PROBLEMY EKOROZWOJU – PROBLEMS OF SUSTAINABLE DEVELOPMENT
2018, vol. 13, no 2, 165-176

Choice Behavior for Intelligent Vehicle: Factors and Relationships

Uwarunkowania wyboru inteligentnego pojazdu: czynniki i powiązania

Yuhong Cao*, Wei Hu**

**School of Management, Shanghai University, Shanghai, 200444, China*
***Corresponding Author, Anhui Cadre Institute of Economics Management, Hefei, 230008, China*
E-mail: angelcaoniuniu@sina.com

Abstract
Intelligent vehicle considered to be the trend of future vehicle for its ecological environment protect and energy conservative feature. The high cost and imperfect technology of it result however in the disinclination of consumers and developers. In this paper, we studied the factor relationships of intelligent vehicle choice behavior between intelligent vehicle manufacturing enterprises, consumers and intelligent vehicle products by constructing Structural Equation Modeling (SEM). The empirical results shows that, Government should help to improve the performance of intelligent vehicle, and they should strengthen consumers' cognition of intelligent vehicle and encourage them to purchase, which will stimulate vehicle manufacturing enterprises' enthusiasm for developing.

Key words: intelligent vehicle; choice behavior; SEM; factors analysis

Streszczenie
Inteligentne pojazdy uważane są za przyszłość motoryzacji z uwagi na ochronę środowiska i oszczędność energii. Wysoki koszt i wciąż niedoskonała technologia powodują jednak niechęć ze strony konsumentów i deweloperów. W niniejszym artykule przeanalizowaliśmy czynniki dotyczące wyboru inteligentnego pojazdu między ich producentami, konsumentami i produktami, wykorzystując modelowanie równań strukturalnych (SEM). Wyniki empiryczne pokazują, że rząd powinien przyczynić się do poprawy wydajności inteligentnego pojazdu, a także powinien upowszechnić u konsumentów informacje odnoszące się do inteligentnego pojazdu i zachęcić do jego zakupu, co przyczyni się do znaczącego rozwoju przedsiębiorstw produkujących takie maszyny.

Słowa kluczowe: inteligentny pojazd, SEM, zachowanie zarządzające wyborem, analiza czynników

Introduction

Because of the characteristics of ecological environment protection and energy saving, intelligent vehicles can effectively improve the disadvantages of traditional automobile's energy consumption and pollution. In the day of automobile consumption increasingly mature, consumers have differentiated consumer demand structure in the different consumption stages and psychological cognitive level, the traditional automobile is not good enough to attract consumers' attention, intelligent vehicle came into being (Orsato,2007). Similarly, automobile manufacturers in the automobile development project selection is also faced with the choice of developing traditional vehicles or intelligent vehicle. Therefore, if we can grasp the driving factors of automobile enterprise intelligent vehicle development and manufacturing, and understand the influencing factors of consumer's intelligent vehicle purchase decision, we can realize multi-information symmetry, and benefit the balance of intelligent vehicles' supply and demand.

Based on the three dimensions of automobile manufacturing enterprises, consumers and intelligent automobile products, this paper explores the relationship and intensity among them. According to the theory of purchasing behavior, select the feature factors from the dimension of intelligent vehicle buying behavior, intelligent vehicle product features, manufacturing enterprise intelligent vehicle development decision-making behavior, to build structural equation model, using empirical data to explore the relationship among the three dimension to grasp the status quo of intelligent vehicle market. On the micro level, we can understand the interaction and its strength among them. On the macro level, it is conducive to the government to grasp the behavior characteristics of automobile manufacturing enterprises and consumer, targeted control the intelligent vehicle market, it is also conducive to vehicle manufacturers to accurately grasp the market demand of intelligent vehicle, and help consumers select intelligent vehicle better.

The rest of the paper is organized as follows. In Section 2, we analysis the intelligent vehicle selection behavior mechanism, including present the definition of intelligent vehicle and selection behavior, and analysis intelligent vehicle selection behavior' influencing factors and make assumptions. Section 3 construct the SEM model of intelligent vehicle consumption choice behavior. In Section 4, present an empirical analysis. The research result is discussed and recommendations are given in Section 5.

2. Intelligent vehicle selection behavior mechanism analysis

2.1. Definition of intelligent vehicle and selection behavior

According to the American Highway Safety Administration's definition of intelligent vehicle, intelligent vehicle are an integrated system that combines environmental awareness, planning decisions, and multi-level aided driving. It focuses on the use of computers, modern sensing, information fusion, communications, artificial intelligence and automatic control technology. Intelligent vehicle has at least six systems, navigation information database, navigation and positioning system, road conditions information system, vehicle anti-collision system, wireless communication systems and automatic driving system. This article defines the intelligent vehicle as follows: adding advanced sensors, controllers, actuators and other devices to the ordinary automobile, through the automobile sensor system and information terminal for people, cars, roads and other intelligent information exchange, ultimately to achieve the traffic environment perception, scientific planning and decision-making, multi-level auxiliary driving, and the final unmanned and other functions, bring the gospel for mankind in the solution of automobile exhaust emissions, traffic congestion and frequent traffic accidents. This paper only consider the intelligent vehicle's manufacture and sold for the first time, consider the intelligent vehicle' choice behavior from the following two aspects: first, the rational choice of automobile manufacturing enterprises to produce intelligent vehicle investment behavior; second, consumers' purchase behavior to intelligent vehicle based on their own needs.

2.2 Intelligent Vehicle selection behavior' influencing factors analysis and assumptions

2.2.1. Automobile manufacturing industry dimension

The automobile manufacturing industry is the supplier of intelligent vehicles, their decision affects the number of intelligent automobile, and then produced an impact on the intelligent vehicle market. But automobile manufacturing industry takes the profit maximization as the core goal, and is affected by the joint action of interior and exterior market (Seliger, 2007). The market expectation of the auto manufacturing industry express the anticipation of future intelligent vehicle market, optimistic anticipation stimulates manufacturing industries' development behavior, and pessimistic anticipation will stagnate manufacturing industries' development behavior.

