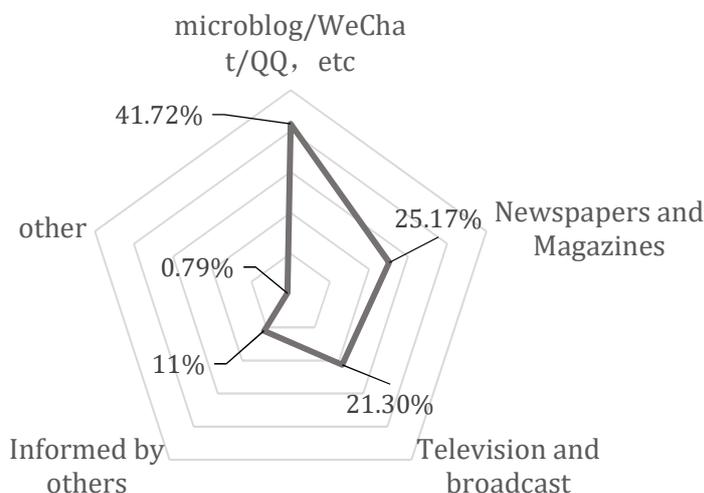
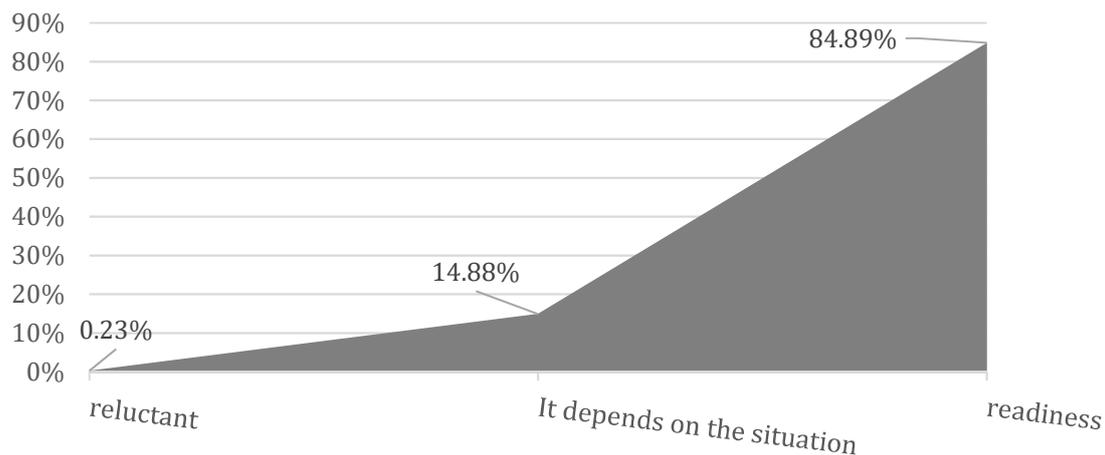


Figure 2. Distribution of cognitive channels

In the survey of cognitive channels, the results are shown in Figure 2: 41.72% of the residents know about "intelligent transportation" through microblog/WeChat /QQ/ public account, accounting for the largest proportion. Residents have diversified cognitive channels for "intelligent transportation".

In terms of willingness to accept, the survey results are shown in Figure 3: 84.89% of the respondents are willing to use intelligent transportation, which means that the market prospect of intelligent transportation is very good.



**Figure 3.** Distribution of respondents' willingness to accept intelligent transportation

In order to further improve residents' willingness to accept intelligent transportation, the following uses structural equation model to find out the constraints of residents' willingness to accept intelligent transportation, so as to provide suggestions for its popularization.

### 3.3. The Restrictive Factors and Path Analysis of Residents' Willingness to Accept Intelligent Transportation

In order to further study the restrictive factors of residents' acceptance of intelligent transportation, structural equation model was used to obtain the relationship between the influencing factors. Structural equation model (SEM) is a multivariate statistical method based on the covariance matrix of variables to analyze the relationship between variables. Compared with traditional exploration methods, SEM is better at processing some difficult to be observed data, and can reveal the relationship between external and internal potential variables more efficiently and quickly, so as to make the research more scientific and objective. It can be seen from the above that the reliability and validity of the data are good, and the model can be established. Since latent variables are difficult to observe directly, five aspects of perception norm, acceptance attitude, subjective norm, government trust and willingness to accept are taken into account in combination with the questionnaire content. For details, see Table 1:

