Master Dissertation in Engineering

Analysis of risk factor of innovation resistance in perspective of potential consumer towards different levels of self-driving vehicle

- Focused on impacts from perceived risk and customer attitude -

잠재적 소비자의 관점으로 자율주행자동차에 대한 혁신저항 분석
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- Focusing on impacts from perceived risk and customer attitude -

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Abstract

Analysis of risk factor of innovation resistance in perspective of potential consumer towards different levels of self-driving vehicle

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Because of developed technology in artificial intelligence (AI), robots can replace human work and reduce time and resources. One of the main technological applications of AI is in autonomous (self-driving) cars which are expected to be driven by robots and AI systems instead of human drivers. The National Highway Traffic Safety Administration (NHTSA) have presented five degrees of autonomous car level employing Advanced Driver Assistance Systems (ADASs). From non-autonomous to fully autonomous cars, the functions carried out by an ADAS are added sequentially. Currently, vehicles in level 2, which includes two primary function junctions, are available on the automobile industry market, so the need for research into self-driving cars is obvious to investigate the gap between the market situation and customer perspective toward autonomous cars.

In previous literature, a technology acceptance model (TAM) has only emphasized technological aspects and their effect on customers' positive adoption, and innovation has always been seen as a positive aspect. However, the concept of innovation resistance has given new insight into accepting innovation in the psychological area. Therefore, in this paper, the focus is on innovation resistance and its factors, which are customer attitude and perceived resistance, with regard to different levels of autonomy based on Ram's (1987) innovation model, but with extended variables of perceived risk and customer attitude.

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. The target participants for the survey were individuals who were willing to buy a car within 10 years and had a driver's license. The model was analyzed with a multiple regression model using dependent variables of innovation resistance and intention to adopt. Potential risks were shown to have a positive impact whereas customer attitudes were shown to have a negative impact on innovation resistance. In addition, we found that customer attitude and potential risk factors had different effects on innovation resistance and innovation acceptance. As a result, while the risk of social and physical risks influenced innovation resistance, consumer attitudes such as economic risk, pleasure, and rigidity were more influential on the intention to adopt.

Keywords: Innovation, Consumer Attitudes, Perceived risk, Autonomous driving, Innovation Resistance

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Chapter 1. Introduction

1.1 Introduction

Artificial intelligence (AI) is changing our lives. With developed technology in AI, robots can replace human work and reduce time and resources (Istvan, Z. 2016). One of the main technological applications of AI is in self-driving vehicles which are expected to be driven by robots and AI systems instead of human beings, and test models with self-driving vehicles are currently operating in the U.S.A. As research on self-driving vehicles continues to progress, moral dilemmas have occurred in many situations (Bonnefon, Shariff & Rahwan, 2016), such as when people are in a self-driving car; if there is an accident involving a self-driving car, it has not yet been decided on who is responsible. Furthermore, this device may come across a situation where a moral choice must be made about who survives and who is killed. This is not about the technological area, but rather the psychological, moral, and social area. Therefore, in this matter, potential customers might hesitate to adopt new innovation concerning self-driving cars.

1.2 Problem Description

Although the market for self-driving cars will expand after their commercialization by automobile companies, there are still barriers to adopting this new technology. Therefore, the need for research into self-driving cars to reduce the gap between the market situation and customer perspective with regard to this innovation is definitely huge.

With the advent of self-driving cars, previous research only focused on technological facts rather than customer perspective, and had a narrow focus on simulation or a specific function like the Advanced Driver Assistance Systems (ADAS) used in self-driving cars. Next, research on self-driving cars concerning customer perspective received attention and focused mostly on user acceptance not resistance (Strand, Nilsson, Karlsson, & Nilsson, 2014).

Schoettle and Sivak (2014) reported that the majority of respondents in their study understood and had heard about the concepts of self-driving cars, and Kyriakids (2015) discovered that over 70% of respondents said that the market share of autonomous car will not be reached until 2020, at which time self-driving cars will dominate the car market. Research by Rödel, Stadler, Meschtscherjakov, and Tscheligi (2014) examined attitudes and potential barriers of users toward self-driving cars. They investigated user acceptance of autonomous cars according to level from 0 to 5 set by the National Highway Traffic Safety Administration (NHTSA) and found that the values of user experience and user intention to adoption were different with regard to each level of autonomy. Research on consumer experience and motivation for purchasing has already been carried out, but research on the impact of the perceived risk of using autonomous vehicles and innovation resistance toward them has not yet been conducted, and so research focusing on innovation resistance, which views innovation negatively, is needed. In this research, we investigate the connection between innovation characteristics and the self-driving car using the concept of innovation resistance derived by customers' perceived risk and attitude.

1.3 Research Objective

This research will fulfil the role as a bridge to connect innovation characteristics and the self-driving car using the theory of innovation resistance. In this research, we give new insight to remove barriers to the widespread adoption of self-driving cars and to understand potential customers using innovation characteristics. The research questions are as follows.

Research Question 1: How do perceived risk and customer attitude differ with regard to the levels of autonomy in self-driving car?

Research Question 2: Are there differences between drivers that affect innovation resistance and the intention to adoption? Are innovation resistance and the intention to adoption reverse relationships?

Research Question 3: If the customers are divided into four different groups, is innovation resistance related to the intention to adopt based on regression analysis results?

The rest of this paper is organized as follows. Section 2 contains a literature review based on prior research on innovation resistance in which two views toward innovation are introduced. Section 3 concerns methodology and shows the research framework and basic formulae used in the study, and also reports on how this research was conducted. Next, Section 4 is based on the empirical analysis results covering the data used and analyses and implications. Finally, conclusions of this study are presented.

Chapter 2. Literature Review

2.1 Self-Driving Car

2.1.1 **Definitions of Self-Driving Car**

With developed technology in artificial intelligence, robots can replace human work and it reduced time and resource (Istvan, Z. 2016). One of main applications of artificial intelligence (AI) is self-driving vehicle. Self-driving car is defined by vehicles with AI system, assisting the driver with driving, are available in the market, but the driver is expected to maintain control to car for whole driving hour (Swedish Transport Agency, 2014). This innovative product is predicted to have both advantages and disadvantages. Representatively, increasing productivity are beneficial to potential customer who buy self-driving car. If autonomous vehicle were accepted and widespread, the ability to move from an ownership-model to a rental or ride-sharing model of car usage would be created. Fagnant & Kockelman (2013) predicted the biggest improvement from the widespread use of Autonomous Vehicles will be large reductions in number of automotive crashes. Although there are lots of advantages to use self-driving car, critical disadvantages are also existed. For example, one of most important challenges of self-driving car is moral dilemma. Autonomous car cannot distinguish who is responsible for accidents. Therefore, it could be occurred from this issue. Therefore, self-driving car should be carefully considered with these many challenges and opportunities.

2.1.2 Five levels of Self-driving car

In this study, we investigate self-driving car not for whole concept but each level of self-driving car. In connection to policy, NHTSA (National Highway Traffic Safety Administrators) represented five levels of autonomy ranging from level 0 of autonomy ("No-automation") to 4 ("Full self-Driving car"). As the level goes higher, more technology of autonomous vehicle is added (NHTSA, 2013). For example, features of autonomous car includes adaptive Cruise Control system, Lane Keeping, and Stop & Go. With these feature, customer can drive wherever they want arrive (Payre, Cestac, & Delhomme, 2014).

In Level 0 ("No-automation"), the driver has independent control to the vehicle. There' s no automation function included in this level of car. In Level 1("Function-specific Automation"), Automation of one or more specific control functions has included in this level. Likewise, it includes functions of adaptive control, automatically recharged breakers, enabling drivers to regaining control and so on. In Level 2 ("Combined function Automation"), it includes automation function of more than two critical control functions. In level 3 ("Limited Self-Driving Automation"), this level of car has full autonomy control only under certain traffic or environmental condition like highway. In Level 4("Full Self-Driving Automation"), this level of car monitors road way performs all autonomous driving function and all safety-critical driving functions is performed and monitored roadway conditions for an entire trip (NHTSA, 2013; Rödel, Stadler, Meschtscherjakov, & Tscheligi, 2014). At the full autonomy level, the person drives almost to the destination without knowing the command, only when the command conducted. The specific information of each level will be provided in table 1. The autonomous vehicle is divided into five levels, and as the level increases, the autonomy of the autonomous vehicle also increases, with the column for person monitoring at each level. Also, some aspects of responsibility during driving are considered, and who's monitoring means who is legally responsible in perspective of legal.