The predictions of future intelligent vehicle market are based on the following three aspects:

(1) Potential consumers' recognition of intelligent vehicles. At present, consumers all over the world have different cognition about intelligent vehicle. The development status of intelligent vehicle in China market and in foreign market is basically the same. But relative to the international mainstream automobile manufacturing enterprises, domestic automobile manufacturing enterprises show leeward temporarily in the smart car system research and development. This is mainly limited by consumer's consumption habits and cognition and other factors. If consumers are optimistic about the intelligent vehicle market, the purchase willingness will strong, which will lead to strong market demand and promote automobile manufacturing enterprises' decision to enter into intelligent vehicles market and product related products.

(2) Manufacturing cost. Develop a large number of stable and reliable sensors and other electronic equipment and software will bring intelligent automotive industry a great cost, which is the a major bottleneck in the development of intelligent automobile industry. Future intelligent vehicles will install all kinds of high-tech sensors, reflecting a variety of computer technology, for example, Google driverless car equipped with a large number of sensors, which cost up to $250 thousand, the total cost of the car exceed more than 300 thousand U.S. dollars. There is no doubt that their prices will gradually decline with the maturity of technology, but for a long

period of time these devices or devices are still difficult to be accepted by the public. Data from EnfoDesk shows that, in 2016, China's pre-installed vehicle navigation penetration rate is still less than 15%, which confirm the above point. How to significantly reduce the cost of hardware and software has become the key point to promote the wide application of intelligent vehicles.

(3) Demand forecast. The factors that influence the demand of intelligent vehicle include population structure and quantity, income level, consumers' green value, consumer satisfaction, etc..

Thus, this paper presents the following hypothesis:

H1: The market expectation of automobile manufacturing enterprises has a positive impact on enterprises manufacture intelligent vehicle decision.

The development of intelligent vehicles will promote lots of professions and trades flourishing, led to the promotion of national economy, and ultimately improve national industrialization level (Alam & Saini, 2015). The economic externalities brought by the development of intelligent vehicles can lead to market failure, positive economic externalities lead to the development of intelligent vehicles is bound to lower than the social optimal level (Dai & Li, 2015). The common method used by government and scholars to solve the regulation failure caused by the market externalities including the *Pigou tax* and *Coase law*, that is, the government adopts tax, financial subsidies, defined property rights and other means to manoeuvre the markets. Therefore, the policy environment plays an important role on automobile manufacturing enterprises' decision-making (Joao, 2013). In automobile market, the manufacturers and consumers are separated, and the resources that consumers save cannot be shared by the manufacturers, but the cost of R&D and manufacture of intelligent vehicles is relatively large, so the government financial subsidy is a relatively easy method to manoeuvre the intelligent vehicles markets. Therefore, the financial support policies can play an important role for the development of intelligent vehicles. Since the intelligent vehicles was taken as a key development areas in the report of *Made in China 2025*, China's central and local governments have introduced various policies. In 2016, the national network of intelligent vehicle (Shanghai) pilot demonstration area closed test area open. In 2017, Shanghai officially introduced a Shanghai intelligent network of automotive industry innovation project implementation plan, and began to implement the relevant policies and measurements related to intelligent manufacturing, such as *heavy diesel vehicle pollutant emission limits and measurement methods (China's sixth stage)* (referred to as *heavy truck country six standard*), limited license area licensing concessions, smart car manufacturing financial subsidies, and other economic support policies. Thus, this paper presents the following hypothesis:

H2: Incentive policies have a positive impact on automobile manufacturing enterprises manufacture intelligent vehicle decision.

Automobile manufacturing enterprise reputation represents its brand in the minds of the community, peers and consumers, it is a symbol of appeal and public praise. Well-known automobile manufacturing enterprises often with a perfect synergy of cross-industry and cross-regional, not only contribute to the construction of intelligent vehicle infrastructure and intelligent driving laws and regulations, but also can improve the level of intelligent vehicle technology, which can reduce the overall cost of intelligent vehicles and improve its market penetration. In addition, the well-known automobile manufacturers generally have a strong sense of social responsibility, they will combine their own development and social responsibility, seeking for *green development* and *sustainable development*. Most of these enterprises aim at ecological harmony, actively advocate and practice green value, and lead the development direction of intelligent manufacturing industry (Meyer, 2014). Such as Google, SAIC, GM, Ford and Audi, they are all committed to intelligent vehicles manufacture, and play a good demonstration role in the development of intelligent vehicles. These enterprises all have a good reputation in the intelligent manufacturing industry, indicating that high visibility enterprises are more inclined to manufacture intelligent automobile products, and the intelligent vehicle produced by them is usually been highly recognized in the market (Li, 2015). Thus, this paper presents the following hypothesis:

H3: Enterprise reputation has a positive impact on automobile manufacturing enterprises manufacture intelligent vehicle decision.

2.2.2. Intelligent Vehicle performance dimension

Intelligent control system very extensive and complex, it includes intelligent sensing system, auxiliary driving system, intelligent computer system and other subdivision system. The location service system needs to locate the intelligent vehicle in real time, such as displaying the destination map in the vehicle, determining the position of the vehicle, selecting the appropriate driving path. Safety protection system has made contributions to vehicle theft prevention and vehicle tracking; life service system provide owners with video entertainment, handle official business and other primary functions. These systems eventually led the Intelligent Vehicle to become an intelligent mobile robots that integrate high-end technologies like personal computers, Internet and artificial intelligence. Intelligent vehicles take vehicles as objects, and need communication, software, information, analysis, identification and other technologies to participate in cross-border. Because of cross discipline, there may be many problems, such as communication transmission, signal connection, link physical layer and other inconsistent stand-

ards, resulting in data transmission lag and other issues. How to make communication, interface, testing and other standards unified, how to integrate these technologies and promote information fusion, how to interdisciplinary linkage, all these are the main resistance and challenge in intelligent vehicle's development (Meyer, 2014). Therefore, the technical level is the main problem that restricts the development of intelligent automobile manufacturing industry, and it is also a test of enterprise R&D level. Those automobile manufacturing enterprises who have the advantages of technology research and access to a number of patented technology also have advantage in product cost control, this is another guarantee for the performance of intelligent vehicle (Ding, 2014). Thus, this paper presents the following hypothesis:

H4: The technical level has a positive impact on the performance of intelligent vehicle.