This study is based on the willingness to accept model and behavior theory to study the relationship between potential variables. Before people are willing to try intelligent transportation, they will first judge the value and benefits brought by intelligent transportation according to their existing cognition level, and incorporate them into the evaluation norms, thus affecting people's concepts and attitudes toward intelligent transportation. Finally, based on the above perception, they will decide whether to accept and try intelligent transportation. Therefore, the following hypotheses are made in this study:

H1: "perceived norms" have a positive influence on "participation attitude";

H2: "perceived norm" has a positive influence on "subjective norm";

H3: "participation attitude" has a positive influence on "participation intention";

H4: "subjective norms" have a positive impact on "participation intention";

H5: "Government trust" has a positive impact on "participation intention".

**Table 1.** Setting of latent variables and observed variables

Latent Variable	Observed variables	Observe the specific content of the variable
Perceptual norms	Perceptual Norms 1	I think the travel experience of intelligent transportation is very good
	Perceptual Norms 2	I think intelligent transportation is very cost-effective
	Perceptual Norms 3	I believe the government guarantees the reliability of intelligent transportation
Acceptance attitude	Accepting Attitude 1	I understand and believe that intelligent transportation can save energy and protect the environment
	Accepting Attitude 2	I feel the need to embrace intelligent transportation to ease energy and environmental pressure
	Accepting Attitude 3	I think it is everyone's duty to accept new modes of transportation
Subjective norms	Subjective Norms 1	The promotion of intelligent transport by the media, the community and environmental agencies encourages me to accept it
	Subjective Norms 2	People around me have a higher degree of influence on my acceptance of intelligent transportation
	Subjective Norms 3	People I know around me often share relevant policies on social media
	Subjective Norms 4	I will take the initiative to respond to the government's call and accept the new mode of transportation
Government Trust	Government Trust 1	I think the government has a high ability to implement the construction of intelligent transportation
	Government Trust 2	Government participation in intelligent transportation engineering is relatively high
	Government Trust 3	I think the government's policy on intelligent transportation is in place
Willingness to accept	Willingness to Accept 1	I'm interested in using new technologies to get around
	Willingness to Accept 2	I am willing to take the time to understand the acceptance of intelligent transportation
	Willingness to Accept 3	I am willing to lead my friends around to accept intelligent transportation

AMOS28.0 software was used to draw the causality path diagram of the structural equation model according to the above assumptions, and a coefficient of measurement index corresponding to each potential variable in the model was specified as 1, the measurement error coefficient of measurable variables of exogenous potential variables and endogenous potential variables was specified as 1, and the causality path was set, as shown in Figure 4.