Level 0 autonomy is the vehicle in which all autonomous rights belong to the consumer, and the operator is responsible for all liability under any circumstances. Level 1 autonomy vehicle contains several specific control functions, including electronic stability control and brakes for these control functions. Level 2 vehicle includes several additional functions for autonomous vehicles, including additional automation technology from added functionality of level 1, such as lane centering, which is one example of this level technology. Level 3 autonomy car allows drivers to basically operate and intervene in any situation for autonomous vehicles, but self-driving car drives directly in only under special conditions such as highways. Level 4 autonomy car has been progressing to develop with the fully autonomous technology of the autonomous vehicle and it is the level of autonomous driving with the state that can be performed by self-driving car fully. (NHTSA, 2013)

Table 1. Levels of autonomy (NHTSA, 2013)

Level	Definition	Monitoring of driving environment	Who's taking Control(Driving, Parking etc)	Who is responsible for safety	Whether driver can intervene
0	No-automation	Driver	Driver	Driver	O
1	Functioned automation	Driver	Driver/Automobile	Driver	O
2	Combined function automation	Driver	Automobile	Driver	O
3	Limited Self-Driving Automation	Automobile	Automobile	Automobile	O
4	Full Self Driving Automation	Automobile	Automobile	Automobile	X

2.1.3 Current state of Self-driving car in a market

2.1.3.1 Tesla

Tesla has occupied largest proposition of self-driving car among electric car industry (최주한, 2016). In 2015 October, this corporation commercialized function of self-driving car in level 2. This function of 'auto pilot' self-driving used big data by external camera collecting by drivers (Muoio, 2017; Tesla, 2017 & Lambert, 2017). Using new Tesla vision cameras, sensors and computing power, it can drive automatically until 80mph and navigate on more complex road (Tesla, 2017).

2.1.3.2 BMW

As one of automobile corporations, BMW has been progressed to develop self-driving car actively. It signed a contract about self-driving vehicle with Intel. Also, BMW continued its research to support Uber's technical support and it tested its driving cars to follow “ride-haling firms” like Uber (Reuters, 2016). BMW focused on technological development for commercialization of autonomous vehicles until 2018, and the current level is evaluated as level 3 autonomous. Moreover, it aimed to provide self-automobile cars that offer an perfect optimized environment by predicting consumer needs by utilizing the data (최주한, 2016).

2.1.3.3 Google

Google has involved in joining actively to produce self-driving car among IT corporation (Streitfeld, 2017). As the representatives of ICT corporation, google gave new standards to insights of self-driving car. In 2014, it launched new prototype of self-driving car without pedal. The name of Google’s self-driving car is “Waymo.” It uses LIDAR system to create 3D image of its surroundings (Erico, 2013). “Waymo” has been operating in level 3 of autonomy since 2013. The 3 level of autonomous vehicles were operated by using big data base from roadway in memory of autonomous driving computer system. It learned new algorithms from roadway driving while travelling on road over 3 miles per day

(Google, 2017).

2.1.3.4 Other automobile companies

In Korea, there are few automobile companies which research on self-driving car such as Hyundai automobile corporation, and Kia automobile. From consumer electronics show(CES) in Hyundai, the new car brand were introduced their new innovative functions with voice system, service of automatically found on parking lot, and the emergency call service. These integrated autonomous running functions will be commercialized from 2020 (이병윤, 2016). For the case of Kia automobile, it launched “Drive Wise” brand which is driver assistance system in level 3 with features ranging from active control to emergency braking. Therefore, this autonomous car might autonomously do self-parking and drive expressway itself without driver’s intervene (Ziegler, 2016).

2.1.4 Challenges of Self-driving car

According to University of Michigan Transportation research institute, nearly half of respondents in U.S still weren’t excited about accepting self-driving car. Nearly half of respondents reply that their proffered level of automation in self-driving was “no-self driving” in survey conducted by the University of Michigan Transportation Research institute (Sumagaysay, 2016). As there are many people who have negative attitudes toward autonomous vehicles, challenges have existed that autonomous vehicles must bring forward.

2.1.4.1.1 Moral Dilemma

Firstly, one of most important challenge of self-driving car is Moral Dilemma. Autonomous car cannot distinguish who is responsible for accidents. Owning an object, which can kill you in certain situation, is one of reason to hesitate buying self-driving car in perspective of potential customer. Moreover, the regulation of self-driving car is related with utilitarian, minimizing total number of death (Gentt, E. 2016). Therefore, this moral area should be discussed in further, not to come to immoral decisions by self-driving car.

2.1.4.1.2 Security

Next challenge is security in vehicle-to vehicle communication for autonomous car. Security is definitely needed to guarantee of communicating vehicle-to vehicle constantly to receive any advantages from autonomous vehicles. However, even tiny infection to other vehicles in the vicinity could make serious effect in security vehicles. Also, Security breaches could enable hostile agents to do anything from illegally collecting masses of data to completely disrupting transport systems and causing deadly mass-crashes.

2.1.4.1.3 Government subsides

Since adoption of autonomous cars may be Inhibited by their initially high cost, it is required to introduce some subsides to governments and policy-makers, or provide other incentives such as special autonomous vehicle’s high-speed motorway lanes to accelerate initial adoption of autonomous vehicles. Incentives could also be issued to auto-makers to ensure development of mutually beneficial systems, standards and communication technologies. Later on in the adoption process, stronger policy-pressures such as mandatory vehicle to vehicle(V2V) communication and autonomous capabilities could finalize the process (Silberg, G., et al, 2012).

2.2 Innovation Resistance

2.2.1 Two different views for innovation

There are two different views concerning innovation, namely innovation adoption and innovation resistance. Innovation adoption focuses on the positive aspects whereas innovation resistance focuses on the negative aspects of innovation. As innovation can be expressed by these two different points of view, research has been progressed to discover these relationships. Intention to adopt is defined as a specific behavior related to the willingness to purchase an item. Research on the relationship between innovation resistance and intention to adopt is continuing, but research on this aspect concerning autonomous vehicles has not progressed. The relationship between innovation resistance and the intention to adopt is not determined simply as a reverse relationship since the elements affecting these two variables need to be considered in many different ways, and various methods must be considered.

2.2.1.1 Innovation Adoption

Innovation Adoption is adoption when people accepts new ideas, products, or services as time passed. In the decision of innovation process, people decide whether they accept technology or not (Rogers, 2010). Previous research about innovation adoption (Venkatesh & Davis, 2000) applied concept of TAM (technology Acceptance model) to understand beliefs, attitude, perceive of usefulness, and so on. Moreover, it also identified external factors, which effect to adoption process (Wei, 2009).

There was also a limit to the theory of innovation adoption. Crucial limit for intention to adoption is that had been overlooked for proactive which is why potential adopters refuse or reject innovation (Rogers, 2010; Ram, 1987; Sheth, 1981). Prior TAM theory only emphasized technology aspect and focused on only customer's positive adoption effect (Venkatesh & Davis, 2000). Consequently, innovation were seen in positive aspect. However, concept of innovation resistance gives new insights to accept innovation in psychological area with negative perspective.

2.2.1.2 Innovation Resistance

Innovation resistance is one form of resistance to change offered by consumers imposed by innovation (Zaltman, G., & Wallendorf, M,1979). Proposed by Ram and Sheth (1989), innovation resistance is defined as "the resistance offered by consumers to an innovation." Therefore, it means negative attitude towards change from status quo or conflicts with their prior belief structure (Ram, 1987). The negative attitude towards change came from resistance to change. Resistance to change is anticipated to be a multidimensional placement, which comprises cognitive, behavioral, and affective components (Oreg, 2003, 2006).

Innovation resistance is not opposite concept of Innovation adoption. According to Ram & Sheth (1989), If the level of customer innovation resistance is extremely high, adoption period of innovation would slow down. So, innovation resistance has to be overcome to succeed adopt innovation. Innovation resistance determines the degree of discontinuity (Ram & Sheth, 1989). It reflects natural psychological characteristics of customer. In the decision process of purchasing products, there are three kinds of innovation resistance, which are adoption rejection, adoption postponement and rejection (Szmigin, I., & Foxall, G, 1998). According to innovation adoption, conscious postponement is referred as active resistance by customer's rational judgment (Laukkanen, Sinkkonen, & Laukkanen, 2009). Active resistance means "negative attitude driven by factors that evolves during new innovation product evaluation (Kuisma et al., 2007; Laukkanen, Sinkkonen, & Laukkanen, 2009; Nabih et al., 1997)." It forms active resistance by consumer attitudes and evaluation towards innovation product (Talke & Heidenreich, 2014).

In comparison with active innovation resistance, passive innovation resistance is perceived by customer's habits, cognitive rigidity, and reluctance to lose, and other factors. It is based on individual's status quo to resist innovations and change, but not to adopt new product innovation (Talke & Heidenreich, 2014). Driven by perceived degree of change or discontinuity, adoption of the innovation is connected to discontinuity (Heidenreich &

Kraemer, 2015; Nabih et al., 1997).

There are numerous studies of innovation resistance for long time, specifically innovation resistance model variable comprising with customer consumer characteristics, innovation characteristics, and propagation mechanism variable blocks (Ram, 1987). In this study, innovation resistance view will be focused to investigate why potential consumers hesitate to buy high levels of autonomous car. Also, the research of self-driving car has mostly concentrated on innovation adoption, therefore it is needed to different perspectives towards self-driving car.