Intelligent vehicle do not just mean automatic driving, it refers to the automatic driving based on configuration of various types smart sensors and intelligent road etc. (Weiß, 2015). To achieve this function, first, intelligent vehicle need equipped with a comprehensive navigation information database, which includes the information of domestic real-time highway, national road, city road various units and various service facilities (food and entertainment, gas stations, tourist attractions, accommodation, etc.); Second, intelligent vehicle need equipped with GPS satellite positioning system, it will use this system to accurately locate the vehicle current location, match the information with navigation information in database, and determine the follow-up trip according to the match result; thirdly, intelligent vehicle need equipped with information system of real-time road conditions which control by traffic control center, through this system, traffic control center can feedback the real-time conditions of road sections timely, such as construction, accidents, traffic jams, provide driver some advice on how to change the route ahead of time. In addition, it is also necessary to configure vehicle collision avoidance system (including radar detection system, vehicle emergency control system and information sharing system),wireless communication system, automatic driving control system etc. (Zhang, 2016). Perfect intelligent vehicle infrastructure can not only promote the promotion of intelligent vehicle penetration but also promote effective coordination of relevant departments. Thus, this paper presents the following hypothesis:

H5: The improvement of infrastructure has a positive impact on the performance of intelligent vehicle.

A good policy environment is the prerequisite for a country to achieve sustainable development, if lack a clear national policy planning, or different policy planning cannot be well coordinated, it may hinder the development of intelligent automobile (Xu, 2015). Such as the unification of the industry standards, many automobile enterprises have their own on-board system, there is no uniform standard in the hardware or software, which seriously restricting the development and experience of vehicle applications. On the one hand, manufacturers can only develop software for one or several type of automobile, which lead to poor compatibility and high cost. On the other hand, the owners paid the price for the application but not get a good experience, which may cause consumers lack of interest and let the automobile enterprises face an embarrassing situation. This is very similar to the era of functional machines before smartphones appear. National policy improvement can promote the effective coordination of relevant departments and improve technology chain, industrial chain and value chain, it also helps to build a complete intelligent network of automotive ecochain (Gibson, 2015). At the same time, the perfect policy can promote the relevant authorities responsible for the detailed assessment and information transmission of intelligent vehicles development, help to effective integration of existing social resources, make automobile industry, communication industry, internet industry, transportation field, and university and scientific research institution form a true alliance, ultimately, promoting the formation of cross-domain innovation development model with win-win goal. Thus, this paper presents the following hypothesis:

H6: Perfect policies and regulations have a positive impact on the performance of intelligent vehicle.

2.2.3. Consumer dimension

The research perspective of consumer behavior is usually carried out from two levels: macro and micro. On the macro level, consumer behavior is related to the concept of consumption lifestyle, which is usually a description of consumer demographic characteristics and consumer behavior characteristics. On the micro level, consumer behavior is usually associated with consumer awareness, attitudes, purchase intentions, decision-making process and other specific purchase behavior, it tends to explain the behavior of consumers in specific information communication, purchase decision, product use, brand attitude, etc. The theory of planned behavior proposed by Ajzen & Fishbein (1980) is one of the important theories to study consumer choice and decision making. This theory point out that behavioral intention influences individual behavior, consumer's intelligent vehicle selection is a process from externalization of internal effectiveness to behavior, the main factors affecting the behavior intention is the attitude (positive or negative evaluation to product cognition), subjective criteria (consumer's psychological positioning of the product), and perceived behavioral control (consumer's evaluation on consumer behavior completion).

Kotler (2008) proposed a general model of consumer behavior: under the external stimulation of marketing and environment, consumer will produce pur-

chase decisions through the behavior *black box* processing. Kotler suggests that there are many factors that affect the *black box*, including social culture, personal habits, etc., he also pointed out that, under the influence of black box, the consumer's consumption will have the herding effect, and the behavior of the reference group can influence individual decision by influencing the individual's value and the group-based consistency. The impact of the black box, consumer spending will exist in the herd effect, the behavior of the reference group can influence the decision of the individual by influencing the individual's values and the behavior criterion based on the consistency of the group. Intelligent vehicle is a green fashion product advocated by the public in modern society, at the same time, it is also the product that affects the trip and even living habits after buying, Consumers in the whole process of consumption will be constraint to rational consumption and objective environment and consumption trend. Thus, this paper presents the following hypothesis:

H7: Consumption habits have a positive impact on intelligent vehicle purchase decisions.

Perceived behavior is the judgment of whether an individual has the ability to complete an action, and the perceived validity plays an important role in consumer behavior. In the process of decision making, consumers form attitudes through the information provided by the manufacturer, they actively collect information related to the goods as the evaluation criteria and generate motivation to buy, and on the basis of considering the price, service and promotion factors, the purchase decision is formed (Teece, 2010). Considering that the intelligent automobile is still belong to advanced consumption, the price is the most important factor influencing the consumption, it's the signal of relationship of supply and demand in the market. Therefore, although the intelligent vehicle has many advantages which other cars do not have, the high price makes only the family's actual consumption level to a certain extent before buying. Therefore, this paper chooses the *purchasing power* to measure the factor of consumer self-efficacy. Thus, this paper presents the following hypothesis:

H8: Purchasing power has a positive impact on intelligent vehicle purchase decisions.

According to Belk (1975), the process of purchase decision is divided into five stages:

(1) know the demand,
(2) information collection,
(3) scheme evaluation,
(4) purchase decision,
(5) post purchase behavior.

