



**Master Dissertation in Engineering** 

# Analyzing consumers' purchasing intention of self-driving vehicle and vehicle equipped with ADAS

- Using technology acceptance model -

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Graduate School of Seoul National University Technology Management, Economics, and Policy Program

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# Analyzing consumers' purchasing intention of self-driving vehicle and vehicle equipped with ADAS

- Using technology acceptance model -

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## 조해송

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## Abstract

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Self-driving vehicle is regarded as future trend of vehicle. However not all new technology are accepted in the market at the beginning. People feel more ease, useful, fun and trust on previous technology. This is same in self-driving vehicle. This study try to figure out the structure of decision making when people purchase vehicle. Technology Acceptance Model was adopted and additional explanatory variable are selected considering vehicle usage context. Based on the standard of autonomy level of vehicle suggested by NHTSA, we made level 1 to 4 survey questionnaires respectively.

The result shows that people perceive that self-driving vehicle(level 3, 4) is less ease of use, useful, trustable and enjoyable that manual driving vehicle(level 1, 2). Perceived

enjoyment and Trust are the main factor affecting consumers' purchasing intention of self-driving vehicle. Moreover the person who has high personal innovativeness are more willing to buy self-driving vehicle. Personal innovativeness and Gender moderate the perceived enjoyment and perceived usefulness respectively in level 2 and 4.

From this research, it can give managerial implication for vehicle companies how to prepare self-driving vehicle. Furthermore, this study give a guideline for future selfdriving vehicle research or TAM research in vehicle context.

Keywords: Self-driving vehicle. Technology acceptance model, ADAS, Perceived enjoyment

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## Chapter 1. Introduction

#### 1.1 Motivation

Vehicle is highly related with people's daily life.(Thrun, 2010) Therefore, development of vehicle technology directly changes society. After Henry ford produce Model T, which made automobile popular in 20<sup>th</sup> century, vehicle is now facing revolutionary change. This change is the shift to self-driving vehicle.

After vehicle was first made, automobile companies have put a great deal of effort to make more safe and convenient vehicles. They focused not only on the hardware part of the vehicle but also on the software part, also known as advanced driver assistant systems(ADAS). Vehicle has different level of vehicle autonomy depending on how ADAS is combined in that vehicle. The final destination2015(from now on) of autonomy is full self-driving automation.(NHTSA, 2013)

However, new high technology does not always lead to immediate public acceptance. According to the research done by Sheth(1979), although new high technology receive a wide range of attention from the mass media, the fact that the public are reluctant to accept the technology is another matter.

From the research done by Brookhuis and deWaard(2006), Schaller et al(2008), it has been shown that people have positive view on ADAS applied car. On the other hand in the research of Eckoldt, Knobel, Hassenzahl and Schumann (2012), Hoedemaeker(1996), Helldin, Falkman, Riveiro and Davidsson(2013), people also express concerns on self-driving vehicle.

According to the theory of reasoned action(TRA) and technology acceptance model(TAM), people's belief and perception about the technology is highly related to the acceptance of technology. (Davis, 2000) Therefore, in order to find the amount of acceptance people express on self-driving vehicle, we should investigate people's perception on the technology. Moreover, by using the knowledge on psychological structure and relationship between belief and acceptance, adjustment on design, functional, and marketing strategy of self-driving vehicle can be made to attract consumer's attention and thus effectively increase purchasing intention of potential buyers.

#### **1.2 Problem Description**

Among many research done on self-driving vehicle, some of them focus on how people perceive about it. Even though controversial ideas about self-driving vehicle exist, non investigate what is the major factor that affect people's acceptance on self-driving vehicle.

Technological shift to the self-driving vehicle is not a radical innovation but an incremental innovation based on evolution of ADAS. Thus, more appropriate approach of research requires investigation on progressive development of vehicle instead of parochial focus on the complete self-driving automation technology itself. According to the guide line of National highway traffic safety administration(NHTSA, 2013) on the

vehicle, level of vehicle autonomy can divided into five different levels rated from 0 to 4.(NHSTA, 2013) Level 4 refer to fully automated vehicle, also known as "self-driving vehicle". Under level 4, incremental progress of vehicle can be seen by development of ADAS. Many research about self-driving vehicle only focus on level 4 of vehicle autonomy. We need to note that before fully automated vehicle became popular, there are more possibility that low autonomy level of vehicle is adopted in the market. So it is important to know consumers perception about all level of vehicle autonomy.

Furthermore, acceptance of high-tech product can appear differently based on demographic information of consumer such as gender, family structure and personal innovativeness. (Rodel et al, 2014; Venkatesh et al, 2003; Agarwal & karahanna, 2000) This is in correlation with the fact that vehicle is essential part of daily life and it can be differ by personal life style. Therefore, it can be deduced that demographic information influence acceptance of vehicles. This is main interest for the market of vehicle companies because it can be useful information of market segmentation.

#### **1.3 Research Objective**

To fill this gap and deficiency of self-driving vehicle research, this study will investigate what factor affects the acceptance of 4 different level of vehicle autonomy. Level 0 was excluded from the subject because it refers to the first version of vehicle and not used frequently in now 21<sup>st</sup> century.(Rodel et al, 2014)

Following are the research questions that should be dealt:

**RQ1** : In 4 level of vehicle autonomy, which factor of consumer' belief affect the consumer's purchasing intention?

**RQ2** : Which consumer characteristics affect the consumer's purchasing intention in 4 level of vehicle autonomy?

Review of literature and conduction of survey to back up the literature review and find the empirical evidence is required to solve these questions.

## **Chapter 2.** Literature Review

#### 2.1 Self-driving vehicle

NHTSA made the criteria of the level of vehicle autonomy considering how ADAS is combined in the cars. It is divided into 5 levels.

Level 0 refers to 'no automation', a concept where an automobile has only hardware device but not softwared assistance that can help driver to be safe and convenient.

Level 1 is known as 'functioned automation', a concept where a vehicle has one or two assisting devices for driver. Navigation system, automatic speed controller(Cruise control) and parking aid are common examples. It has recently been a form of universal vehicle in our society. Level 2 is 'combined function automation'. Additional hightechnology systems, such as lane departure warning system, collision avoidance system, automated parking system, traffic sign recognition system have been added. Compared to level1, level 2 has such features added and thus refers to more advanced vehicle. Level 3 is 'limited self-driving automation' or 'partial self-driving automation'. From this level, a vehicle can be considered as self-driving vehicle. However, its operation is limited only in certain conditions such as highway, where driving is easier than driving in the city. Level 4 is 'full self-driving automation'. In this level, driver does not have to put any effort to reach a particular destination.(NHTSA, 2013) So far, the frontier self-driving vehicle companies like Tesla, Google, BMW have reached level 3. (Kim, 2017)

Several researches have investigated how people think and perceive about vehicle with ADAS and self-driving vehicle. Research of Rodel et al.(2014) shows the relationship between the level of vehicle autonomy and how people perceive its user acceptance(UA) and user experience(UX). There are variables of perceived ease of use(PEOU), attitude towards using the system(ATT), perceived behavioral control(PBC), behavioral intention to use the system(BI), trust(T) and fun(F). Furthermore, it also took note of how responders' characteristics such as driving frequency, age and gender affect UX and UA. It shows that people usually have positive reputation on autonomous vehicles. But UA and UX(T, F) are highest in the level that is most frequently applied nowadays, Level 1. As the level of vehicle autonomy increases, safety and convenience are also increases, so people try to accept it. On the other had, UA and UX declined as the level of vehicle autonomy rises. Also, there was a significant effect of demographic information on UX and UA. The limitation of this research is that it does not take account of the structural relationship between user's perception(UX) and User acceptance but only analysis it separately.