2.2.2 Factors of innovation resistance

When consumers adopt innovation, innovation resistance could be occurred from different factors of innovation resistance. The two main factors of behavioral innovation resistance are perceived risk, and psychological conflicts which are called by cognitive resistance.

2.2.2.1 Perceived risk

Perceived risk is the consumer awareness of risk when they adopting an innovation influenced to resistance to change (Molesworth & Suortti, 2002; Ram & Sheth, 1989). Higher risk perception by a consumer influences to increase resistance to the innovation the higher (Ram & Sheth, 1989). In the previous literature, perceived risk was categorized into four sectors which are functional risk, economic risk, social risk, and psychological risk.

Firstly, physical risk is the "perception that products will harmful to adopters (Ram, 1987)." In addition, it included perception of fear potential damages persons or property which might be caused by innovation (Klerck & Sweeney, 2007; Roselius, 1971). Secondly, Economic risk is referred as the fear of economic loss (Kim, Mirusmonov, & Lee, 2010; Ram & Sheth, 1989). Cost of an innovation is related with economic risk (Kleijnen, Lee, & Wetzels, 2009). Thirdly, Functional risk is the concern of performance uncertainty (Ram & Sheth, 1989).

Fourthly, social risk is the concern of social ostracism or ridicule (Ram & Sheth, 1989). It is related with observability as defined by Rogers (2010). In the consumer decision process, observance from the surrounded people is the most important factor not to be isolated from using unselected innovation to the society (Kleijnen et al., 2009). Finally, system risk is the fear that it would be secure when using a specific system by hacking or personal information leakage (Pousttchi & Wiedemann, 2007). But, in this research, system risk is used as concern about information security and system hacking using self-driving car.

2.2.2.2 Cognitive resistance

Consumer resistance is psychological conflicts with the consumer's beliefs, values or norms (Kleijnen et al., 2009). It is referred as "the consumer's reluctance to change from current practice to which he had become accustomed (Ram & Sheth, 1989)."

The higher conflicts with the consumer beliefs, values or norms by a consumer influences to increase cognitive resistance to the innovation.

		Perceived risk	
		High	Low
Cognitive Resistance	High	Dual Resistance	Cognitive Resistance
	Low	Risk resistance	Low resistance

Figure 1. Types of consumer resistance to innovations (Ram, 1989)

2.2.2.3 Customer characteristics

Customer characteristics determined the amount of resistance that person got from innovation. For example, it is related with customer desire to enhance self -prestige with instrumental characteristics of innovation (Ram, 1987). Moreover, consumer characteristics included as customer attitude, personality, and motivation. It is psychological area how consumer characters affect innovation resistance and intention to adoption. In this study, customer attitude towards self-driving car are used as variable.

2.2.3 **The relationship between innovation resistance and intention to adoption**

As innovation could be seen within two different views which are innovation adoption and innovation resistance, research has been progressed to find out these two views of relationship. Intention to adoption is defined as intention to adoption which belongs to specific behavior of purchase. Research on relationship between innovation resistance and intention to adoption has been continued, but research on autonomous vehicles has not progressed in section of innovation resistance. The relationship between innovation resistance and intention to adoption is not determined simply as a reverse relationship. Elements affecting these two variables are not considered in many different ways but various methods must be considered to detect relationship.

Ram (1987) proposed the theory of innovation resistance. It was revealed the relationship between innovation resistance and acceptance in innovation resistance model. Innovation resistance is consumer negative response to innovation by potential consumers. However, it is not the obverse relationship with the adoption. Adoption requires a reduction in innovation resistance and a decrease in innovation resistance from consumers.

Moreover, Rogers (2010) stated relationship between innovation resistance and intention to adoption when innovation resistance overcame person’s negative awareness. Theoretically, the basis for the relationship between innovation resistance and intention to adoption has been laid out and then an empirical study has progressed that the degree of acceptance of innovation decreases as innovation resistance increases further.

According to Lian, Liu, & Liu (2012), it applied the innovation resistance theory in online shopping to user acceptance and analyzed the relationship between innovation resistance and user acceptance empirically. It used innovation resistance conceptual framework from Ram and Sheth (1989). It categorized innovation resistance into value barrier, usage barrier, risk barrier, image barrier and tradition barrier. Result showed that the barriers gave significant direct effect to intention to adopt.

Heidenreich(2016) used scenario-based experiment and it gave first empirical evidence that resistance type for new product adoption. It examined effects of each resistance on intention to adopt, and innovation resistance is categorized by cognitive resistance, situational passive resistance, and dual resistance.

As it is mentioned above, in previous study, there were lots of research about direct impact on innovation resistance from intention to adoption. Therefore, as innovation resistance decreased, it had expected adoption towards self-driving car will show increasing trend. In this research, the relationship between the resistance of technological innovation and intention to adoption as the level of autonomous vehicle becomes higher. Also, based on the intention to adoption and innovation resistance, analysis will be conducted according to customer groups which are related with innovation resistance and intention to adoption and investigated whether some variables influence the significance for each group.

2.2.4 Highlights gaps from previous research

Still, there is a lack of research on the degree of innovation in the stage, previous innovation resistance study investigated on a single level within a single item. So, there is need to investigate different discontinuity levels of innovation resistance. Currently, research on autonomous vehicles is limited to the development of technology; only fewer studies are available in perspective of consumers. In particular, research on innovation only focuses on positive side of self-driving car using technology acceptance model.

Chapter 3. Methodology

3.1 Research Model

In this study, we identify the factors of innovation resistance toward self-driving cars by considering the level of autonomy. We suggest an empirical research model for the different levels of autonomy according to innovation resistance and the intention to adopt. There are five different levels of autonomy level proposed by the NHTSA, so we can compare how innovation resistance rises or falls according to each level. In this research, we discover how perceived risk and customer attitude affect innovation resistance and the intention to adopt, and how this differs with regard to the five levels of vehicle autonomy. Second, we focus on the marginal effects with regard to the five autonomy levels with significant perceived risk and customer attitude.

Research Question 1: How do perceived risk and customer attitude differ with regard to the levels of autonomy in self-driving car?

Research Question 2: Are there differences between drivers that affect innovation resistance and the intention to adoption? Are innovation resistance and the intention to adopt reverse relationships?

Research Question 3: If the customers are divided into four different groups, is innovation resistance related to the intention to adopt based on regression analysis results?

The research model is shown well in figure 2. It is explicitly well to show the innovation resistance driven by factors of innovation resistance by perceived risk and customer attitude. This model would allow to analyze dynamic innovation resistance by considering the levels of autonomy in self-driving car.

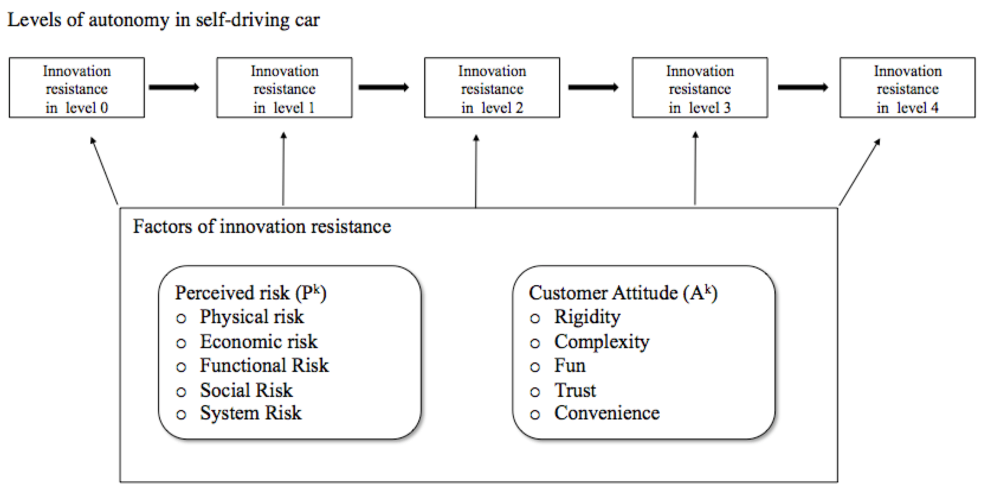

Figure 2. Research Model for innovation resistance

3.2 Variables

In this research, it is identified that variables that affect innovation resistance and intention to adoption were largely divided into risk factors and consumer attitudes. Variable was referred from the literature review about drivers of innovation resistance

3.2.1 Dependent Variable

In this study, dependent variables are used as innovation resistance, and intention to adoption. According to Ram & Sheth (1989), If the level of customer innovation resistance is too high, adoption period of innovation will be slow down. So, innovation resistance has to be overcome to succeed adopt innovation. Therefore, in this research we will investigate how different factors impact to both innovation resistance and intention to adoption.