In this process, variables that influence consumer decision-making include motivation, lifestyle, beliefs, attitudes, intentions, evaluation criteria, and other factors. Consumer's choice decision behavior for intelligent vehicle is based on their own past experience and the surrounding consumer's judgments on the impression of intelligent automobile products, and the amount of information consumers have about smart cars helps them to judge whether or not they have the ability to complete the choice task. As the intelligent vehicle is still a new thing, consumer' recognition on it is different, some people are eager to buy, some people wait and see, some people comment negative, but only the people who knowing intelligent vehicle and have the intention to buy is the people who will promote the development of intelligent vehicle market. Thus, this paper presents the following hypothesis:

H9: Cognitive psychology has a positive impact on intelligent vehicle purchase decisions.

2.2.4. The basic principles of Intelligent Vehicle selection behavior

In the intelligent vehicle selection system, the relationship among the three parts(the intelligent automobile manufacturing enterprises, consumers and the intelligent automobile products) belong to the coupling relationship, they contain each other and promote each other. From the perspective of supply and demand, intelligent vehicle manufacturer is intelligent vehicle suppliers, consumer is intelligent vehicle demander, intelligent vehicle is products that supply or demand, only the intelligent vehicle market can reach the balance between supply and demand, the multi utility maximization can be realized. The intelligent automobile manufacturing enterprise is the main body of the intelligent automobile market, and enjoys a strong initiative in the intelligent vehicle selection system. However, from a certain point of view, the intelligent automobile manufacturing enterprises are passive, because the intelligent automobile products need to meet certain evaluation standards, such as environmental perception, auxiliary driving and experience comfort. The development of intelligent automotive products improves the economy of the whole life cycle, and reduces the cost of car buyers as a whole. The increase in the consumption of intelligent vehicle, in turn, can improve the market expectations and business level of manufacturing enterprises, and encourage the R&D and innovation of intelligent automotive technology (Hevelke, 2014). This kind of R&D and innovation can promote the performance of intelligent automobile products, indirectly affect the consumers' experience of intelligent vehicle, and attract consumers to choose intelligent vehicle, and the purchase decision of intelligent vehicle will must stimulate intelligent vehicle market development. In addition, the characteristics of intelligent vehicle can also positively affect manufacturing enterprises' decision-making. The more widely used of intelligent vehicle features, the more mature technology level in the market, the lower cost of using this technology, the more intelligent vehicle manufacturers willing to develop intelligent vehicles (Rodrigo, 2014). In intelligent vehicle selection system, consumers can choose the intelligent automobile freely, but also be restricted by

Table 1. Potential Variables Cronbach'α Coefficient and Measurement Variable Factor Load

Potential variable	Cronbach'α coefficient	Observation variables	Factor load
Market Expectation (ME)	0. 897	ME1:intelligent vehicle cognition	0.919
		ME2:manufacturing cost	0.899
		ME3:Market demand forecast	0.791
Incentive Policy (IP)	0. 887	IP1:R&D investment	0.885
		IP2:tax preference	0.888
		IP3:consumption subsidy	0.895
Enterprise Reputation (ER)	0. 864	ER1:public effect	0.877
		ER2:social responsibility	0.867
		ER3:product brand	0.882
Technical Level (TL)	0. 701	TL1:R&D level	0.732
		TL2:cost control	0.812
		TL3:patent quantity	0.757
Infrastructure (IS)	0. 937	IS1:information network	0.882
		IS2:satellite positioning	0.935
		IS3:intelligent road	0.916
Policies and Regulations (PAR)	0. 801	PAR1:technical standard	0.681
		PAR2:industry regulations	0.925
		PAR3:intelligent driving regulations	0.882
Purchasing Power (PP)	0. 759	PP1:wage level	0.835
		PP2:family income	0.932
		PP3:fixed assets	0.912
		PP4:occupation type	0.010
Consumption Habits (CH)	0. 926	CH1:purchase intention of emerging products	0.874
		CH2:the influence of social culture	0.886
		CH3:enterprise propaganda	0.891
Cognitive Psychology (CP)	0. 904	CP1:intelligent vehicle price acceptance	0.923
		CP2:Identification of trip change with intelligent vehicles	0.922
		CP3:intelligent vehicle market forecast	0.945
Intelligent Vehicle Development Decision (IVDD)	0. 943	IVDD1:requirements of automotive intelligent performance	/
		IVDD2:requirements of automobile cost control	/
		IVDD3:requirements of automobile meets the ecological development	/
Intelligent Vehicle Performance (IVP)	0. 806	IVP1:information Technology	/
		IVP2:data communication transmission technology	/
		IVP3:electronic sensing technology	/
		IVP4:control technology	/
		IVP5:computer technology	/
		IVP6:security	/
		IVP7:comfortability	/
		IVP8:economic performance in the whole life cycle	/
Consumer Purchase Decision (CPD)	0. 855	CPD1:purchase intention	/
		CPD2:purchase tendency	/
		CPD3:the ratio of income to smart car price	/

the existing products, and interact and restrict each other with the manufacturing enterprises. As a result, the intelligent vehicle market is affected by manufacturing enterprise, intelligent vehicle performance and consumer factors, these factors interact with each other within the complex system of intelligent vehicle market and form a causal relationship (Xu, 2015). Thus, this paper presents the following hypothesis:

H10: The performance of intelligent vehicle has a positive impact on manufacturing enterprise's manufacture decisions.

H11: The performance of intelligent vehicle has a positive impact on consumer's purchase decision.

H12: Consumers' intelligent vehicle purchase decisions have a positive impact on manufacturing enterprise's manufacture intelligent vehicle decisions.

3. Construction of Intelligent Vehicle choice behavior SEM model

3.1. Potential variables and measurement variables selection

Based on the theoretical analysis and model construction requirements, combined with the availability of data, the potential variables and measurement variables are set as shown in Table 1.