Another research done by Kyriakidis and Happee (2014) has done an international survey data with 5000 responders. It finds that personality trait, income, mileage are important factors on user acceptance, concerns and willingness to buy. It also shows that people feel manual driving (non-automated vehicle) more enjoyable than automated driving. Most people worry about hacking and cybersecurity issues. The unique point of this study is that it considers the additional factor: price of automated vehicle. Most responders have positive attitude on automated vehicle, but when the condition that the market price of automation goes up to \$3000 was shown to the respondents, positive responses declined to 20%.

The limitation of this research is that it does not consider the level of vehicle autonomy but only investigates fully automated vehicles. As aforementioned, fully automated vehicle has not yet been released, and change towards automated vehicle is an incremental process. There is certainly a gap between currently released vehicle and ideal fully automated vehicle.

It is important to understand the relationship between user's psychological perception and user's acceptance. So in this research we bring technology acceptance model to figure out this structure.

#### 2.2 Technology Acceptance Model(TAM)

Technology acceptance model(TAM) is first developed by Davis in 1989 to

explain acceptance of information system. TAM is often compared with theory of reasoned action(TRA; Ajzen & Fishbein, 1975) and Theory of planned behavior(Ajzen, 1985). These models give a good framework to understand how people's belief, attitude, behavioral intention affect acceptance of information system and high-technology product based on psychosocial theory.

#### 2.2.1 Traditional TAM

Especially in TAM, it assumed that perceived usefulness and perceived ease of use are the main factors on users in accepting information system. Perceived usefulness is defined as "the degree to which a person believe that using a particular system would enhance his or her job performance" and perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis 1989). After TAM is first introduced, various follow-up studies were done by many researchers because of its simplicity of structure of structure and high scalability.(You & park, 2010)

#### 2.2.2 Variable expansion of TAM

Research regarding TAM try to extend following 3 point of view(osswald et al, 2012) One is introducing variables from similar model. The second is introducing related belief factors. The third is finding former factor that can have effect on existing variables or adopting moderators on TAM model.

Davis(1989) adopt self-efficiency theory and diffusion of innovation theory on his previous work. Adams, Nelson and Todd (1992) focus on how user's pre-experience, characteristics, expertise could affect technology acceptance by doing replication research of Davis. Agarwal and karahanna(2000) made model that describes the effect that personal innovativeness and playfulness can have on cognitive absorption of technology and it finally affect behavioral intention to use.

#### 2.2.3 Variety focus of TAM

TAM expands the scope of research on variety of information system. Its application is not only limited to hardware product like PC(Davis 1989, Igbaria et al, 1997) and smartphone(park & chen 2007) but also software products such as WWW service(Agarwal & karahanna, 2000 ; Moon & Kim 2001), E-shopping(Lim, 2012) and mobile banking(Luarn & Lin, 2005;).

In such kind of expansion, additional variable should be taken into account in TAM considering specificity and context of product.(Moon & Kim, 2001). Davis also mentioned that research on technology acceptance model should consider other variable that may affect on usefulness, ease of use and user acceptance.(Davis, 1985)

There are some researches that applyied TAM on ADAS and self-driving car. Research of Osswald, Wurhofer, Trösterer, Beck and Tscheligi (2012) studied acceptance of technology in the context of vehicles. It gives theoretical explanation on driver's receptiveness of in-car technology. According to the paper, in the context of vehicles, there are potential risks when compared with computer or order information system. Based on the traditional TAM, the paper involved safety and anxiety factor and proposed car technology, acceptance model(CTAM)

#### 2.2.4 Perceived ease of use and Perceived usefulness

Based on these literatures, this paper will introduce new factor that can affect technology acceptance of vehicle with ADAS and self-driving vehicle. First, according to traditional TAM introduced by Davis(1989), perceived ease of use(PEOU) and perceived usefulness(PU) should be included as independent variables. It is uncontroversial to apply traditional concept of PEOU to this field, but PU in the context of vehicle differs from that used in information system. In information system, PU is measured based on following question: "How does this information system improve your working productivity" In the vehicle context, Defining productivity of vehicle is important. According to aforementioned research, people's expectation on performance of ADAS added vehicle and self-driving vehicle is "To reach a destination safely" (Osswald et al, 2012). According to the report from NHTSA, 94% of serious car accident is due to human mistakes, and thus automated vehicle can be solution of this problem.(NHTSA, 2013) Anderson, Nidhi, Stanley, Sorensen, Samaras and Oluwatola(2014) also mentioned that automated driving system can be possible troubleshooter of accident by increasing safety on road. Moreover, Howard and Dai(2014) claimed that automated driving system are useful in reducing accident and traffic congestion. Furthermore Thrun(2010) argued that robotic cars will increase driver's safety significantly. Therefore, in this research we assumed that PU as enhancement on safety by using ADAS and self-driving vehicle.

Considering these literature, we assume that perceived ease of use and perceived usefulness have positive influence on purchasing intention of self-driving vehicle.

H1 : Consumer's perceived ease of use of vehicle will positively influence purchasing intention toward vehicle. (Davis, 1989)

H2 : Consumer's perceived usefulness of vehicle will positively influence purchasing intention toward vehicle. (Davis. 1989 ; Osswald et al, 2012)

#### 2.2.5 Perceived enjoyment

It is possible to find that, in a wide range of researches on vehicle and selfdriving vehicle, researchers assumed that enjoyment as an important factor in vehicle. Rodel et al. (2014) investigated how people feel enjoyment as the degree of vehicle autonomy changes. In addition, in study of Kyriakidis and Happee(2014), they asked whether people regard automated vehicle as more enjoyable product when compared to manual driving. The result shows that respondents claimed that manual driving is more enjoyable.

Not only research of self-driving vehicle, but also in TAM research, enjoyment is assumed to be the important factor that affect acceptance of technology. Davis, in his 1992 paper applied enjoyment from psychology to explain computer usage. In this study, enjoyment had significant effect one usage intention, and the relationship between enjoyment and usefulness was found. This relationship suggests that if people enjoy it, they regard it useful. Study of Agarwal and Karahanna(2000) also regard enjoyment(in that paper playfulness) as a fundamental factor that affect intention to use.

Therefore, in this research we have involved perceived enjoyment on driving as positive factor of intention to use self-driving vehicle.

H3 : Consumer's perceived enjoyment of vehicle will positively influence purchasing intention toward vehicle. (Davis, 1992 ; Agarwal & Karahanna ,2000)

#### 2.2.6 Trust

Another factor called trust is important in vehicle because driving is always along with risky situation and reliability of function of vehicle should be guaranteed.(Rodel et al, 2014) Study of Rodel et al.(2014) also investigate on the amount of trust people have on different level of vehicle autonomy. Result shows that level 1 of autonomy is regarded as the most trustable vehicle, and as the level increases, people's trust decrease. Possible explanation for such phenomenon is that people tend not to trust new technology which they have no experience. The main reason for negative perception on ADAS or vehicle related system is that people do not trust this new technology.(Da waard et al, 1999 ; Helldin et al, 2013) Pavlou(2003) brings trust in TAM model to explain acceptance of e-commerce. Trust influences the motive to transact both directly and indirectly by affect PU, PEOU and perceived risk.

In this research, trust is regarded as direct possitive factor on behavioral intention to use vehicle.

H4 : Consumer's Trust of vehicle will positively influence purchasing intention toward vehicle. (Pavlou et al, 2003 ; Rodel et al ,2014)

#### **2.2.7 Information security**

Self-driving vehicle is based on information technology and there is a concern that the system can be hacked by external agent.(Schoettle & Sivak, 2014). Kyriakidis and Happee(2014) figured out that people are most anxious on software hacking problem in automated vehicle. Therefore, information security of vehicle can be new variable that can be involved in TAM.