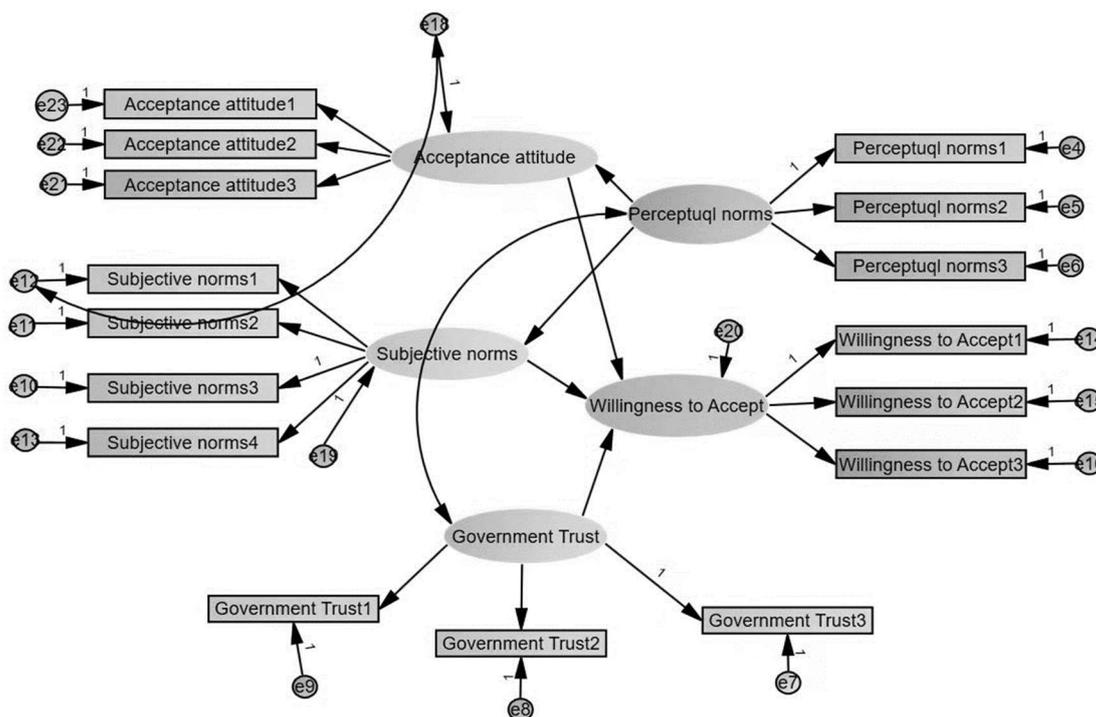


Figure 4. Path correction diagram of structural equation4

Table 2. Standardized structural equation factor load table

Variable	Path	Variable	Estimates	S.E	C.R.	P
Subjective norms	<---	Perceptual norms	0.915	0.054	19.593	<0.001
Acceptance attitude	<---	Perceptual norms	0.954	0.043	21.641	<0.001
Willingness to accept	<---	Subjective Norms	0.521	0.065	2.373	<0.01
Willingness to accept	<---	Acceptance attitude	0.163	0.118	4.829	<0.001
Willingness to accept	<---	Government trust	0.312	0.134	2.601	<0.01
Perceptual Norms 2	<---	Perceptual norms	0.819	0.052	20.387	<0.001
Perceptual Norms 3	<---	Perceptual norms	0.807	0.051	20.101	<0.001
Acceptance Attitude 2	<---	Acceptance attitude	0.869	0.045	22.578	<0.001
Acceptance Attitude 3	<---	Acceptance attitude	0.852	0.047	22.036	<0.001
Subjective Norms 2	<---	Subjective Norms	0.904	0.039	26.923	<0.001
Subjective Norms 3	<---	Subjective Norms	0.887	0.041	25.762	<0.001
Subjective Norms 4	<---	Subjective Norms	0.934	0.048	19.673	<0.001
Government Trust 2	<---	Government Trust	0.857	0.045	23.423	<0.001
Government Trust 3	<---	Government Trust	0.849	0.046	22.983	<0.001
Willingness to Accept 2	<---	Willingness to Accept	0.859	0.037	25.789	<0.001
Willingness to Accept 3	<---	Willingness to Accept	0.834	0.038	24.173	<0.001

Based on the above analysis, the maximum likelihood estimation method was used in this study to estimate the parameters and compare the goodness of fit of the model. The results are shown in Table 2. The significance meets the requirements and the model has a good effect.

Next, the structural equation was tested for goodness of fit. The results showed that the Chi-square value of the structural equation model was 450.487, and the significance P value was less than 0.05. The overall fitting effect of the model was good, and the CFI value was greater than 0.9, which was not affected by the degree of complexity. In this study, the structural equation path graph was finally used to explain the path situation of the restricted factors of residents' willingness to accept the new intelligent transportation mode.

To sum up, the model has a good fitting effect: each path coefficient has its own meaning. According to the previous hypothesis on the one-way influence relationship between each latent variable, the following conclusions are drawn:

According to the results, the regression coefficient between residents' subjective norms and willingness to accept intelligent transportation is 0.521, indicating that an increase of 1 percentage point in residents' subjective norms will directly increase residents' willingness to accept by 0.521 percentage points.

For the latent variable trust in the government, the regression coefficient between residents' trust in the government and their willingness to accept is 0.312, indicating that 1 percentage point increase in residents' trust in the government will increase residents' willingness to accept by 0.312 percentage points. However, residents' acceptance attitude has little influence on the degree of willingness to accept, and the regression coefficient is only 0.163.

From the perspective of perception norms, the influence on acceptance attitude and subjective norms is analyzed. The regression coefficients of latent variable perception norms, acceptance attitude and subjective norms are 0.954 and 0.915, respectively. From the positive and negative data, it can be concluded that perception norms have a positive impact on acceptance attitude and subjective norms. The residents' acceptance attitude and subjective norm of intelligent transportation increased by 0.954 and 0.915 percentage points respectively. From the numerical point of view, the influence of perception norms on residents' acceptance attitude and subjective norms is large, but the influence on residents' acceptance attitude is relatively large, and the indirect influence on acceptance willingness is large. Therefore, improving residents' perception norms, acceptance attitudes and subjective norms of intelligent transportation will help increase residents' willingness to accept it and help popularize intelligent transportation. It is necessary to strengthen the role of media channels of intelligent transportation, promote pilot work and improve relevant policy systems.