3.2. Intelligent vehicle selection behavior model

There are many influencing factors of intelligent vehicle selection behavior, and there may be have indirect influence between some influencing factors, so the model relationship is relatively complicated. The structural equation model is a statistical method for multiple variables. The method integrate the factor analysis and path analysis to test the relationship among latent variables, observed variables and error variables, so as to find the effects of many independent variables on the dependent variable, including direct effects, indirect effects and total effects. Compared with simple regression analysis, it's superiority lies in: it can deal with the existence of multiple dependent variables at the same time (McDonald, 2002). The structural equation model can consider and deal with multiple variables at the same time, and does not ignore other variables because of dependent variable influence. It is particularly competent for the analysis of complex model structures. Because SEM can further analyze the load effect and path effect between multiple variables, while avoiding the limitation of equation regression, it provides the possibility of further optimization of existing models, which can be better to understand the affecting relationship among various factors. To this end, this article chose to use the SEM method for the next study.

The structural model, as part of the SEM, is a model used to evaluate the relationship between latent variables after determining the potential variables in the measurement model. Among them, the variables reflecting the relationship among variables are also called path coefficients. The construction and assumptions of structural models are complementary to each other, if the structural model is determined, the hypothetical relation can be determined, and if the hypothesis relation is determined, the structural model also can be drawn (Podsak & Organ,1986). In this paper, 12 assumptions are made on the 12 factors involved in intelligent automobile manufacturing enterprises' manufacture decision making, intelligent vehicle performance and consumer decision making, and the structural equation model is constructed as shown in Figure 1.

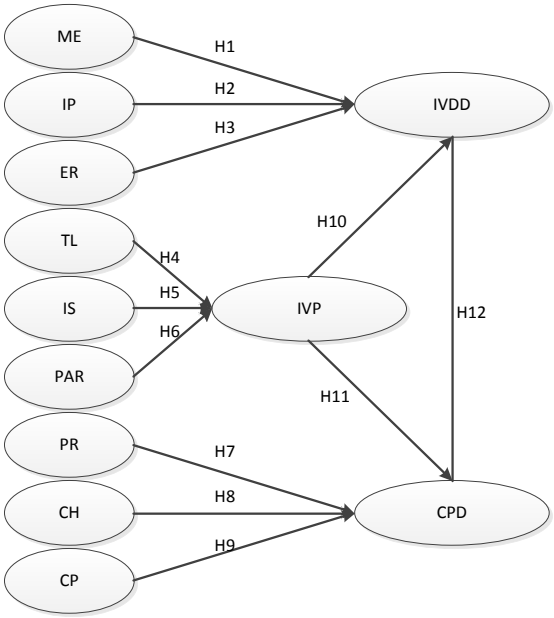

Figure1. Path diagram of intelligent vehicle selection behavior structure model.

4. Empirical analysis

4.1. Data collection and testing

4.1.1. Data collection

In this paper, empirical data were obtained by questionnaires, the problem was set based on the mature scale, and the AMOS software was used to test the hypothesis. In order to ensure the validity of the questionnaire (reliability and validity), taking into account the simplicity and readability of the problem, this questionnaire, based on a large number of relevant literature, combs the views and determines the logical relationship between variables. The questionnaire forms are all multiple-choice questions. In addition to quantitative questions about the basic information of individuals, the remaining attitude problems can be used Like Te five-point scale for qualitative measurement, from 1 to 5, indicating an increase in the degree of understanding or consent.

In order to ensure the scientificity and adequacy of the research, this study uses stratified method to investigate, and distribute the questionnaire in the way of combinative online survey and offline survey. The survey published a total of 300 copies questionnaire, among them, 100 copies paper edition questionnaire for smart car manufacturing enterprise, 100 copies paper edition questionnaire for consumer (for the screening of consumer samples, consumers who have never been exposed to smart cars are not surveyed in this study), 100 copies of the network questionnaire. A total of 267 questionnaires were recovered, the recovery rate was 89%. Among them, 260 valid questionnaires were effective and the effective recovery rate was 86.7%.All the sample information were listed in Table 2.

Reliability analysis tools mainly uses SPSS19.0.Reliability, namely reliability, is the degree of which the results can be obtained by repeating the measurement in the same way. The most commonly used method of reliability analysis is Cronbach'α coefficient , which was proposed by Cronbach in 1951 for the internal consistency measure of the secretary. The coefficient is between 0 and 1, the greater the value, the higher the reliability of the scale. In this study, the reliability of the measured variables was tested by Cronbach'α coefficient, and the results were shown in Table 1. In addition to technical level,

Table 2. Sample data recovery table

Distribution method	Distribution / recycling channels	Recycling quantity (copies)
on-line	WeChat	51
	QQ	32
	E-MAIL	17
offline	4S shop, customers who consult intelligent automobile	58
	Managers of intelligent automobile manufacturing enterprises	109
Total		267
Recovery rate (effective recovery rate)		89%（86.7%）

Table 3. Model fitting results

Test indicators	$\mid x^{2/df}$	RMSEA	NFI	CFI	IFI
Test result	1. 7796	0. 0647	0. 8918	0. 8955	0. 8966

purchasing power is between 0.7-0.8, the reliability of the other variables is higher than 0.8, the reliability is higher, indicating the reliability of the scale can be considered better, and the same latent variable descriptive problem internal correlation high.

4.1.2. Reliability and validity test

The validity analysis uses SPSS19.0 and structural equation model statistical tools. In this study, we use the factor analysis method to do KMO and Bartlett test in the questionnaire, results showed that KMO values of the two questionnaires were about 0.7, and the significance level of model was less than 0.001. The confirmatory factor analysis was carried out by principal component analysis, the factor loadings of all variables on each latent variable were all greater than 0.5 (Table 1), indicating that the model had good convergent validity. However, factor analysis found that the variable PR4 (occupation type in purchasing power) was not divided into any group. Taking into account the occupation type is a descriptive problem, does not mean a view or an attitude, moreover, there is no direct causal relationship between occupation type and purchase power, thus removing PR4,and the latent variable *purchasing power* observation variables change to 3, still meet the requirements of measurement, this research can proceed to the next test.