H5 : Consumer's Information security of vehicle will positively influence purchasing intention toward vehicle. (Pavlou et al, 2003 ; Schoettle & Sivak, 2014)

#### 2.2.8 Gender, Marriage, Personal innovativeness

Characteristics of users like personal innovativeness, gender, marriage can influence acceptance of vehicle with ADAS and self-driving vehicle both directly and indirectly.(Agarawal & Karahanna, 2000).

These variables are used as moderators of PU, PEOU, Enjoyment, Trust, information security.(Venkatesh et al, 2003 ; Osswald et al, 2012)

H6 : Influence of Consumer's belief on vehicle will be moderated by gender, marriage and Personal innovativeness. (Venkatesh et al, 2003 ; Osswald et al, 2012 ; Agarawal & Karahanna, 2000)

## Chapter 3. Methodology

#### **3.1 Research Model**

In this research, we adopt technology acceptance model in explaining vehicle with ADAS and self-driving vehicle. There are 5 level of vehicle autonomy from level 0 to level 4 proposed by NHTSA. But in level 0 do not exist in current days so it is out of our interest. Based on traditional TAM introduced by Davis(1989) we add some variables considering context of driving vehicle. Independent variables are Perceived ease of use(PEOU), Perceived usefulness(PU), Perceived enjoyment(PE), Trust(T) and Information security(IS). And dependent variable is Purchasing intention of vehicle which present technology acceptance. Gender(GEN), Marriage(MAR) and Personal innovativeness(INNO) are used as moderator which affect explanatory power of dependent variables on independent variable. This application of TAM will be done in respectively 4 level of vehicle. As aforementioned, level 1 and 2 are just including 3 or 4 function of ADAS, while level 3 and 4 have partially and fully automated function. After analysis, we can get the result of 4 level of vehicle autonomy. For each level, we can figure out what consumer's belief factor significantly affect consumer's behavioral intention. Moreover comparison as the level of vehicle autonomy increase can be possible.

The research model (figure 1) shows structure of research and analysis.



Innovation level of Self-driving vehicle : Level 1~4

Figure 1. Research model of study

#### 3.2 Variables

In this study, we bring definition of each variables from previous research on

technology acceptance model. Purchasing intention is from research of Davis(1989), and used as dependent variable. It means consumer's willingness to buy certain level of vehicle. Perceived usefulness is from traditional explanatory variable of technology acceptance model.(Davis, 1989) And we defined it as belief of additional benefit of safety using self-driving vehicle.(Osswald et al, 2012) Perceived ease of use is defined as 'belief that using such technology do not require additional efforts.(Davis, 1989) Perceived enjoyment is newly adopted variable in this research. We define perceived enjoyment as 'belief that using such technology gives joy and fun'. Trust is people believe that this technology will work without making trouble. And information security is defined as 'belief that system is secure from attack of hacking.(Schoettle & Sivak, 2014; Kyriakidis & Happee, 2014)

Туре	Variable	Definition	Reference
Dependent	Purchasing intention	Willingness to buy and adopt it	Davis, 1989;
– Independent –	Perceived usefulness	Belief of additional benefit that increase productivity of there work. In this case additional safety.	Davis, 1989; Osswald et al, 2012;
	Perceived ease of use	Belief that using such technology do not require additional efforts.	Davis, 1989;
			Davis, 1992;
	Perceived enjoyment	Belief that using such technology give joy and fun.	Rodel et al, 2014; Agarwal & karahanna, 2000; Kyriakidis and
			ix yr fakturs and

 Table 1. Variables in this study

	Trust		Rodel et al, 2014;
		Belief that this technology will work	1999 :
		without making trouble	Helldin et al, 2013 ;
			Pavlou, 2003
	Information	Belief that system is secure from attack	Schoettle & Sivak,
	security		2014 ; Kyriakidis &
		of nacking.	Happee, 2014
Moderator	Gender	Mala/Famala	Venkatesh et al,
		Mate/Female	2013
	Marriage	Single/Married	
	Personal		Agarwal &
	innovativeness		karahanna, 2000

#### 3.3 Data collection

Survey was construct to verify the research model by empirical data. It is consist with single item questionnaire for each dependent and independent variables. Because there are 4 level of vehicle autonomy and each level should be measured respectively. So we try to make survey with highly reliable items in reference to previous studies. Reliability test was computed to assure it rigidity. All items regarding variables are 5point Likert scale for the convenience of research and reliability test.

The data were collected from 335 samples from online surveys, the participants

of which ranged in age from 20 to 60; the data were distributed uniformly by age and gender groups. So it is hard to say that it represent general Korean population. Also we do not consider the location of responder. This is weakness of this research and should be improved later. The target participants for the survey were individuals who were willing to buy a car within 10 years and had a driver's license. Macromill Embrain who is professional survey agency in seoul took a survey in April.

Below table 2 shows how questions are written for each variables and its source. **Table 2.** Variables and survey questionnaires

Туре	Variable	Question	Reference	
Dependent	Purchasing intention	Willingness to buy and adopt it	Davis, 1989;	
		When using this level of vehicle, is it		
	Perceived	reliable to assure your safety from	Davis, 1989;	
	usefulness	unexpected situation(Bad weather	Osswald et al, 2012;	
		condition, accident)?		
-	Perceived	Is this level of vehicle autonomy felt	D	
	ease of use	complex for you to use?	Davis, 1989;	
-			Davis, 1992;	
Independent _			Rodel et al, 2014;	
	Perceived	Is this level of vehicle autonomy felt fun	Agarwal &	
	enjoyment	for you to use?	Karahanna, 2000;	
			Kyriakidis &	
			Happee, 2014	
			Rodel et al, 2014;	
		Do you feel this level of vehicle	Da waard et al,	
	Irust	autonomy reliable?	1999 ;	
			Helldin et al, 2013;	

Pavlou, 2003

	Information	Are you worried about this level of	Schoettle & Sivak,
	security	vehicle whether have security problem	2014 ; Kyriakidis &
		like hacking?	Happee, 2014
Moderator	Gender	Mala/Formala	Venkatesh et al,
		Male/Female	2013
	Marriage	Single/Married	
	Personal		Agarwal &
	innovativeness		Karahanna, 2000

The simple demographic information of responders is expressed in table 3 and 4. Male and Female are equally distributed by almost 50% and Age from 20 to 70 are also equally distributed by 25%. Married people are 65% of all respondent. And in personal innovative, it follows similar shape of innovation adoption curve suggested by Rogers(2010).

**Table 3**. Descriptive statistics for responder demographics

01				
Obs	Mean	Std. Dev.	Min	Max
334	1.515	0.501	1	2
334	40.057	10.809	22	69
334	1.653	0.477	1	2
334	0.76	0.632	0	2
224	2 1 5 2	1.002	1	E
334	3.153	1.003	1	5
	Obs           334           334           334           334           334           334           334           334	Obs         Mean           334         1.515           334         40.057           334         1.653           334         0.76           334         3.153	ObsMeanStd. Dev.3341.5150.50133440.05710.8093341.6530.4773340.760.6323343.1531.003	ObsMeanStd. Dev.Min3341.5150.501133440.05710.809223341.6530.47713340.760.63203343.1531.0031

Div	vision	Frequency	Percent rate(%)	Definition
Candan	Male	162	48.5	Female=0
Gender	Female	172	51.5	Male=1
	20-29	82	24.55	Age group 20-29 = 2
-	30-39	82	24.55	Age group 30-39 = 3
Age	40-49	86	25.75	Age group $40-49 = 4$
_	50-59	67	20.06	Age group 50-59 = 5
	60-69	17	5.09	Age group $60-69 = 6$
M	Single	116	34.73	Signgle = 0
Marriage	Married	218	65.27	Married $= 1$
	Innovator	13	3.89	Innovator = 5
	Early adopter	71	21.26	Early adopter $= 4$
Personal	Early Majority	138	41.32	Early Majority = 3
innovativeness –	Late Majority	76	22.75	Late Majority = 2
	Laggard	36	10.78	Laggard $= 1$

Table 4. Distribution of responders depending on demographic information

The concept of Personal innovativeness is from innovation diffusion theory. (IDT; Roger, 2010) In this research if responder think that "I try to use new product when it is first released in market", he(or she) is 'Innovator'. If responder think that "I'm interested in new product and I usually buy it before people buy it", he(or she) is 'Early adopter'. If responder think that "I usually buy new product when many people buy it", he(or she) is 'Early majority'. If responder think that "I buy new product after many people buy it", he(or she) is 'Late majority'. If responder think that "I'm reluctant to buy new product even after many people buy it", he(or she) is 'Laggard'. From this demographic information, we can divide responders by 4 criteria, gender, age, marriage, personal innovativeness. In this research, we only use 3 criteria, gender, age, personal innovativeness to find out moderating effect.