3.2.1.1 Innovation resistance

In this study, innovation resistance was used as a dependent variable. Innovation resistance was first proposed by Ram(1987) as resistance to change driven by innovation from potential consumers. Innovation resistance was measured by resistance of potential consumers of autonomous car using Likert 5 scale from survey. The scale of 1 to 5 means that the value of 1 means that consumers have a low level of innovation resistance and the value 5 has a high level of innovation resistance.

3.2.1.2 Intention to adoption

In this study, intention to adoption was used as a dependent variable. Intention to adoption belongs to behavioral intention to purchase. Behavioral intention means “strength of ones intention to perform a specified behavior (Fishbein & Ajzen, 1977).” Therefore, intention to adoption is the intention to perform adoption like purchase. It is not exactly reverse concept of innovation resistance, because it is possible to exist someone who have lower innovation resistance and lower intention to adoption (Heidenreich & Kraemer, 2015). Intention to adoption was measured by the purchase intention of potential consumers of autonomous automatic using Likert 5 from survey. The scale of 1 to 5 means that the value of 1 means that consumers have a low level of intention to adoption and the value 5 has a high level of intention to adoption.

3.2.2 Explanatory Variables

In this study, explanatory variables are used to describe the effects of innovation resistance and intention to adoption on autonomous vehicles depending on levels of autonomy. Explanatory variables are categorized largely into customer attitude and perceived risk. Customer attitude is the degree that a person who have a favorable evaluations or unfavorable evaluations to the self-driving car (Ajzen, 1991). Customer attitude has subdivided by rigidity, complexity, fun, trust, and convenience. The variables which are rigidity, complexity are brought from unfavorable evaluations in customer attitude. On the contrary, fun, trust, and convenience variable are comprised in favorable evaluation in customer attitude. Perceived risk is belief of the uncertainty regarding possible negative outcomes(Thakur & Srivastava, 2014). Perceived risk are subdivided by physical risk, economic risk, function risk, social risk and system risk. In order to examine innovation resistance and acceptance according to the level of autonomous vehicles, it is necessary to identify and analyze these drivers.

3.2.2.1 Rigidity

Firstly, rigidity means unwillingness to consider alternative ideas on perspective. (Heidenreich, Kraemer, & Handrich, 2016). In this study, it is used for customer’s attitude that unwillingness to consider alternative levels from prior level to current level. Rigidity is used to measure of change, which allows people to change depending on the level. Therefore, this variable is analyzed after by processing the original data reversely.

3.2.2.2 Complexity

Secondly, complexity for customer attitude towards self-driving car is used in this study. Ram (1987) defined this variable as complexity of idea and complicated execution. For the reason of the characteristics of autonomous vehicles, complexity is included in customer attitudes variables. In this study, complexity is used to measure customer attitude as perceived complexity of customer attitude.

3.2.2.3 Fun

Thirdly, fun is the perception to be enjoyable when using a particular system (Davis, Bagozzi, & Warshaw, 1992). For people who drives car, perceiving fun from vehicle could be main reason to drive self-driving car. However, if self-driving car have alternative cars to potential customer, there would be more possibility not to be persuaded to drive self-driving car. Therefore, fun is used to measure perceptiveness which perceive fun to self-driving car with respect to level of autonomy.

3.2.2.4 Trust

Fourthly, trust is defined as customer attitude that is expected to “help achieve an individual’s goal” in such a uncertain situation (Lee & Moray, 1992). As the function of the autonomous vehicle increases with increased level of autonomy, the reliability from potential consumer to the autonomous vehicle will give a big influence on innovation resistance and intention to adoption. In this study, it is used to measure trustfulness when potential customer use self-driving car as one of customer attitude variables.

3.2.2.5 Convenience

Finally, convenience is defined as ease of use and allows availability of other option with no pressure in the service use (Kim, Mirusmonov, & Lee, 2010). It is investigated by how convenient for consumer to perceive self-driving. The higher convenience consumers consider self-driving car with convenience product, they will have lower the innovation resistance of autonomous vehicles or have higher intention to adoption. In this study, it is used to measure customer attitude with regard to levels of self-driving car that it is convenient to use.

3.2.2.6 Physical risk

First, physical risk is the perception that it is harmful to adopters (Ram, 1987). Physical risk is the concern that consumers feel directly from outbreak situation. Furthermore, enormous number of autonomous vehicles couldn’t convince potential consumer of their coping skills to solve perfectly in every situation. In this study, physical risk is used to measure how much degree consumer perceive safety from outbreak situation regards different levels of autonomy.

3.2.2.7 Economic risk

Secondly, economic risk is the fear of economic loss (Ram, 1987). Economic risk is related with cost. If there are more automobiles functions included to self-driving car, then it is expected to cost higher than previous product. As a result, consumers could feel burden from high rocky cost of self-driving car. As this autonomous vehicle has been progressed to develop having more functions of autonomy, innovation resistance or intention to adoption is likely to be driven by economic risk. In this study, it is used to measure economic burden from self-driving car.

3.2.2.8 Functional risk

Thirdly, functional risk is the fear of performance uncertainty (Ram, 1987). There is a possibility that functional failure is occurred as including enormous number of functions. Since autonomous vehicles is utilized in artificial intelligence technology and provide functions with cutting-edge advanced technologies, functional risk is critical issue for consumers. In this study, it is used to measure concern of autonomy function, which didn’t operate well.

3.2.2.9 Social risk

Fourthly, social risk is the fear of social ostracism or ridicule. It is also related with observability as defined by Rogers (2010). In the consumer decision process, observance of surroundings rule or customs is primary factor not to be isolated from using unselected innovation product in society (Kleijnen, Lee, & Wetzels, 2009). In this study, this variable is used to measure negative awareness from each consumer’s surrounding people.

3.2.2.10 Systemic Risk

System risk is the fear that it would be secure when using a specific system by hacking or personal information leakage (Pousttchi & Wiedemann, 2007). In system such as self-driving car, customers' perceptions of security and trust is major factor of consumer decision whether to purchase innovative product or not. In this research, system risk is used as concern about information security and system hacking using self-driving car.

Table 2. Definitions of dependent variables and explanatory variables

Variable	Definition	Source of date
Innovation Resistance	Resistance offered by consumers to changes imposed by innovation	(Ram, 1987)
Intention to adoption	Intention to adoption which belongs to specific behavior of purchase	(Fishbein & Ajzen, 1977)
Physical risk	Perception that products will be harmful to adopters.	(Ram, 1987)
Economic Risk	Fear of economic loss.	(Ram, 1987)
Social Risk	Fear of social ostracism or ridicule	(Ram, 1987)
Functional risk	Fear of performance uncertainty.	(Ram & Sheth, 1989)
System Risk	Concern about information security and system hacking using self-driving car.	(Pousttchi & Wiedemann, 2007)
Rigidity	Unwillingness to consider alternative ideas on perspective	(Heidenreich, Kraemer, & Handrich, 2016)
Complexity	Complexity of idea and complicated execution	(Ram, 1987)
Fun	Perception to be enjoyable when using a particular system	(Davis, Bagozzi, & Warshaw, 1992)

Variable	Definition	Source of date
Trust	Attitude expected to help achieve an individual's goal in such a uncertain situation	(Lee & Moray, 1992)
Convenience	ease of use and allows availability of other option with no pressure in the service use	(Kim, Mirusmonov, & Lee, 2010)

3.3 Survey Procedure and Sampling

Data were collected through survey constructed with a single item of explanatory and dependent variable. The survey question was used in order to proceed the constructs of the research model. This survey was conducted by Embrain Macromill corporation. The respondents of this survey is 334 who completed survey. Target population was for consumer who is willing to buy car in 10 years and have driver license. The sample of survey data was not focused on specific age group but distributed to each age group from 20 years to over 50 years.

All perceived risk, customer attitude variables were constructed in single-item for reducing complexity to measure all levels of autonomy. Moreover, innovative resistance and intention to adoption variables for each level were constructed in single-attribute scales. A 5-point Likert scale was used for this survey to measure degrees of variables for potential consumer. In a detail, a value of 1 indicated that respondent strongly disagree on each given statement. A value of 5 indicated that respondents strongly agree on each given statement.