4.2. Model fitting and testing

When the internal structure of model is good, the next step is to evaluate overall fitting quality of the model, so as to evaluate external quality of model. To evaluate the overall fit, two problems need to be solved: first, which index should be used to test the model, because the index is a statistic that reflects the agreement degree between the theoretical model and the sample data; Second, how large index is considered a *good* , where the exponential value is similar to the cutoff value of the statistics in usual hypothesis test. Different scholars have different views on the fitting degree index which SEM should use. Combined with the characteristics of hypothetical model and samples number, this study refers to the definition of MCDONALD (2002) and Creswell (1995),choose the x^2/df chi-square degree of freedom, the smaller the better, generally take the chi-square value P<2 as a judge, that is, P<2, the model has a good fit), RMSEA(asymptotic residual mean square and square root, less than 0.05, the smaller the better) to measure the model's absolute fit degree; choose non-compliant fit index NFI (greater than 0.9, the closer to 1 the better, CFI(comparative fitness index, greater than 0.9, the closer to 1 the better), IFI(value-added adaptation index, greater than 0.9, the closer to 1 the better) to measure model's relative fit degree. Based on the measurement model, this paper constructs the SEM model, and uses AMOS21.0 to fit the whole structural equation model. The model fitness test results are shown in Table 3, and the model results path diagram are shown in Fig 2.

The hypothesis test showed that H3 and H8 were rejected at a significant level of 0.005,which means that, the hypothesis of enterprise reputation has a positive impact on automobile manufacturing enterprises manufacture intelligent vehicle decision, and the hypothesis of purchasing power has a positive impact on intelligent vehicle purchase decisions, all are not valid. We also can know from the Figure 2 that, the other hypotheses, including H1, H2, H4, H5, H6, H7, H9, H10, H11 and H12, are all established.

5. Results analysis and recommendation

5.1. Results analysis

From the perspective of automobile manufacturing industry, market expectations, government policies have played a positive role in intelligent vehicle development decision-making, among which the government policy effect is most significant. The reason is, even though technological progress and continuous innovation is fundamental to the development of intelligent vehicle, but enhance the overall competitiveness of intelligence automobile industry depends on the strong support of government and related in-

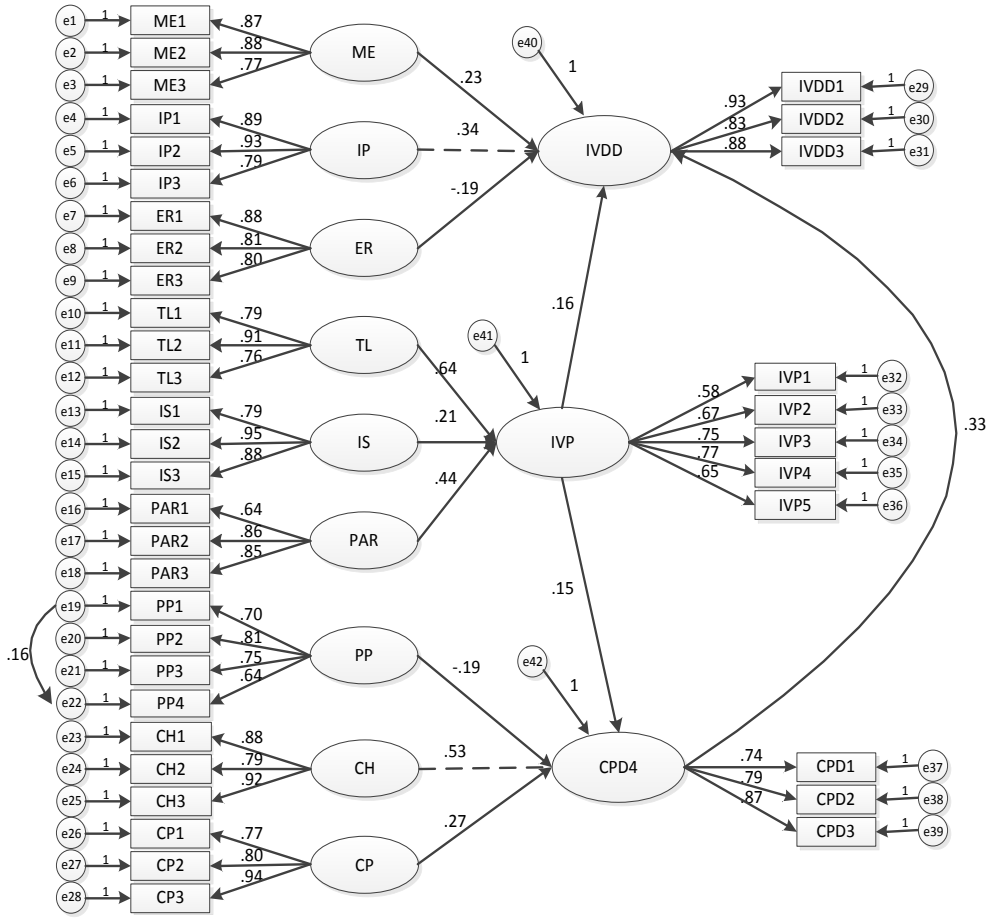

Figure 2. Structural Equation Model Path Coefficient Chart

dustries largely, including: automobile networking and other infrastructure, advanced policy planning, and appropriate incentives. Following the *China made 2025* and *China made 2025, key technology roadmap*, under the incentive of a variety of preferential policies, the development of China's intelligent vehicle manufacturing is very fast. In 2016, the national intelligent driving DA/PA stage penetration rate is about 16%, driven by intelligent driving hardware, software, electronics, communications and Internet, the cost of mechanical cycling increased in 20000-30000 Yuan. Combined with the vehicle annual growth anticipation rate of 3%, it is expected that the smart driving market space will achieve 35% compound growth rate in the next five years, and the market space will exceed 230 billion yuan in 2020. These seem to suggest that intelligent driving is in the takeover phase with the support of the Chinese government policy. In addition, due to market expectations related to the economic efficiency statue of automotive manufacturing industry, at present, there is still have a big gap between China's intelligent vehicle industry and Germany's or United States', but China has a huge market space, the act of increasing profits will must attract the automobile manufacturing industry which guided by interests. However, this empirical result deny the corporate reputation play an positive role on automotive manufacturing's develop intelligent vehicle decision making. Get this results may be due to the number of development enterprises involved in this questionnaire is limited, the coverage is not wide enough, there are some limitations; On the other hand, it shows that in the process of intelligent vehicle manufacturing, the emerging industry chain enterprises with technological advantages have great development potential in the whole industry.