#### **3.4 Method of Analysis**

In general Technology acceptance model, regression analysis, structural equation and Partial Least Squares are used as methodology.(You & park, 2010) When verifying simple causal relationship, regression analysis is commonly used. Davis (1989) and Luarn and Lin (2007) also use regression analysis in their research of TAM. When there are complex intermediary cause and complex model, regression are not enough to analyze. In this case, structural equation is better methodology than regression. When we use structural equation, we can evaluate suitability of model, explanation power of each variables and complex relationship between factors. When there are not enough samples, partial least squares can be used. In this case only causal relationship can be verified not suitability of model.

In this study, we only use simple causal relationship between consumer's belief and purchasing intention. Moreover, we have enough samples, so regression analysis is the best methodology for our research. Multiple regression analysis and Moderated regression analysis are adopted to verifying model and find the relation between consumer's belief(independent variables), consumer's behavioral intention(dependent variable) and characteristics of consumer(moderators). Statistical analysis package IMB SPSS 23 are used in regression analysis in this study

#### 3.4.1 Multiple regression analysis

Multiple are used when there are one dependent variable and two or more explanatory variables. In here there are 5 consumer's belief factor which are candidates for being explanatory variables of consumer's behavioral intention. There are many studied which use multiple regression analysis as analysis methodology in TAM research.(Lim, 2012; Moon & Kim, 2001; Pavlou et al, 2003)

Multiple regression equation is in below

 $PI = \beta_{0i} + \beta_{PEOUi}PEOU + \beta_{PUi}PU + \beta_{Pei}PE + \beta_{Ti}T + \beta_{Isi}IS + \varepsilon$ 

Where i stands for autonomy of level, from 1 to 4

*PI* = *Purchasing Intention* 

*PEOU* = *Perceived ease of use* 

PU = Perceived usefulness

*PE* = *Perceived enjoyment* 

T = Trust

*IS* = *Information security* 

We will compare each level of vehicle autonomy which explanatory variable shows significant and there standardized coefficients to see the main factor of purchasing intention.

#### 3.4.2 Moderated regression analysis

Moderated regression analysis is frequently used in psychology studies.(Baron & Kenny, 1986) Some TAM studied(Shin et al, 2008 ; Venkatesh et al, 2003) adopt moderating effect to analyze characteristics of responders. Moderators regulate the effect of independent variables on dependent variable. Therefore it seems that moderator changes the coefficient of independent variable. In figure 2 helps understanding moderating effect.



Figure 2. Effect of moderator

Gender affects the slope between perceived usefulness and purchasing intention. so it can be interpreted that for male, perceived usefulness is more influential factor that affect purchasing intention compared with female.

Moderators are used in regression analysis by modified as interaction term. If R<sup>2</sup> of regression equation increase when moderator are involved in equation, it is possible to

say that there is moderating effect. Moreover we can figure out how moderator effect on equation by looking coefficient of interaction term.

## Chapter 4. Analysis Result

#### 4.1 Data quality

#### 4.1.1 Reliability test

To verify consistency of survey data, reliability test was computed. Cronbach's alpha which is based on correlation of items is used to show reliability. If Cronbach's alpha is around 0.7, it can be regarded the items as reliable. In the table 5 show, cronbach's alpha of Consumer's belief for each level of vehicle. Initial cronbach's alpha when all item's are included shows low. After eliminated some of items that can possibility to increase cronbach's alpha, **all value exceed 0.6 and almost 0.7**.

	Before elimination		After elimination	
Level	Items	Cronbach's alpha	Items	Cronbach's alpha
	Consumer's belief		Consumer's belief	
Level 1	(PEOU, PU, PE, T,	0.476	(PU, PE, T)	0.604
	IS)		eliminate PEOU, IS	
	Consumer's belief		Consumer's belief	
Level 2	(PEOU, PU, PE, T,	0.526	(PU, PE, T)	0.714
	IS)		eliminate PEOU, IS	

	Consumer's belief			
Level 3	(PEOU, PU, PE, T,	0.520	(PU, PE, T)	0.688
	IS)		eliminate PEOU, IS	
	Consumer's belief		Consumer's belief	
Level 4	(PEOU, PU, PE, T,	0.588	(PU, PE, T, IS)	0.684
	IS)		eliminate PEOU	

#### 4.1.2 Correlation analysis

Correlation analysis is required to find out relationship between variables. In all level of vehicle autonomy, all correlation values are under 0.7. And all variance inflation factor(VIF) used in diagnosis of multi-collinearity are all below 10. So that we can assure that **there is no multi-collinearity problem**.

#### 4.1.3 Character of residual

In all regression model, Durbin-watson values are around 2 which means that residual is **independent**. **Normality** and **homoscedasticity** are also tested from SPSS statistics package.

#### 4.2 Simple mean comparison analysis

There are simple mean value comparison between level of vehicle autonomy in

Table 6.

 Table 6. Simple mean comparison analysis

level	PEOU	PU	PE	Т	IS	PI
-------	------	----	----	---	----	----

1	3.34	3.16	3.38	3.47	3.20	3.44
2	3.07	3.26	3.51	3.33	2.81	3.45
3	2.97	2.99	3.40	3.03	2.48	3.22
4	2.93	2.84	3.41	2.87	2.28	3.05

Perceived ease of use and Trust as level goes higher. It shows similar result with previous studies(Eckoldt et al, 2012 ; Helldin et al, 2013) Information security also decrease for the automated vehicle. This is also consistent with study of Kyriakidis and Happee.(2014) Perceived usefulness and Perceived enjoyment show highest in level 2 which is non-automated vehicle but equipped with 3-4 ADAS. Research of Kyriakidis and Happee(2014) also shows that responders are most enjoyable in manual driving than automated driving. Until now people are more prefer to buy non-automated vehicle (level 1, 2) than automated vehicle (level 3, 4).

Table 7 compare Male and Female about mean value of variables.

Level	Gender	PEOU	PU	PE	Т	IS	PI
1	Male	3.44	3.17	3.36	3.51	3.31	3.43
1	Female	3.24	3.16	3.41	3.44	3.09	3.46
2 -	Male	3.21	3.25	3.48	3.38	2.98	3.50
	Female	2.94	3.26	3.55	3.28	2.65	3.41
2	Male	3.02	3.07	3.36	3.03	2.62	3.30
3 -	Female	2.92	2.92	3.44	3.03	2.35	3.15
4 -	Male	2.98	2.94	3.47	2.96	2.35	3.30
	Female	2.88	2.74	3.35	2.78	2.22	2.82

 Table 7. Comparison between genders

Male are more prefer automated vehicle compared with female. On the other

hand, Female are more willing to buy vehicle equipped with ADAS. This is similar result with Rodel et al(2014) but different result with Piao et al(2005) that said female ar more willing to adopt self-driving vehicle than male.