Table 3. Survey questions

Variable	**Question**	**Source**
Rigidity	1. I would like to try driving this level of car than prior level of car.	(Talke & Heidenreich, 2014)
Complexity	2. If you use this level of car, is it complex to use?	(Shim, Kim, & Altmann, 2016)
Fun	3. If you use this level of car, is it fun to use?	(Rödel, Stadler, Meschtscherjakov, & Tscheligi, 2014)
Trust	4. If you use this level of car, is it trust to use?	(Rödel et al., 2014) (Merritt, Heimbaugh, LaChapell, & Lee, 2013) (Tussyadiah, Zach, & Wang, 2017)
Convenience	5. If you use this level of car, is it convenient to use?	(Kim, Mirusmonov, & Lee, 2010)
Physical risk	6. When you use this level of car, do you think that it is safe from unexpected situation (Deteriorating weather conditions, and traffic accident etc.)?	(Ram & Sheth, 1989)
Social risk	7. When you use this level of car, do you think that your acquaintances have a negative awareness to you?	(Ram & Sheth, 1989) (Fain & Roberts, 1997)
Economic risk	8. When you use this level of car, you feel lots of burden economically (insurance fee, maintenance fee)?	(Ram & Sheth, 1989)
Functional Risk	9. When you use this level of car, do you fear that functions in this level of car couldn't operate	(Ram & Sheth, 1989)

	appropriately?	
System Risk	10. When you use this level of car, are you worried about information security, and system hacking?	(Garbarino & Strahilevitz, 2004)
Intention to Adoption	11. Are you willing to buy this level of car?	(Fishbein & Ajzen, 1977)
Innovation resistance	12. Are you uncomfortable towards this level of car?	(Ram, S. 1987)

3.4 Data Distribution

Descriptive statistics for customer demographics and dependent variables in table 4 and table 5. The distribution of respondents according to customer demographic and perceived risk, customer attitudes in table 6.

Table 4. Descriptive statistics for customer demographics

Variable	Obs	Mean	Std. Dev.	Min	Max
Gender	334	1.515	0.501	1	2
age	334	40.057	10.809	22	69
marriage	334	1.653	0.477	1	2
kids	334	0.760	0.632	0	2
education	334	2.835	0.502	1	4
income	334	3.841	1.406	1	6
carownershp	334	2.317	0.549	1	3
experience	333	3.769	1.447	1	5
expert	334	1.787	0.410	1	2
adopter	334	3.153	1.003	1	5

Table 5. Descriptive statistics for explanatory variables and dependent variables

Variable	Obs	Mean	Std. Dev.	Min	Max
lv0_rigidity	334	2.982	1.060	1	5
lv0_complexity	334	2.880	0.970	1	5
lv0_fun	334	2.943	0.989	1	5
lv0_trust	334	3.246	0.873	1	5
lv0_convenience	334	2.808	1.079	1	5
lv0_physicalrisk	334	3.249	0.934	1	5
lv0_socialrisk	334	2.656	0.896	1	5
lv0_economicrisk	334	2.937	0.910	1	5
lv0_function risk	334	2.898	0.881	1	5
lv0_systemrisk	334	2.386	1.027	1	5
lv0_IntentiontoUse	334	2.919	1.041	1	5
lv0_IR2	334	2.731	0.926	1	5
lv1_rigidity	334	2.246	0.680	1	4
lv1_complexity	334	2.662	0.843	1	5
lv1_fun	334	3.383	0.712	1	5
lv1_trust	334	3.473	0.687	1	5
lv1_convenience	334	3.754	0.624	2	5
lv1_physicalrisk	334	2.838	0.797	1	5
lv1_socialrisk	334	2.455	0.822	1	5
lv1_economicrisk	334	2.970	0.831	1	5
lv1_function risk	334	3.081	0.843	1	5
lv1_systemrisk	334	2.802	0.919	1	5
lv1_IntentiontoUse	334	3.443	0.736	1	5
lv1_IR2	334	2.371	0.831	1	5
lv2_rigidity	334	2.201	0.738	1	5
lv2_complexity	334	2.931	0.848	1	5
lv2_fun	334	3.515	0.754	1	5

Variable	Obs	Mean	Std. Dev.	Min	Max
lv2_trust	334	3.326	0.709	2	5
lv2_convenience	334	3.793	0.690	2	5
lv2_physicalrisk	334	2.743	0.824	1	5
lv2_socialrisk	334	2.446	0.839	1	5
lv2_economicrisk	334	3.257	0.798	1	5
lv2_function risk	334	3.419	0.851	1	5
lv2_systemrisk	334	3.189	0.899	1	5
lv2_IntentiontoUse	334	3.452	0.703	1	5
lv2_IR	334	2.530	0.830	1	5
lv3_rigidity	334	2.407	0.918	1	5
lv3_complexity	334	3.027	0.954	1	5
lv3_fun	334	3.401	0.887	1	5
lv3_trust	334	3.033	0.803	1	5
lv3_convenience	334	3.743	0.767	1	5
lv3_physicalrisk	334	3.006	0.894	1	5
lv3_socialrisk	334	2.623	0.884	1	5
lv3_economicrisk	334	3.506	0.852	1	5
lv3_function risk	334	3.671	0.816	1	5
lv3_systemrisk	334	3.518	0.896	1	5
lv3_IntentiontoUse	334	3.222	0.823	1	5
lv3_IR2	334	2.808	0.887	1	5
lv4_rigidity	334	2.485	1.159	1	5
lv4_complexity	334	3.075	1.087	1	5
lv4_fun	334	3.410	1.044	1	5
lv4_trust	334	2.868	0.962	1	5
lv4_convenience	334	3.826	0.927	1	5
lv4_physicalrisk	334	3.165	1.013	1	5
lv4_socialrisk	334	2.728	0.962	1	5
lv4_economicrisk	334	3.766	0.897	1	5
lv4_function risk	334	3.871	0.893	1	5

Variable	Obs	Mean	Std. Dev.	Min	Max
lv4_systemrisk	334	3.719	0.973	1	5
lv4_IntentiontoUse	334	3.051	1.037	1	5
lv4_IR2	334	2.892	1.008	1	5

Table 6.The distribution of respondents with respect to customer demographic characteristics

Division		Frequency	Percent rate(%)	Definition
Gender	Male	162	48.5	Male = 1 , Female =2
	Female	172	51.5	
Age	20 -29	82	24.55	Age group 20-29 = 2, Age group 30-39 = 3, Age group 40-49 =4, Age group 50-59 = 5, Age group 60-69 = 6
	30- 39	82	24.55	
	40-49	86	25.75	
	50-59	67	20.06	
	60-69	17	5.09	
Marriage	Single	116	34.73	Single =0, Marry_Nokids =1, Marry_Kids=2
	Marry+No kids	192	54.49	
	Marry +Kids	36	10.78	
Education	No school graduate	4	1.2	No school graduate = 1, High school graduate=2,University Graduate=3, Graduate school(Master, PhD) = 4
	High school graduate	62	18.56	
	University Graduate	253	75.75	
	Graduate school	15	4.49	
Income	Lower	5	1.5	Lower than $1000 =1, From

Division		Frequency	Percent rate(%)	Definition
	than $1000			$1000 to $1999 =2, From $2000 to $2999 =3, From $3000 to $3999 =4, From $4000 to $5000 =5, Higher than 5000 =6
	From $1000 to $1999	52	15.57	
	From $2000 to $2999	110	32.93	
	From $3000 to $3999	55	16.47	
	From $4000 to $5000	48	14.37	
	Higher than 5000	64	19.16	
carownership	None	14	4.19	None in respondent's house= 1, one =2, more than 2 = 3
	one	200	59.88	
	more than two	120	35.93	
Experience	Less than one year	39	11.68	Driving Experience after receiving driver license. Less than one year =1, 1~2 year =2, 2~3 year =3, 3~4 year =4, More than 4 year =5
	1~2 years	39	11.68	
	2~3 years	44	13.17	
	3~4 years	49	14.67	
	More than 4 years	163	48.8	
Expert	Working in automobile	71	21.26	Working in automobile =1, Who's not related in automobile =2
	Not related in	263	78.74	

Division		Frequency	Percent rate(%)	Definition
	automobile			
Adopter	Innovator	13	3.89	I began to use new product because I like to use new things. (Innovator) =1, I used to buy new product earlier than surrounding people. (Early Adopter) =2, I used to buy new product earlier than surrounding people. (Early Marjoity) =3, I used to buy new product earlier than surrounding people.(Late Majority) =4, I used to buy new product earlier than surrounding people. (Laggards) =5
	Early Adopter	71	21.26	
	Early Majority	138	41.32	
	Late Majority	76	22.75	
	Laggards	36	10.78	

The distribution of the respondents according to adoption of self-driving car is above table 4. Moreover, adopter groups are distributed innovator as early adopter, early majority, and late majority, and laggards with evaluation of personality, innovativeness, or different communication behavior. (Rogers, 2010) In this research, it was collected rogers diffusion model in figure 3. Innovator, early adopter, early majority, late majority, laggards. Firstly, the rate of innovator among respondents was 3.89 %. Followed by early adopter, the rate of early adopter among respondents was 21.26%. The rate of early majority among respondents was 41.32 %. And, the rate of late majority among respondents was 22.75%.

The rate of Laggards among respondents was 10.78 %.