From the perspective of intelligent vehicle, technical level, infrastructure and policies and regulations are all have positive effects on the quality of intelligent vehicles, among them, technical level have the greatest impact. This shows that the future development of intelligent vehicles market largely depends on manufacturer's technical level or R&D capability, at present, the key technologies of intelligent vehicles is still missing in China, and the key components have been monopolized by Germany and United States. Only constantly improving technology research and development level can reduce vehicle cost, thereby enhancing the public demand for intelligent vehicles, and maintaining intelligent vehicles industry sustainable development. Infrastructure is

the basis for intelligent vehicles driving, to enhance intelligent automobile penetration rate, manufacturers should think from the perspective of market consumers, that is, in addition to economic factors, security and comfort and other factors need to be considered either, for example, in the car driving environment, V2X can perform frontal collisions and intersections crash warnings; DSRC should have sufficient flexibility to support mobility and applications, like charges, transportation services, weather services and commercial vehicle services, the realization of these functions is the prerequisite for intelligent driving. The impact of policies and regulations on intelligent vehicles performance is also very obvious, which shows that only through technology to improve vehicle safety performance is more difficult. In intelligent vehicle development process, we should also promote the establishment and improvement of relevant technical standards and industry standard, around the intelligent network of automotive system architecture and related industry development goals, develop and improve the intelligent network of related technical standards and industry standards system, and actively participate in relevant international standards development. Only pay attention to vehicle information security technology development, and attach importance to the formulation and implementation of standards and regulations, is it possible to ensure the safety of intelligent network vehicles.

From the consumer dimension, consumption habits and cognitive psychology play an important role in intelligent vehicles purchase decision, this verified the view of planned behavior theory. Among them, consumption habits have the greatest impact, which means that consumers' behavior is greatly influenced by the outside world, when intelligent vehicle performance is outstanding and give consumers a comfortable and convenient experience, it will form a radiation effect to attract consumers to make a buying-decision, which also confirms the cause of high intelligent vehicle permeability in other countries. In addition, the results show that the consumers who interest in science and technology innovation products are more willing to buy intelligent vehicle, these people mainly in age degree between 25-40 years, bachelor degree or above, male, this point also indirectly shows that intelligent vehicle cognitive has positive effect on consumer purchase decision. The hypothesis that purchasing power affects consumers' purchase decisions does not established, may be due to the current smart car manufacturing are in the primary level (Level2 or Level1), belonging to a specific functional assistance stage, its technical level is not high and has been popular, resulting in intelligent vehicle cost been controlled in a better range, and part of the extra cost has little impact on consumers who can pay for intelligent vehicle, therefore, at this stage, the purchasing power cannot reflect the consumer differences.

The empirical results confirm that there is a positive effect among the three dimensions of intelligent vehicle selection model. Among them, compared with the intelligent vehicle performance factors, the impact of consumer purchase decision-making on the automobile manufacturing development decision-making is more significant. The current automobile manufacturing industry face excessive production, national policy restrictions, and other problems. Moreover, compared to traditional automobile manufacturing, intelligent vehicle manufacturing needs invest more manpower, funds and material resources. Therefore, only the potential demand of the market is large, and consumers have a strong desire to purchase intelligent cars, it is possible for the automobile manufacturers to choose to develop and manufacture intelligent cars. In addition, the results show that, intelligent vehicle's performance have a positive correlation with automobile manufacturing enterprise manufacture decision-making and consumer purchasing decision-making respectively, and the effect intensity is similar. All these shows that automobile manufacturers and consumers have similar awareness of intelligent vehicles. For automotive manufacturing enterprise, intelligent vehicles performance improvement means the improvement of industries' overall level and the diffusion of intelligent technology, lifting the technical cost factors that restrict the development of intelligent vehicles. For consumers, intelligent vehicles performance improvement means more comfortable driving experience and more economical consumption. Therefore, improving the overall technical level of the industry can improve intelligent vehicles performance, while encouraging the automotive manufacturing industry to manufacture intelligent vehicle and consumers to buy intelligent vehicle.

6. Recommendations

China is currently in the initial stage of intelligent vehicle development, the influence factors analysis of consumer choice behavior is an important means and way to promote intelligent vehicles performance and enhance intelligent vehicles marketization. Based on the model construction analysis and research empirical results, this paper proposes the following recommendations:

To enhance automobile manufacturing industry's enthusiasm for manufacture intelligent vehicle, the government can further expand and perfect the incentive measures on the basis of existing incentives policy to raise the revenue expectation of automobile manufacturing enterprise. At present, China has implemented tax relief, financing concessions and other policies, but if there is a targeted R&D investment and related social capital guidance, it can better stimulate automotive manufacturing enterprise to develop intelligent vehicle. First, improve intelligent vehicle development plan, financial and tax support

mechanism, financing support system, management system and market incentives and competition mechanism, by properly arranging the relationship of rights and responsibilities of market players(such as intelligent vehicle manufacturers, market investors, research institutions, central government departments and other players in the smart car Industry chain),to promote the effective link of all sectors in the smart car industry chain, and strive to eliminate the institutional and institutional barriers affecting intelligent vehicles development. Second, in policy formulation, pay attention to improve the interaction of industrial development planning vision and the actual development of intelligent vehicles industry. Finally, in order to cope with the collaborative development characteristics of intelligent vehicle industry, we should actively promote cross-cutting cooperation, such as actively developing various network interconnection, developing car networking technology, increasing the convenience, comfort, safety and fast performance of intelligent driving, improve the overall penetration level of intelligent vehicles.