#### 4.3 Multiple regression analysis

In multiple regression analysis in SPSS 23, backward elimination was applied. So if some variable are not significance or problem with multi-collinearity, that variables are eliminated in regression model. We investigate into change towards level of vehicle autonomy.

Model	$\mathbf{P}^2$	adjusted	Variables	D	s o P	Q	significance
WIGUEI	ĸ	$\mathbf{R}^2$	variables	Б	s.e. d	þ	probability
			Const	0.526			
			PEOU	0.136	0.040	0.155*	0.021
Level 1	0.265	0.259	PU	0.112	0.043	0.121*	0.010
	0.365	0.358	РЕ	0.424	0.052	0.410***	0.000
			Т	0.195	0.057	0.182**	0.001
			IS		no	n-significant	
			Const	0.912			
			PEOU	0.113	0.037	0.136**	0.002
Land 2	0.250	0.252	PU		no	n-significant	
Level 2	0.339	0.555	PE	0.401	0.046	0.430***	0.000
			Т	0.236	0.049	0.238***	0.000
		-	IS		no	n-significant	
Level 3	0.444	0.439	Const	0.674			
	0.444		PEOU		no	n-significant	

Table 8. Multiple regression analysis result

			PU	0.170	0.044	0.185***	0.000
			PE	0.378	0.043	0.408***	0.000
			Т	0.248	0.052	0.242***	0.000
			IS		no	n-significant	
			Const	0.305			
			PEOU		no	n-significant	
T	0.529	0.524	PU	0.140	0.051	0.136**	0.006
Level 4	0.528	0.524	РЕ	0.411	0.046	0.414***	0.000
			Т	0.331	0.059	0.307***	0.000
			IS		no	n-significant	

Note : \* represents p value<0.05, \*\*represents p value<0.01, \*\*\*represents p value<0.001. Standard errors in parentheses

In each level  $R^2$  which means explanatory power of regression model are from 3.5 to 5.3. This means that dependent variables have 35~53% of total explanatory power. This result is acceptable in social science researches.

The impact and significance of dependent variables which affect purchasing intention were shown differ by level of vehicle autonomy. Most impressive result is that perceived enjoyment(PE) are most influential factor on purchasing intention for all level of vehicles. Next rank is Trust variable(T). In 2016 U.S. Initial Quality Study(IQS), Trust(Reliability) ranked top list of purchase factors of car.(Murtha, 2016)

PE and T show significant for all level of vehicle autonomy while IS is not significant. This means that people aware that information security will decrease as level grows up but it is not important factor affecting purchasing intension.

PEOU is not significant in level 3 and 4. It means that people how try to buy automated vehicle, ease of use do not affect on purchasing intention. But in non-automated car with ADAS, ease of use are factor that affect purchasing because they have to drive manually.

While in level 2 PU shows non-significant. According to Table 6, level 2 shows highest PU in all level but it does not connected to purchasing intension.

#### 4.4 Moderated regression analysis

To verify moderating effect of we made interacting term which is production between moderator and independent variables. Above previous regression result, interacting term with moderator and significant independent variable are added.

Figure 9 shows moderated regression analysis result.

Model	Moderator	R <sup>2</sup>	adjusted R <sup>2</sup>	Variables	В	s.e. B	β	significance probability
	Non	0.359		Const	0.912	0.203		
			0.353	PEOU	0.113	0.037	0.136**	0.002
				PE	0.401	0.046	0.430***	0.000
Level				Т	0.236	0.049	0.238***	0.000
2				Const	0.959	0.204		
		0.266	0.259	PEOU	0.116	0.037	0.140**	0.002
	INNO	0.366	0.358 -	PE	0.339	0.057	0.364***	0.000
				Т	0.233	0.049	0.235***	0.000

 Table 9. Moderated regression analysis result

				PE*INNO	0.016	0.009	0.105	0.067	
				Const	0.674	0.161			
				PU	0.170	0.044	0.185***	0.000	
	Non	0.444	0.439	PE	0.378	0.043	0.408***	0.000	
				Т	0.248	0.052	0.242***	0.000	
				Const	0.599	0.163			
Loval				PU	0.159	0.044	0.172***	0.000	
Level 2	GEN	0.453	0.447	PE	0.384	0.043	0.415***	0.000	
3				Т	0.251	0.051	0.245***	0.000	
				GEN	0.161	0.068	0.105       0.067         0.185***       0.000         0.408***       0.000         0.242***       0.000         0.172***       0.000         0.415***       0.000         0.415***       0.000         0.245***       0.000         0.192***       0.000         0.192***       0.000         0.397***       0.000         0.136**       0.000         0.136**       0.000         0.307***       0.000         0.340***       0.000         0.134**       0.000		
				Const	0.472	0.177			
				PU	0.176	0.043	0.192***	0.000	
	INNO	0.456	0.449	PE	0.368	0.043	0.397***	0.000	
				Т	0.235	0.052	0.229***	0.000	
				INNO	0.090	0.034	0.110**	0.008	
			0.524	Const	0.305	0.150			
				PU	0.140	0.051	0.136**	0.006	
	Non	0.528		PE	0.411	0.046	0.414***	0.000	
				Т	0.331	0.059	0.307***	0.000	
				Const	0.393	0.140			
Level	CEN	0.552	0.540	PE	0.419	0.044	0.422***	0.000	
4	GEN	0.553	0.549	Т	0.366	0.049	0.340***	0.000	
				PU*GEN	0.125	0.024	0.196***	0.000	
				Const	0.101	0.174			
				PU	0.137	0.050	0.134**	0.007	
	INNO	0.535	0.530	PE	0.399	0.046	0.401***	0.000	
				Т	0.332	0.059	0.308***	0.000	
				INNO	0.088	0.039	0.085*	0.026	

In the level 2, personal innovativeness moderate effect of perceived enjoyment(PE) on purchasing intention(PI) it means that innovative person regard enjoyment as more important factor on decision of purchasing. In level 3 and 4, personal innovativeness do not have moderating effect but it has direct effect on purchasing intension. It means that innovative person are more willing to buy self-driving vehicle. Gender also have significant both moderating effect and direct effect on self-driving vehicle purchasing. For the level 3, Gender has direct effect on purchasing intention. So male are more willing to buy self-driving vehicle. It is consistent result with research of Rodel et al.(2014) which mentioned men prefer fully automated vehicle. In level 4 Perceived usefulness is moderated by gender. So male regard perceived usefulness as more important factor when purchasing self-driving vehicle than female.

#### 4.5 Hypothesis test

There were 6 hypothesis in this study.

**H1** : Consumer's perceived ease of use of vehicle will positively influence purchasing intention toward vehicle.

**H2** : Consumer's perceived usefulness of vehicle will positively influence purchasing intention toward vehicle.

**H3** : Consumer's perceived enjoyment of vehicle will positively influence purchasing intention toward vehicle.

**H4** : Consumer's Trust of vehicle will positively influence purchasing intention toward vehicle.

**H5** : Consumer's Information security of vehicle will positively influence purchasing intention toward vehicle.

**H6** : Influence of Consumer's belief on vehicle will be moderated by gender, marriage and Personal innovativeness.

Table 10 show whether hypothesis on each level are supported or rejected.

Hypothesis	Level 1	Level 2	Level 3	Level 4
H1	Supported	Supported	Rejected	Rejected
H2	Supported	Supported Rejected		Supported
Н3	Supported Supported		Supported	Supported
H4	Supported Supported		Supported	Supported
Н5	Rejected	Rejected	Rejected	Rejected
		Supported	Rejected	Supported
Н6	Rejected	(INNO)	(Only direct	Supported (CEN)
		(IIIIO)	effect)	(GEN)

Table 10. Hypothesis test

The detail hypothesis results for each level are show in figure 3 to 6.