### **3.4. Forecast the Future Market Scale of Intelligent Transportation**

In order to further grasp the future development prospects of intelligent transportation, the grey prediction model is mainly used in this study to forecast the intelligent transportation market. Through this method, the market size of intelligent transportation can be estimated in the next five years, and the forecast results are analyzed at last.

#### **3.4.1. The Grey Prediction GM(1,1) Model is Established**

Before the grey prediction model GM(1,1) is established, the time series is tested by level ratio. If it passes the stage ratio test, the series is suitable for constructing the gray model; if it fails the stage ratio test, the series is "translated", so that the new series meets the stage ratio test. The result of the stage ratio test showed that all the stage ratios of the sequence after translation conversion were within the interval (0.846, 1.181), and the sequence after translation conversion was suitable for constructing the gray prediction model. Next, the model is established:

Set the original data sequence as; and sum it once to get a new generated data column, call it 1-AGO sequence;  $x^{(0)} = (x^{(0)}(1), x^{(0)}(2), \dots, x^{(0)}(n))$  The form is as follows:

$$x^{(1)} = (x^{(1)}(1), x^{(1)}(2), \dots, x^{(1)}(n)) \quad (1)$$

Where:

$$x^{(1)}(m) = \sum_{i=1}^m x^{(0)}(i), m = 1, 2, \dots, n \quad (2)$$

Construct a first-order differential equation for a sequence of discrete variables:

$$\frac{dx}{dt} + ax = u \quad (3)$$

Where,  $a$  is called the developing grey number;  $u$  is called endogenous control grey number. The discrete form and prediction formula are as follows:

$$\Delta^{(1)}(x^{(1)}(k+1)) + a(x^{(1)}(k+1)) = u \quad (4)$$

$$x^{(1)}(k+1) = \left[ x^{(1)}(1) - \frac{u}{a} \right] e^{-ak} + \frac{u}{a} \quad (5)$$

Solution of the predicted value:

$$\hat{x}^{(1)}(k+1) = \left[ x^{(1)}(1) - \frac{\hat{u}}{\hat{a}} \right] e^{-\hat{a}k} + \frac{\hat{u}}{\hat{a}} \quad (6)$$

The market size of intelligent transportation is taken as the research variable, the market size data of intelligent transportation from 2011 to 2021 is substituted as the original data, and the demand area data of China from 2022 to 2026 is predicted by GM(1,1) model.

### 3.4.2. Model Testing

That passes the test can be used for prediction. The test steps are as follows:

Subtract the calculated  $\hat{x}^{(1)}$  once and convert it into  $\hat{x}^{(0)}$ , and calculate the residual:

$$e(k) = x^{(0)}(k) - \hat{x}^{(0)}(k), k = 1, 2, \dots, n \quad (7)$$

The standard deviation of the original sequence  $x^{(0)}$  is:

$$S_1 = \sqrt{\frac{\sum_{k=1}^n [x^{(0)}(k) - \bar{x}^{(0)}]^2}{n-1}} \quad (8)$$

The standard deviation of residual sequence  $E$  is:

$$S_2 = \sqrt{\frac{\sum_{k=1}^n [e(k) - \bar{e}^{(0)}]^2}{n-1}} \quad (9)$$

Calculate the posterior difference ratio as:

$$C = \frac{S_2}{S_1} \quad (10)$$

### 3.4.3. Result Analysis

After testing, the results show that the posterior difference ratio is 0.003, the model is highly accurate, and the average relative error of the gray prediction model is 2.371%. The model fitting effect is good, and the prediction results are credible. The prediction results are shown in Table 3:

**Table 3.** Predicted values

Projected number of years	Forecast market size (billion yuan)
2022	2062.582
2023	2277.696
2024	2504.436
2025	2743.429
2026	2995.337

As can be seen from Table 3, GM(1,1) model predicts the market size of intelligent transportation in the next five years, and it can be found that the market size of intelligent transportation will continue to increase in the future, and it is expected that the market size will reach 29.9337 billion yuan in 2026. Intelligent transportation has a good market prospect under the background of energy conservation and emission reduction, and the development opportunity should be seized. Continue to promote the improvement of intelligent transportation products and technologies; We will intensify publicity, raise people's awareness of environmental protection and energy conservation, and guide the conscious implementation of energy conservation and emission reduction measures.