Intelligent vehicles quality performance aspects, In terms of short-term development, decision-makers can focus on upgrading the technical industrialization and after-sales service level, improve the safety of intelligent vehicles, reduce the unneeded for intelligent equipment, reduce vehicle manufacturing costs. To this end, we should first increase R&D investment, etc., to improve the intelligent vehicle customization, personalized domestic production capacity; Second, strict control product quality, improve the reliability of intelligent vehicle equipment and key components, and reduce technical failure. In terms of medium-term development, policymakers should focus on the improvement of R&D capacity and infrastructure. At present, the main parts or accessories needed for intelligent vehicles must be imported from overseas, and the core technology of independent intellectual property rights lacking. Therefore, the innovation system of intelligent automobile industry should be established, which is guided by the government, led by the market, take enterprises as the main body, and close cooperation between government, industry, University and research institutions. Government should continue to play a role In promoting intelligent vehicle technology demonstrations and standardizing technical standards and providing R&D funding support. On the other hand, due to the imperfect infrastructure, many highway information intelligent construction lags behind and did not form a real automatic driving. Through the establishment of a perfect navigation database, equipped with road real-time status system and other ways to solve the problem, the government can provide financial assistance in infrastructure construction.

In terms of consumer behavior, it is influenced by consumption habits and cognitive psychology obvious. Therefore, if we want to encourage consumers to increase the purchase of intelligent vehicle, we must reduce intelligent vehicle *perceived cost* first. Perceived cost is often reflected in the time, energy, physical strength, money and other transaction costs that consumers spend on intelligent vehicle, as well as the subjective feelings after consumer use. When consumers *perceived cost* is high, they often do not choose to buy intelligent vehicle, or transfer to buy another vehicle, on the contrary, when the consumer *perceived cost* is low, they often willing to choose to buy and use, even will actively recommend and share with others in the future.

Acknowledgments

This work was partially supported by Planning of Shanghai soft science (No. 17692103800; No. 18692104400).

References

1. AlAM K.M., SAINI M., 2015, Toward social internet of vehicles: Concept, architecture, and applications, in: *IEEE Access*, No.3, pp.343-357.
2. AJZEN I, FISHBEIN M., 1980, *Understanding Attitudes and Predicting Social Behavior*, Englewood Cliffs, Prentice-Hall, NJ.
3. BELK R.W., 1975, Situational Variables and Consumer Behavior, in: *Journal of Consumer Research*, Vol 2 , No. 3, p.157-164.
4. CRESWELL J W., 1995, *Research design: Qualitative and quantitative approaches*, Thousand Oaks, Sage, CA, p.117- 178.
5. DAI Y.F., Li K.Q., 2015, Analysis of the status quo and development trend of automotive intelligent network, in: *The automobile manufacturing industry*, vol.18, No.1, p.14-17.
6. DING X.H., 2014, *Smart Grid Key Technology Series: Smart Grid and Electric Vehicle*, Electric Power Press, Beijing, China.
7. GIBSON T., 2015, Virginia's Smart Road: Where Researchers Make the Extreme Weather, in: *Weatherwise*, Vol. 68, No. 4, p. 20-27.
8. HEVELKE A., 2014, Responsibility for Crashes of Autonomous Vehicles: An Ethical Analysis, in: *Science and Engineering Ethics*, Vol. 17, No. 1, p. 41-52.
9. KOTLER P.G., WONG V., 2008, *Principles of Marketing*, 5th European ed.,Prentice Hall Europe, Harlow.
10. LI K.Q., 2015, Enterprise Network and Technology Transformation of Future Car, in: *Science Chinese*, Vol. 10, No.1, p.40-48.
11. McDONALD P., 2002, Principles and practice in reporting structural equation analysis, in: *Psychological Methods*, No.7, p.64-82.
12. MEYER G., 2014, Bosch's Vision and Roadmap Toward Fully Autonomous Driving, Road Vehicle Automation, in: *Springer International Publishing*, Vol. 22, No. 2 , p. 49-59.

13. MEYER G.., 2014, City Mobil2: Challenges and Opportunities of Fully Automated Mobility, in: *Road vehicle Automation*, Springer, Vol. 22, No. 4, p. 169-184.
14. ORSATO R,J, WELLS P., 2007, The Automobile Industry & Sustainability. in: *Journal of Cleaner Production*, vol. 15, no 11, p. 989-993.
15. PODSAKOFF P.M.,ORGAN D.W., 1986, Self-reports in organizational research: Problems and prospects, in: *Journal of Management*, Vol. 12, No. 4, p. 531-544.
16. RODRIGO G.V., JOAO A.P., GUO C.L, 2014, *International electrical engineering advanced technology translation: electric cars into the modern power grid*, Machinery Industry Press, Beijing.
17. SELIGER G., 2007, Sustainability in Manufacturing. in: *Recovery of Resources in Product and Material Cycles*, Springer.
18. SERRA J.V.F., 2013, *Electric Vehicle Technology, Policy and Market*, Mechanical Industry Press, Beijing.
19. TEECE D.J., 2010, Business models, Business strategy and innovation, on: *Long Range Planning*, Vol 43, No. 2, p.172-194.
20. WEIß C., 2011, V2X communication in Europe–From research projects towards standardization and field testing of vehicle communication technology, in: *Computer Networks*, Vol. 55, No. 12, p. 3103-3119.
21. XU K., XU N., 2015, A global perspective on the development path of intelligent network, in: *Chinese automobile industry review*, No. 9, p. 14-23.
22. XU N., 2015, Internet +boost the auto industry intelligent transformation, in: *Industry*, No. 4, p. 34-43.