Innovation level of Self-driving vehicle : Level 1

Figure 3. Hypothesis test result of Level 1

In level 1 of vehicle, perceived ease of use, perceived usefulness, perceived enjoyment, trust shows positive significant. While information security and moderator do not show significant. This is because in the level 1 of vehicle it do not have possibility of hacking of any other cyber-security issue. And in this level it is manual driving so perceived ease of use is important for consumer in purchasing.



Innovation level of Self-driving vehicle : Level 2

Figure 4. Hypothesis test result of Level 2

In level 2, most result shows same but not in perceived usefulness. Level 2 of vehicle is manual driving accompany with ADAS. In this case, people think this level is most useful than any other level and there is no controversial opinion on usefulness. So rather than usefulness another variables determine purchasing intention for the consumer. Perceived enjoyment is moderated by personal innovativeness, it mean that higher innovative person consider perceived enjoyment as more important factor in purchasing level 2 of vehicle.



Innovation level of Self-driving vehicle : Level 3

Figure 5. Hypothesis test result of Level 3

In level 3, perceives ease of use shows non-significant. This means that people do not consider perceived ease of use in purchasing level 3 of vehicle. And even in level 3, information security does not show significant. It is because even in automated vehicle, information security is minor issue for consumer. This is lack of security consciousness of consumer. And in moderator, there is no moderating effect but, moderators show direct effect on purchasing intention. so male and innovativeness person is more likely to purchase level 3 of vehicle.



Innovation level of Self-driving vehicle : Level 4

Figure 6. Hypothesis test result of Level 4

In level 4, it show almost same result with level 3 but moderator show different.

Perceived usefulness is moderated by gender. So it means male consumer consider perceived usefulness as more important factors in purchasing intention.

## Chapter 5. Conclusion

In this research, technology acceptance model was adopted to analyze relationship between consumer's belief and purchasing intention of vehicle with ADAS and self-driving vehicle. From traditional TAM, perceived ease of use and perceived usefulness were selected as independent variable. Also considering context of self-driving vehicle, Perceived enjoyment, trust and information security are newly adopted. This expanded TAM model is verified with empirical survey data and statistics. Main result is that perceived enjoyment are the most influential factor on purchasing intention. People also concern about information security but it has no significant impact on purchasing. As the level of vehicle autonomy increase, perceived ease of use also decrease but it doesn't influence purchasing intension.

Implication for the developer of self-driving vehicle is that make and feel drivers more fun and trust which is the main influencer of purchasing intention in this study. According to simple mean value comparison, level 3 and 4 of vehicle are regarded as less enjoyable and trustable vehicle than level 1, 2. So if they make of advertise it enjoyable and trustable, that they can increase sales of self-driving vehicle. For the marketing segmentation, they should focus on male and innovative person who have higher willingness to buy self-driving vehicle according to this research.

Limitation of this research is that survey should be more concrete with multiple items. And sampling method should be improved more to reflect general population of Korea. In this research we only make simple causal relationship. In the next research we can bring more complex model about technology acceptance of self-driving vehicle and use structural equation to analyze it.

For the future research it is worth doing survey which is focus on only automated vehicle(level 3, 4) and rigid questionnaires to figure out what make people want to use self-driving vehicle more detail.

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## Appendix 1: Survey questions in this research