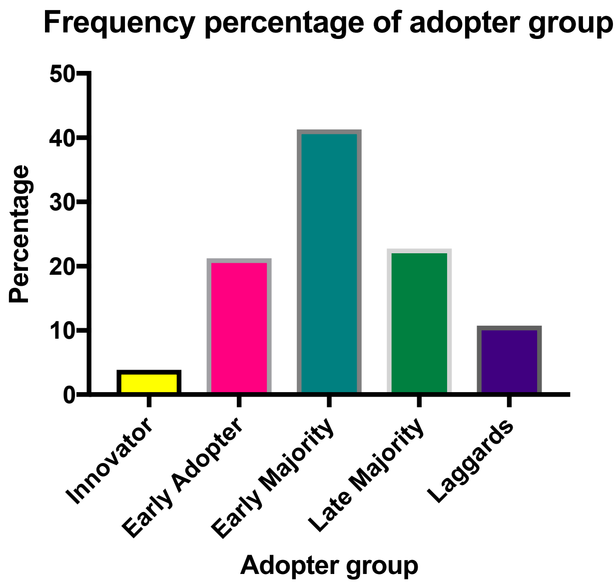

Figure 3. Frequency percentage of adopter group

3.5 Data Quality

For data quality, it is needed to check for multicollinearity before running a regression analysis. Multicollinearity is needs to be checked before running a regression analysis. Multicollinearity is to obtain the correlation with the variables in between X variables. If multi-collinearity appears high, results predicted by regression anlaysis are not correct. This multi-collinearity can be measured by variance-inflating factor (VIF). The VIF is the most commonly used formula in regression analysis, which is applicable only to data consisting of numerical types. Multicollinearity can be suspected for multi -

collinearity when VIF value is between 5 and 10, and for ensuring multicollinearity when it is more than 10. In this study, all VIF values are less than 3, therefore there's no multicollinearity problem in this study.

After checking the multicollinearity, the validity test was conducted by KMO and bartlett. Sampling adequacy was measured by this factor analysis. It is recommending way to check whether can be executed to proceed on research or not. If the value of KMO is over 0.6, it is accepted to conduct research. Also, Bartlett's Test of Sphericity is for checking suitability and validity for responses from survey used in this research. It should be less than 0.05.

The explorative analysis was obtained using the SPSS program and the degree of correlation between the items was calculated by KMO and Bartlett (Williams, Onsman, & Brown, 2010). In this study, we have KMO value over 0.60, and significance level in Bartlett is 0. Therefore, we completed to check validity and suitability of the responses.

Table 7. Explorative anlaysis

Level	Variable	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	Bartlett's Test of Sphericity		
			Approx. Chi-Square	df	Significance.
0	Customer Attitude	0.784	650.919	10	0
	Perceived risk	0.665	251.485	10	0
1	Customer Attitude	0.748	409.151	10	0
	Perceived risk	0.694	314.973	10	0
2	Customer Attitude	0.747	377.216	10	0
	Perceived risk	0.637	172.789	10	0
3	Customer Attitude	0.729	826.264	10	0
	Perceived risk	0.772	395.824	10	0
4	Customer Attitude	0.775	492.681	10	0
	Perceived risk	0.604	223.828	10	0

3.6 Methodology

In this study, multiple regression model is used to estimate influential factors to innovation resistance and intention to adoption. With data from survey, perceived risk variables and customer attitude explanatory variables are used as significant factor of innovation resistance and intention to adoption.

3.6.1 **Multiple regression model**

Regression analysis are widely used for forecasting, and are used to understand which dependent variable relates to explorative variables. In this study, we want to analyze the relationship in which one dependent variable is affected by two or more explanatory variables. Multiple regression analysis was performed because there were two or more independent variables. (Greene, 2003)

In this paper, the dependent variable of multiple regression analysis is innovation resistance that varies with each level from no automation to full-automation. The independent variable corresponded to five different perceived risk and five different customer attitude. Also, to compare with innovation resistance, another model with intention to adoption as dependent variable is turned into multiple regression model.

In this research, we will use the following multiple regression formulas for innovation resistance and intention to adopt.

3.6.1.1 Innovation resistance

$$y_{ij} = \beta_0 + \beta_1 P_{ij}^1 + \beta_2 P_{ij}^2 + \beta_3 P_{ij}^3 + \beta_4 P_{ij}^4 + \beta_5 P_{ij}^5 + \beta_6 A_{ij}^6 + \beta_7 A_{ij}^7 + \beta_8 A_{ij}^8 + \beta_9 A_{ij}^9 + \beta_{10} A_{ij}^{10} + \varepsilon_{ij} \ldots\ldots \text{Eq. (1)}$$

y = innovation resistance

where i stands for each respondent

where j stands for autonomy of level , it can be either only 0,1,2,3 or 4

where $P^k (if \;\; k = 1,2,3,4,5)$, stands for perceived risk variable.

$(P^1 = physical \;\; risk, \; P^2 = Social \;\; risk, \; P^3 = Economic \;\; risk$

$P^4 = Function \;\; risk, \quad P^5 = System \quad risk)$

where $A^k (if \;\; k = 6,7,8,9,10)$, stands for customer attitude variable.

$(\mathrm{A}^1 = \text{Rigidty}, \; \mathrm{A}^2 = \text{Triability}, \; \mathrm{A}^3 = \text{Trust}, \; \mathrm{A}^4 = \text{Fun}, \; \mathrm{A}^5 = \text{Convenience})$

In equation 1, innovation resistance is used as a dependent variable. This model analyzes each level of innovation resistance driven by perceived risks and customer attitudes. Exploratory variables are represented by P^k and A^k. As you see above explanation, each number of k stands for each variable.

3.6.1.2 Intention to Adoption

$$\mathrm{y}_{ij} = \beta_0 + \beta_1 P_{ij}^1 + \beta_2 P_{ij}^2 + \beta_3 P_{ij}^3 + \beta_4 P_{ij}^4 + \beta_5 P_{ij}^5 + \beta_6 A_{ij}^6 + \beta_7 A_{ij}^7 + \beta_8 A_{ij}^8 + \beta_9 A_{ij}^9 + \beta_{10} A_{ij}^{10} + \varepsilon_{ij} \qquad \ldots.\mathrm{Eq.}\,(2)$$

y = intention to adoption

where i stands for each respondent

where j stands for autonomy of level , it can be either only 0,1,2,3 or 4

where $P^k(if\ \ k = 1,2,3,4,5)$, stands for perceived risk variable.

$(\ P^1 = physical\ \ risk,\ P^{\ 2} = Social\ \ risk,\ P^3 = Economic\ \ risk$

$P^{\ 4} = Function\ \ risk, \qquad P^5 = System \quad risk)$

where $A^k(if\ \ k = 6,7,8,9,10)$, stands for customer attitude variable.

$(\ \mathrm{A}^1 = \mathrm{Rigidty},\ \mathrm{A}^{\ 2} = \mathrm{Triability},\ \mathrm{A}^3 = \mathrm{Trust},\ \mathrm{A}^{\ 4} = \mathrm{Fun},\ \mathrm{A}^5 = \mathrm{Convenience})$

After collecting data from survey, data processing processed followed by above formula. In this study, variable rigidity and physical risk were taken on the opposite scale during the process of data on the questionnaire. This is in order to measure the correct value so that people do not arbitrarily set the value by asking the concept opposite to the definition in the questionnaire item.

Chapter 4. Analysis Result

4.1 Multiple regression Model

4.1.1 Model 1: Innovation resistance

In this research, multiple regression model is used to analyze relationship among perceived risks and customer attitudes to innovation resistance. With this model, it is significant factors for innovation resistance and investigated into dynamic changes towards level of autonomy. In this model, significant variables among perceived risks and customer attitudes to innovation resistance and intention to adoption are investigated. Multiple regression model is useful to compare innovation resistance and intention to adoption model driven by different drivers in table 8.

Table 8. Multiple regression models for innovation resistance

	Level of autonomy				
	0	**1**	**2**	**3**	**4**
Variables	Innovation resistance	Innovation resistance	Innovation resistance	Innovation resistance	Innovation resistance
Perceived risk	-0.09	-0.037	-0.015	0.039	0.126*
Physical risk	(0.049)	(0.048)	(0.047)	(0.054)	(0.053)
Social risk	0.243***	0.329***	0.470***	0.384***	0.312***
	(0.045)	(0.051)	(0.041)	(0.048)	(0.045)
Economic risk	-0.022	0.115*	0.075	-0.003	0.100*
	(0.052)	(0.052)	(0.045)	(0.053)	(0.051)
Function risk	0.169**	-0.012	0.108*	0.089	0.044
	(0.057)	(0.056)	(0.045)	(0.068)	(0.061)
System risk	0.133**	0.161**	0.103*	0.093	0.09
	(0.048)	(0.051)	(0.042)	(0.056)	(0.053)
Customer attitude	0.248***	0.113	0.142*	0.240***	0.266***
Rigidity	(0.056)	(0.069)	(0.057)	(0.060)	(0.052)
Complexity	0.239***	0.180***	0.079	0.107*	0.081*
	(0.045)	(0.049)	(0.042)	(0.044)	(0.039)
Fun	0.006	-0.075	-0.084	0.004	-0.155**
	(0.061)	(0.065)	(0.057)	(0.063)	(0.057)
Trust	-0.192**	-0.038	-0.111	0.025	-0.004
	(0.059)	(0.065)	(0.059)	(0.067)	(0.064)
Convenience	-0.05	-0.074	-0.103	-0.056	-0.022
	(0.057)	(0.076)	(0.060)	(0.068)	(0.057)
Constant	0.947*	0.844*	0.993**	0.255	0.474
	(0.482)	(0.510)	(0.453)	(0.562)	(0.520)
Observations	334	334	334	334	334
R squared	0.469	0.427	0.526	0.337	0.484

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

4.1.1.1 Levels Interpretation

The impacts of factors which affect to innovation resistance were shown differ according to level of autonomy. In Level 1, social risk had significant relationship with innovation resistance. (β =.133) Customer who cared surrounding people s opinion, it was highly to get innovative resistance.