## 4. Conclusion and Suggestions

### 4.1. Research Conclusion

First, through descriptive analysis, it can be seen that most respondents have a high cognitive level, but the overall cognitive level still needs to be improved. Compared with traditional media, more residents tend to learn about intelligent transportation through new media channels such as Weibo and wechat; Most residents support the development of intelligent transportation.

Then, according to the structural equation model, it can be seen that in general, the social public's perception norm of intelligent transportation has a positive impact on behavioral attitude and subjective norm, and the perception norm has an indirect impact on the acceptance willingness by influencing the acceptance attitude and subjective norm.

At last, the paper makes a reasonable prediction of the future consumer market of intelligent transportation through the gray prediction model. Combined with the development

characteristics of market demand and energy-saving industry, if the government has little changes in related policies in the short term, the market size of intelligent transportation will show a relatively stable development trend. In general, the research predicts that the market size of intelligent transportation shows a growing trend, and the future development potential of intelligent transportation is huge.

## **4.2. Suggestions**

Based on the above investigation and research on the development of intelligent transportation in Hefei, Anhui province, from the government, environmental protection Bureau and traffic management Bureau, related enterprises and individual residents, this paper puts forward targeted suggestions to deepen people's awareness while improving people's willingness to accept.

### **4.2.1. Government Aspect**

Through the preliminary investigation and research, it is found that China's intelligent transportation legislation is still in a blank state, and there is no targeted special legal provisions. Although there are provisions, but too principle, general. Therefore, from the national level, it is necessary to formulate a special law for intelligent transportation as soon as possible, including the whole process of intelligent transportation planning, design, construction, operation and so on. At the same time, China's intelligent transportation evaluation system is mostly a level evaluation system, which does not adapt to the evaluation standards and technical standards of other links.

Therefore, improving the evaluation system of intelligent transportation and formulating reasonable standards of intelligent transportation are conducive to the healthy development of intelligent transportation norms. The strength of intelligent transportation policy subsidies affects whether intelligent transportation can be popularized more widely. Therefore, China's relevant departments should formulate economic incentive measures and policies suitable for China's national conditions and social development level, such as more policy support for intelligent transportation enterprises to reduce taxes, for the production of ordinary transportation products enterprises to increase taxes and so on.

### **4.2.2. Environmental Protection Bureau and Transportation Administration Department**

The staff should adhere to the evaluation standards of intelligent transportation, resolutely not allow the sale and use of products that do not meet the standards, punish violations in strict accordance with relevant laws and regulations, be transparent and open, find problems and solve them in time.

According to the research, the residents as a whole have a certain understanding of intelligent transportation, and the overall willingness to accept and participate is high, but the overall cognition still needs to be improved. Therefore, the environmental protection Bureau and the traffic administration department should guide the clear direction of development, guide the lower departments to take measures, vigorously promote the popularization of relevant knowledge, enhance the residents' environmental awareness, and improve the overall awareness of the society for intelligent transportation.

### **4.2.3. Related Enterprises**

Relevant enterprises should be targeted to the target depiction of marketing publicity, increase the marketing publicity of middle-aged and elderly people and lower education groups, through advertising and self-media platforms to let the public know intelligent transportation and establish a wide range of social identity, increase efforts to publicize intelligent transportation highlights, stimulate the consumer demand of users.

Relevant enterprises should, in accordance with the requirements of laws and regulations, make clear their responsibilities, strive to improve the level of intelligent transport-related technologies, meet or even exceed the intelligent transportation standards, pursue less energy consumption, reduce waste emissions, reduce user costs, and develop more new intelligent transport-related technologies that can make residents convenient and safe and meet more needs.

#### 4.2.4. Personal Aspect of Residents

When the construction and operation costs of intelligent transportation are reduced to an acceptable range, residents should take the initiative to assume social responsibilities, actively use environmentally friendly transportation products, and phase out products that are less efficient and not environmentally friendly. In addition, residents should also put forward opinions and suggestions on the development of smart transportation around them to promote its sustainable development.

Residents should take the initiative to enhance their environmental protection awareness, understand the relevant environmental protection knowledge, take part in daily environmental protection actions, publicize intelligent transportation, promote the development of intelligent transportation, actively respond to national policies, follow the leadership of the Party, and contribute to the construction of a beautiful China, green water and green mountains.

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