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* 소비자 기본 정보란
```

```
1. 귀하의 성별은 어떻게 되십니까?
  □ 남성
               미여성
2. 귀하의 나이대를 체크해주세요
            □ 만 30-39세 □ 만 40-49세 □ 만 50-59세 □ 만 60-69세
  □ 만 20-29세
3. 귀하의 현재 결혼 여부를 체크해 주십시오 (기혼에 체크하셨다면, 문항 3.2로 가주시고
 미혼에 체크하셨다면 문항 4로 가주세요)
  □ 미혼
               미기혼
3.1 귀하는 자녀가 있습니까?
  □ 네
             □아니오
4. 귀하의 최종학력을 체크해 주십시오.
 □ 고등학교 졸업 미만
                     □ 고등학교 졸업
  □ 대학교 졸업(전문대 포함) □ 대학원 졸업(석, 박사)
5. 현재 귀하의 월평균 소득은 얼마나 되십니까?
    세금을 제외한 모든 보너스, 이자 수입 등을 포함하여 응답하여 주십시오.
  □ 99만원 이하 □100만원 이상~199만원 이하 □ 200만원 이상~299만원 이하
  □ 300만원 이상 ~399만원 이하 □400만원 이상~499만원 이하
                                       □ 500만원 이상
6. 집에 소유하고 계시는 차 대수는 어느정도 이십니까?
  □ 무소유
           □1대
                    □2대 이상
7. 귀하는 자동차를 10년 이내에 구입하실 생각이 있으십니까?
             □아니오
  □ 네
8. 현재 귀하께서는 자동차와 관련된 산업에서 일하십니까? (Ex. 자동차 제조업, 자동차
  판매업, 정비소 등 )
  □ 네
             □아니오
9. 귀하께서는 자동차 운전면허가 있으십니까? (대답이 '네'면, 9.1문항으로 가주시고, 아니
  면 바로 문항 10로 가주세요)
  □ 네
             □아니오
9.1 운전을 한 경력이 얼마나 되십니까?
  □ 1년 이하 □ 1~ 2년 이하 □ 2~ 3년 이하 □ 3~ 4년 이하 □ 4년 초과
```

- 10. 귀하는 물건을 구매할 때 어떤 소비자 그룹에 속한다고 생각하십니까?
  - □ 신제품에 대한 정보를 제품이 출시되기 이전에 미리 알고 있으며, 출시되면 가장 먼 저 구매하는 편이다.
  - □ 신제품에 관심이 많으며, 많은 사람들이 구매하기 전에 먼저 사는 편이다.
  - □ 많은 사람들이 구매에 참여할 때 사는 편이다.
  - □ 대부분의 사람들이 구매한 뒤, 뒤따라서 구매하는 편이다.
  - □ 대부분의 사람들이 사용하여도 쉽게 구매를 하지 않는 편이다.

#### ₩ 자율주행자동차란?

운전자의 개입없이 주변환경을 인식하고 주행 상황을 판단하여 차량을 제어함으로써 스스로 주어진 목 적지까지 주행하는 자동차를 말합니다.

본 설문조사는 미국 NHTSA에서 발표한 자율자동차의 레벨에 따라서 순차적으로 진행될것입니다. 단 계는 1단계부터 5단계까지 구성되며, 단계가 높아질수록 자율주행자동차의 기술이 더 많이 추가되고 마지막 단계에서는 사람은 거의 운전을 하지 않고 명령만 말하면 자동차가 알아서 목적지까지 주행합 니다. 귀하는 각 단계별 귀하가 생각나는 대로 응답해주시면 됩니다.

단 계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추 가된 기능
1	비자동 (No- automation)	운전자	운전자	운전자	0	2 <b>—</b> 1
2	운전자 부분 자율주행 (Functioned automation)	운전자	운전자/자동차	운전자	0	네비게이션, 자 동속도 조절 장 치, 주차 보조 장치 등
3	부분 자율주행 (Combined function automation)	운전자	자동차	운전자	0	자동속도조절 시스템,차선이 탈 경보장치, 충돌예방장치, 자동주차장치, 교통표지판인지 장치 등
4	조건부 자율주행 (Limited Self-Driving Automation)	자동차	자동차	자동차	0	자율주행모드 (특정조건 안에 서)
5	완전 자율주행 (Full Self Driving Automation)	자동차	자동차	자동차	X	완전자율주행

#### \* 1단계 : 비자동(No-automation)

본 설명을 읽고, 생각나는 대로 응답해주세요.

단 계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추 가된 기능			
1	비자동 (No- automation)	운전자	운전자	운전자	0	-			
운전자가 모든걸 스스로 조절해야 하는 레벨. 실제적인 자율주행자동차의 기능이 전혀 들어가 지 않음.(네비게이션을 쓸 수 없음.) 예) 지도를 이용해서 길을 찾고, 주차학때 사이드 미러를 이용하여 주차를 한다.									

1. 귀하는 1단계(비자동:No-automation)의 자동차에 대해 들어보신 적이 있습니까?

ㅁ네 ㅁ아니오

#### 2. 귀하는 1단계(비자동:No-automation)의 자동차에 대해 더 자세히 알고 싶은 생각이 있습니까?

문항	전혀	아니다	보통이	그렇다	매우
	아니다		다		그렇다
1. 귀하는 1단계(비자동:No-automation)의 차를 운전해보고 싶습니					
까?					
2. 귀하는 1 단계의 자동차 사용이 복잡하다고 생각하십니까?					
3. 귀하는 1 단계의 자동차를 사용하는 것이 귀하에게 즐거움을					
준다고 생각합니까?					
4. 귀하는 1 단계의 자동차가 신뢰할 만하다고 생각합니까?					
5. 귀하는 1 단계의 자동차를 사용하는 것이 편리하다고 생각하십					
니까?					
6. 귀하는 1단계의 차를 사용할 때, 주행 중 돌발상황(기상 악화					
및 낙성 등)시 발생할 수 있는 사고에서 안전하다고 생각하십니					
까?					
7. 귀하는 1 단계의 차를 사용할 때, 주변 사람들이 귀하에 대해부					
정적으로 인식한다고 생각하십니까?					
8. 귀하는 1 단계의 차를 사용할 때, 경제적으로 많은 부담(보험,			-		
유지 비용 등)을 느끼십니까?					
9. 귀하는 1 단계의 차를 사용할 때, 기능이 원활하게 작동되지 않					
을까봐 불안하십니까?					
10. 귀하는 1 단계의 차를 사용할 때, 정보보안 및 시스템 해킹에					
대해 걱정하십니까?					
11. 귀하는 1 단계의 자동차를 구매할 생각이 있으십니까?					
12. 귀하는 1 단계의 자동차의 사용에 대해서 거부감을 느끼십니					
까?					

#### ₩ 2단계 : 운전자 부분 자율주행(Function specific Automation)

본 설명을 읽고, 생각나는 대로 응답해주세요.

	단 계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추 가된 기능		
	2	운전자 부분 자율주행 (Functioned automation)	운전자/자동차	운전자/자동차	운전자	0	자동 브레이크, 네비게이션, 자 동속도 조절 장치, 주차 보 조장치		
자동 브레이크나 앞차와의 간격유지 같은 기본적인 운전 보조 기능 적용. 대부분의 자동차가 이 에 해당. 예) 그는 네비게이션을 이용해 길을 찾고, 주차시에 주차 보조 장치(후방 카메라)를 이용하여 주차를 했다.									

1. 귀하는 2단계(운전자 부분 자율주행:Function specific Automation)의 자동차에 대해 들어보신 적이 있 습니까?

ㅁ네 ㅁ아니오

2. 귀하는 2단계(운전자 부분 자율주행:Function specific Automation)의 자동차에 대해 더 자세히 알고 싶 은 생각이 있습니까?

ㅁ네 ㅁ아니오

	전혀	아니다	보통이	그렇다	매우
	아니다		다		그렇다
1. 귀하는 1단계(비자동:No-automation)의 차보다 2단계(운전자 부분					
자율주행:Function specific Automation)의 차를 더 운전해보고 싶습니					
까?					
2. 귀하는 2단계의 자동차를 사용이 복잡하다고 생각하십니까?					
3. 귀하는 2단계의 자동차를 사용하는 것이 귀하에게 즐거움을 준					6
다고 생각합니까?					
4. 귀하는 2단계의 자동차가 신뢰할 만하다고 생각합니까?					
5. 귀하는 2단계의 자동차를 사용하는 것이 편리하다고 생각하십					
니까?					
6. 귀하는 2단계의 차를 사용할 때, 주행 중 돌발상황(기상 악화					
및 낙성 등)시 발생할 수 있는 사고에서 안전하다고 생각하십니					
까?					
7. 귀하는 2단계의 차를 사용할 때, 주변 사람들이 귀하에 대해부					
정적으로 인식한다고 생각하십니까?					
8. 귀하는 2단계의 차를 사용할 때, 경제적으로 많은 부담(보험, 유					
지 비용 등)을 느끼십니까?					
9. 귀하는 2단계의 차를 사용할 때, 기능이 원활하게 작동되지 않					
을까봐 불안하십니까?					
10. 귀하는 2단계의 차를 사용할 때, 정보보안 및 시스템 해킹에					
대해 걱정하십니까?					
11. 귀하는 2단계의 자동차를 구매할 생각이 있으십니까?					
12. 귀하는 2단계의 자동차의 사용에 대해서 거부감을 느끼십니					
까?					

단 계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추 가된 기능			
3	부분 자율 주행 (Combined function automation automation)	운전자/자동차	자동차	운전자	0	자동속도조절 시스템.차선이 탈 정보장치, 충돌예방장치, 자동주차장치, 교통표지판인 지장치, 경사로 주행제어장치, 전기차 주행경 고음장치			