Secondly, the value of social risk at level 3 was lower than at Level 2. This showed that customers were more accustomed to use function of automation as level went higher. As a result, they were less inclined to worry social risk and concerned about other people's opinion. In addition, the functional difference between Level 2 and Level 3 can be interpreted as a socially negative view of the ADAS system, which combines two functions of autonomy.

Finally, in level 4 of autonomy, the value of Fun had a negative correlation ($\beta = -.155$) with innovation resistance. At the level where everything is full automated (level4), people perceive easier to use rather this automated functions than perceive features are complicated. The figures for results of multiple regression of innovation resistance is followed.

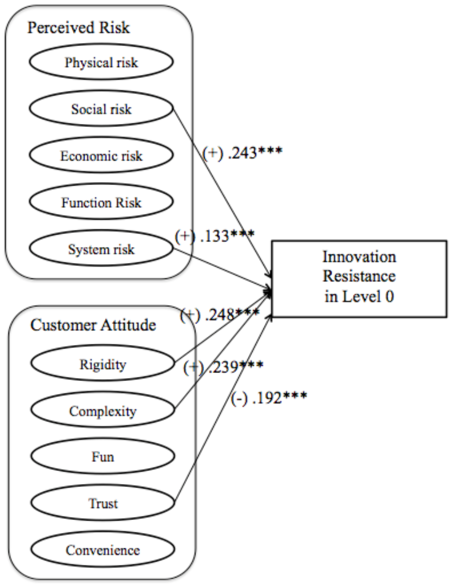

Figure 4. Innovation resistance in level 0

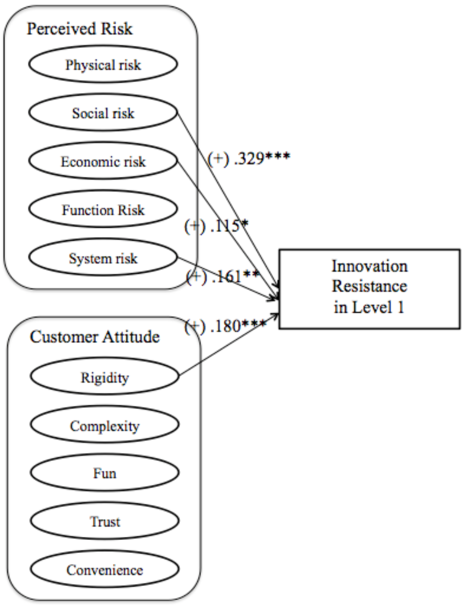

Figure 5. Innovation resistance in level 1

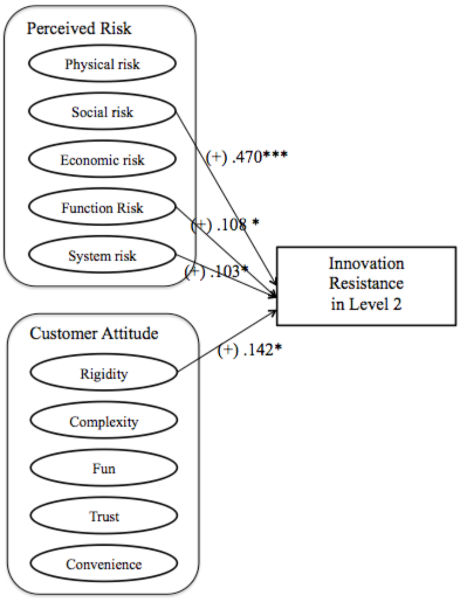

Figure 6. Innovation resistance in level 2

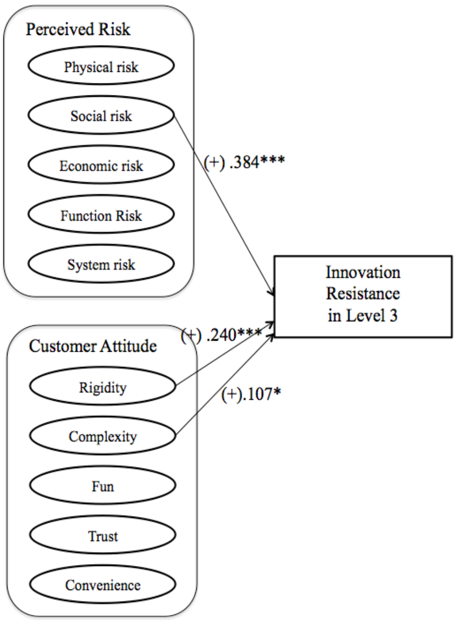

Figure 7. Innovation resistance in level 3

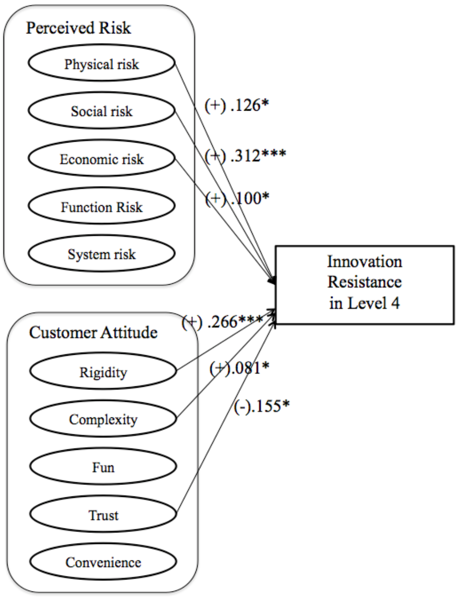

Figure 8. Innovation resistance in level 4

4.1.1.2 Variable Interpretation

After investigating impacts according to level of autonomy, significant factors to innovation resistance were identified in this section. First, physical risk had a significant positive relationship with innovation resistance on Level 4. ($\beta = .126$) When customer gave full driving responsibility to autonomy, they concerned about injury from accidents which occur suddenly, leading to higher innovation resistance.

Secondly, social risk had highest significant among perceived risk and customer attitudes. The reason why Korean consumers do not accept autonomous vehicles is that they are reluctant to buy because of surrounding people. The highest significance level of social risk is autonomy level 2 (β =.470).

Thirdly, function risk is identified as significance variable in non-autonomy car. In advance, potential consumer showed their distrust to function of this level of car. Function risk had low value in level that everything is automated and the function does not work smoothly.

The system risk had a high significance value from level 0 (β =.133) to level 2 (β =.103). When people drive fully automated cars with automated function, the value of system risk increased leading to innovation resistance.

4.1.2 Model 2: Intention to Adoption

In order to investigate effect of innovation resistance and other variables on intention to adoption after innovation resistance, it is estimated by using multiple regression with previous way.

Table 9. Multiple regression models for intention to adoption

	Level of autonomy				
	0	1	2	3	4
Variables	Intention to adoption	Intention to adoption	Intention to adoption	Intention to adoption	Intention to adoption
Perceived risk	-0.143**	-0.066	-0.051	-0.149***	-0.102*
Physical risk	(0.046)	(0.041)	(0.055)	(0.041)	(0.046)
Social risk	-0.084	0.01	-0.06	-0.009	-0.023
	(0.043)	(0.041)	(0.048)	(0.037)	(0.039)
Economic risk	0.115*	-0.025	-0.002	-0.101*	-0.154***
	(0.049)	(0.041)	(0.052)	(0.041)	(0.044)
Function risk	0.019	2.351***	0.083	-0.058	-0.093
	(0.054)	(0.430)	(0.052)	(0.052)	(0.053)
System risk	0.078	-0.066	-0.02	0.027	0.068
	(0.046)	(0.041)	(0.049)	(0.044)	(0.046)
Customer attitude	-0.372***	-0.265***	-0.096	-0.328***	-0.344***
Rigidity	(0.053)	(0.058)	(0.066)	(0.046)	(0.045)
Complexity	-0.011	-0.092*	0.028	-0.018	0.041
	(0.042)	(0.041)	(0.048)	(0.034)	(0.034)
Fun	0.131*	0.223***	0.179**	0.210***	0.213***
	(0.058)	(0.054)	(0.066)	(0.049)	(0.049)
Trust	0.098	0.112*	-0.046	0.171**	0.202***
	(0.056)	(0.054)	(0.068)	(0.052)	(0.056)
Convenience	-0.05	-0.074	-0.103	-0.056	-0.022
	(0.057)	(0.076)	(0.060)	(0.068)	(0.057)
Constant	3.027***	2.345***	2.684***	3.723***	3.170***
	(0.456)	(0.433)	(0.426)	(0.435)	(0.453)
Observations	334	334	334	334	334
R squared	0.623	0.473	0.419	0.540	0.630