운전자가 운전을 하지만 자동차가 속도 조절이나 방향 조정 등 일부 자율기능 수행. 운전자가 편안하고 안 전하게 운전할 수 있도록 지원하는 첨단운전시스템(ADAS)를 갖추고있음. 예) 그녀는 고속도로에서 주행 시 앞 차 량과 사고가 날 만한 상황에서도 충돌예방장치시스템의 도움으로 충돌을 피했다.									

#### \* <u>3단계: 부분 자율주행(Combined function automation)</u>

1. 귀하는 3단계(부분 자율주행:Combined function Automation)의 자동차에 대해 들어보신 적이 있습니까?

□ 네 □아니오

2. 귀하는 3단계(부분 자율주행:Combined function Automation)의 자동차에 대해 더 자세히 알고 싶은 생 각이 있습니까?

口아니오

□ 네

문항		아니다	보통이	그렇다	매우
			다		그렇다
1. 귀하는 2단계(운전자 부분 자율주행:Function specific Automation)	8				
의 차보다 3단계(부분 자율주행:Combined function Automation)의 차					
를 더 운전해보고 싶습니까?					
2. 귀하는 3단계의 자동차를 사용한다면, 사용이 복잡하다고 생각					
하십니까?					
3. 귀하는 3단계의 자동차를 사용하는 것이 귀하에게 즐거움을 준					
다고 생각합니까?					
4. 귀하는 3단계의 자동차가 신뢰할 만하다고 생각합니까?					
5. 귀하는 3단계의 자동차를 사용하는 것이 편리하다고 생각하십	2				
니까?					
6. 귀하는 3단계의 차를 사용할 때, 주행 중 돌발상황(기상 악화					
및 낙성 등)이 발생했을 때, 사고에서 안전하다고 생각하십니까?					
7. 귀하는 3단계의 차를 사용할 때, 주변 사람들이 귀하에 대해부					
정적으로 인식한다고 생각하십니까?					
8. 귀하는 3단계의 차를 사용할 때, 경제적으로 많은 부담(보험, 유					
지 비용 등)을 느끼십니까?					
9. 귀하는 3단계의 차를 사용할 때, 기능이 원활하게 작동되지 않					
을까봐 불안하십니까?					
10. 귀하는 3단계의 차를 사용할 때, 정보보안 및 시스템 해킹에					
대해 걱정하십니까?					
11. 귀하는 3단계의 자동차를 구매할 생각이 있으십니까?					
12. 귀하는 3단계의 자동차의 사용에 대해서 거부감을 느끼십니					
까?	8				

#### \* 4단계: 조건부 자율주행 (Limited Self-Driving Automation)

본 설명을 읽고, 생각나는 대로 응답해주세요.

단 계	정의	운전 상황 모니터링	제어 (운전, 주 차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추 가된 기능			
4	조건부 자율주행 (Limited Self-Driving automation)	자동차	자동차	자동차	0	자율주행 모드 (특정조건 안 에서)			
고속도로와 같이 특정한 환경에서 차선 변경, 추월, 장애물 회피 등을 모두 할 수 있는 수준으 로 상황에 따라 운전자가 전방에서 눈을 뗄 수도 있음									
예) 그는 고속도로에서 자율주행 모드를 눌러 차가 자율적으로 주행하도록 했다. 그리고 고속도로가 끝 나는 지점에서 자율주행 모드를 해제하고 다시 운전을 했다.									

1. 귀하는 4단계(조건부 자율주행:Limited Self-Driving Automation)의 자동차에 대해 들어보신 적이 있습 니까?

2. 귀하는 4단계(조건부 자율주행:Limited Self-Driving Automation)의 자동차에 대해 더 자세히 알고 싶은 생각이 있습니까?

ㅁ 네 ㅁ아니오

문항	전혀	아니다	보통이	그렇다	매우
	아니다		다		그렇다
1. 귀하는 3단계(부분 자율주행:Combined function Automation)의 차					
보다 4단계(조건부 자율주행:Limited Self-Driving Automation)의 차를					
더 운전해보고 싶습니까?		2			
2. 귀하는 4단계의 자동차 사용이 복잡하다고 생각하십니까?					
3. 귀하는 4단계의 자동차를 사용하는 것이 귀하에게 즐거움을 준					
다고 생각합니까?					
4. 귀하는 4단계의 자동차가 신뢰할 만하다고 생각합니까?					
5. 귀하는 4단계의 자동차를 사용하는 것이 편리하다고 생각하십					
니까?					
6. 귀하는 4단계의 차를 사용할 때, 주행 중 돌발상황(기상 악화					
및 낙성 등)시 발생할 수 있는 사고에서 안전하다고 생각하십니					
까?					
7. 귀하는 4단계의 차를 사용할 때, 주변 사람들이 귀하에 대해부					
정적으로 인식한다고 생각하십니까?					
8. 귀하는 4단계의 차를 사용할 때, 경제적으로 많은 부담(보험, 유					
지 비용 등)을 느끼십니까?					
9. 귀하는 4단계의 차를 사용할 때, 기능이 원활하게 작동되지 않					
을까봐 불안하십니까?					
10. 귀하는 4단계의 차를 사용할 때, 정보보안 및 시스템 해킹에					
대해 걱정하십니까?		9			
11. 귀하는 4단계의 자동차를 구매할 생각이 있으십니까?					
12. 귀하는 4단계의 자동차의 사용에 대해서 거부감을 느끼십니					
까?					

#### ∗ 5단계: 완전 자율주행 (Full-Self Driving Automation)

본 설명을 읽고, 생각나는 대로 응답해주세요.

단 계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추 가된 기능		
5	완전 자율주행 (Full Self Driving automation)	자동차	자동차	자동차	Х	완전자율주행		
운전자가 목적지와 주행경로만 입력하면 모든 기능을 스스로 제어하는 레벨								
예) 그녀는 차에 올라타 목적지와 주행경로를 입력하고, 차가 알아서 안전하게 목적지에 데려다 줄 때 까지 개인 업무를 보았다.								

1. 귀하는 5단계(완전 자율주행: Full-Self Driving Automation)의 자동차에 대해 들어보신 적이 있습니까?

2. 귀하는 5단계(완전 자율주행: Full-Self Driving Automation)의 자동차에 대해 더 자세히 알고 싶은 생각 이 있습니까?

ㅁ 네 ㅁ아니오

문항	전혀	아니다	보통이	그렇다	매우
	아니다		다		그렇다
1. 귀하는 4단계(조건부 자율주행:Limited Self-Driving Automation)차					
보다 5단계(완전 자율주행: Full-Self Driving Automation)의 차를 더					
운전해보고 싶습니까?					
2. 귀하는 5단계의 자동차 사용이 복잡하다고 생각하십니까?					
3. 귀하는 5단계의 자동차를 사용하는 것이 귀하에게 즐거움을 준					
다고 생각합니까?					
4. 귀하는 5단계의 자동차가 신뢰할 만하다고 생각합니까?					
5. 귀하는 5단계의 자동차를 사용하는 것이 편리하다고 생각하십					
니까?					
6. 귀하는 5단계의 차를 사용할 때, 주행 중 돌발상황(기상 악화					
및 낙성 등)시 발생할 수 있는 사고에서 안전하다고 생각하십니					
까?					
7. 귀하는 5단계의 차를 사용할 때, 주변 사람들이 귀하에 대해부					
정적으로 인식한다고 생각하십니까?					
8. 귀하는 5단계의 차를 사용할 때, 경제적으로 많은 부담(보험, 유					
지 비용 등)을 느끼십니까?					
9. 귀하는 5단계의 차를 사용할 때, 기능이 원활하게 작동되지 않					
을까봐 불안하십니까?					
10. 귀하는 5단계의 차를 사용할 때, 정보보안 및 시스템 해킹에					
대해 걱정하십니까?					
11. 귀하는 5단계의 자동차를 구매할 생각이 있으십니까?					
12. 귀하는 5단계의 자동차의 사용에 대해서 거부감을 느끼십니					
까?					

## Abstract (Korean)

자율주행자는 미래의 자동차의 트렌드로 여겨지고 있다. 그러나 모든 신기 술이 초기부터 시장에서 쉽게 받아들여지지는 못한다. 자율주행자동차도 마찬 가지로 사람들은 기존에 있는 차량을 더 쉽고, 유용하고, 즐거우며 믿을 수 있 다고 생각한다. 이 연구는 사람들이 자율주행자동차의 구매의사를 결정하는 의사결정 구조를 기술수용모델을 통해서 밝혀내고자 한다. 기존에 정보시스템 의 수용성을 분석하는 기술수용모델에 자동차를 사용하는 사용자의 상황과 환 경을 고려하여 새로운 변수들을 추가하여 자율주행자동차의 구매의사를 결정 짓는 요인을 찾아내고자 하였다. 또한 자동차의 자율주행수준의 기준을 제시 한 NHSTA의 자료를 바탕으로 level 1에서 level 4까지 해당되는 자동차를 두고 각각에 기술수용모델을 적용하였다.

분석 결과 자율주행자동차의 구매 의사에 가장 영향력 있는 소비자의 심리 적 변수는 모든 level의 자동차에서 지각된 재미(PE)와 신뢰(T)가 유의미하게 나왔다. 또한 혁신성(INNO)이 높은 사람일수록 자율주행자동차의 구매의사가 높은 것으로 나왔으며, 성별과 개인의 혁신성이 설명 변수에 영향력을 조절하 는 조절변수로서 작용하고 있음을 확인하였다.

본 연구는 자율주행자동차를 개발하는 회사에 경영학적인 통찰을 주며 이 후에 진행될 자율주행 자동차 연구와 자동차의 맥락 하에서의 기술수용모델에 방향성을 제시할 것이라 기대된다.

#### 주요어 : 자율주행자동차, 기술수용모델, 지각된 재미, 첨단운전자보조시스템

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