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

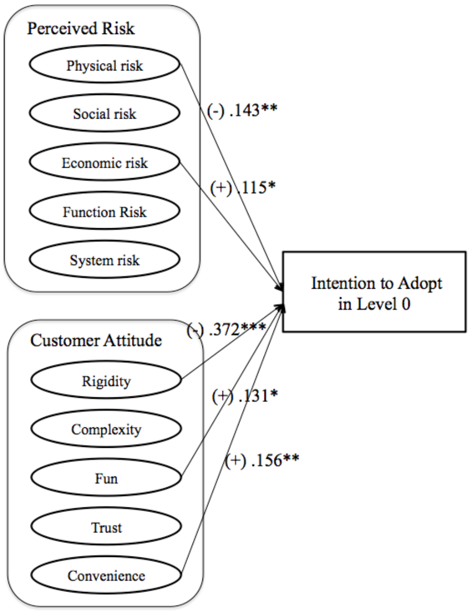

Figure 9. Intention to adopt in level 0

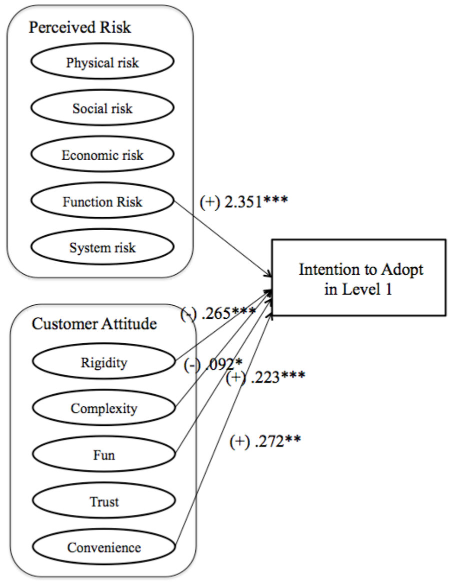

Figure 10. Intention to adopt in level 1

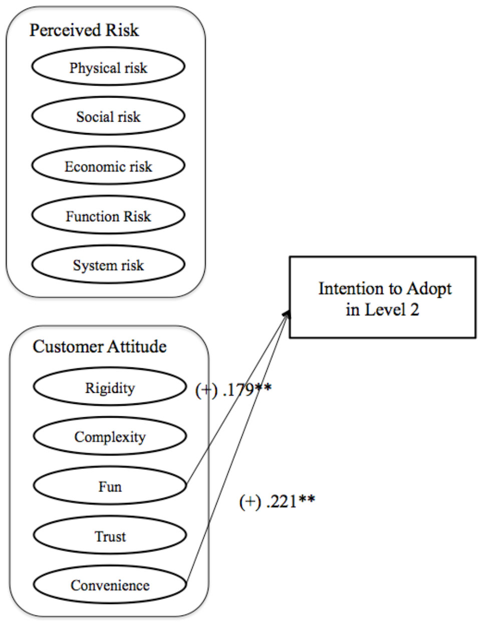

Figure 11. Intention to adopt in level 2

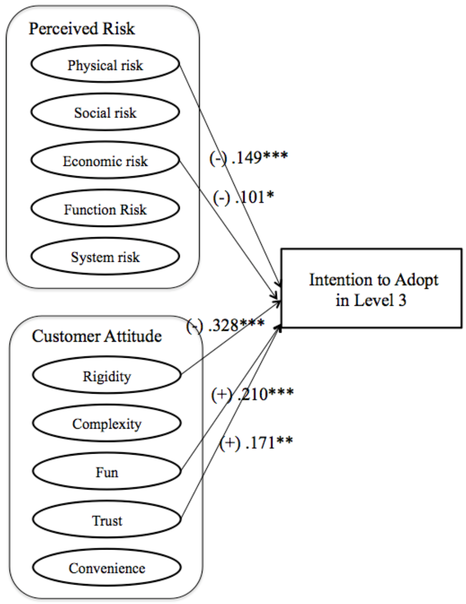

Figure 12. Intention to adopt in level 3

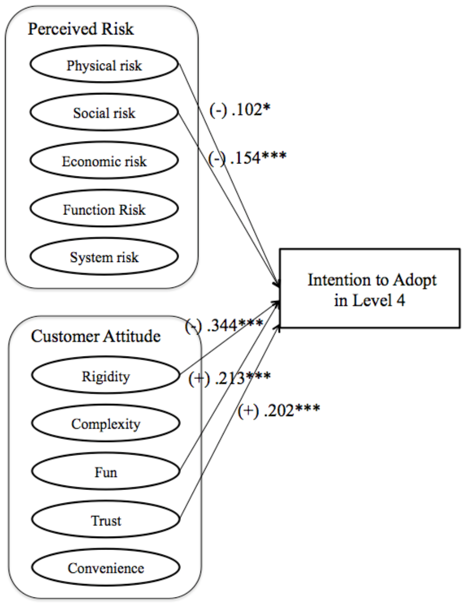

Figure 13. Intention to adopt in level 4

4.1.2.1 Level Interpretation

Firstly, at level 0, the physical risk had negatively significant value to intention to adoption in this multiple regression model. At the level 0, consumers had a perception why they purchase self-driving cars or reason why it reduces intention to adoption. Likewise, fun is one of characteristic of why consumers purchase self-driving car and had a significant influence on intention to adoption. As a whole, customer attitude are crucial factor, leading to intention to adoption. The more people are interested in non-automobiles, the higher the intention to adoption.

Secondly, at level 1, fun had significant positive relationship to intention to adoption. Customers who feel fun when riding a self-driving car in level 1, they more likely to adopt self-driving car. In level 2, it gives a pleasure with basic automation technologies such as navigation and cruise control, related with the purchase of cars.

At level 4, more number of factors gave significant impacts to intention to adoption than any other level of autonomy. It showed that economic risk had a high significance positive relationship with intention to adoption. For who hesitate to buy automobiles because of economic burden, they were less likely to purchase self-driving car. Therefore, if some automobile corporations reduced the economic burden using marketing strategy such as lowering price, it can increase the intention to adoption of the consumers and generate higher profit than other corporations.

4.1.2.2 Variable Interpretation

After investigating different impacts according to level of autonomy, significant factors are identified in this analysis. Firstly, it showed that economic risk had negatively significant relationship with innovation resistance in level 4. ($\beta = -.0.154$) Consumers who perceive full autonomous vehicles as high-tech products, the price of high autonomous vehicles can be a huge burden to them.

Secondly, it revealed that rigidity has negatively significant relationship with innovation resistance in the whole level of autonomy. Consumers who hesitate to change to new products, they less likely to adopt self-driving car. Significantly, the variable of fun showed positive significance with innovation resistance in whole level of autonomy. Taken as a whole, customers who perceived it is fun to drive self-driving car, it is more likely to adopt self-driving car.

Next, it highlighted that there was significant positive between trust and intention to adoption in the level of 1. (β =.112) It appeared that customer who trusted to drive self-driving car are more likely to adopt self-driving car. As a result of examining the factors that significantly affect intention to adoption, it would seem that different factors impact to innovation resistance and intention to adoption.

4.1.3 **Comparison results between innovation resistance and intention to adoption**

As a whole, it is showed that important factors of innovation resistance were based on perceived risk, while important factors of intention to adoption were based on customer attitudes. As most significant variable is perceived risk of innovation resistance, people might concern about other people's perception to innovative product and it affect to innovation resistance on autonomous car. By increasing awareness of social awareness through mass media or social media, innovation resistance can be lowered according to this result.

In the case of intention to adoption, the analysis identified that highest significant variables among perceived risk are physical risk and economic risk. Perceived risk to intention to adoption were observed differ from those of innovation resistance, including consumers consider autonomy functions in the process of decision making to purchase. Our results found that fun and trust are crucial variable when consumers intent to purchase autonomous vehicles. Remarkably, this result was totally different to regression results from innovation resistance.

In previous studies, Ram (1987) argued that lowering the resistance of increases intention to adoption or by increasing the resistance to innovation, the intention to adoption might be lowered in innovation resistance model. As conducted by Heidenreich(2016) and Lian(2012), it demonstrated empirically how increasing innovation resistance lowers intention to adoption.

The evidence from this study contradicted the fact that empirical studies had already been conducted to increase intention to adoption by lowering innovation resistance. Even no matter how much innovation resistance is lowered, there is actually no inverse direct relationship between the variables that affect innovation resistance and the variables that influence intention to adoptionn Therefore, it highlighted the result that lowering innovation resistance does not cause a direct effect to higher intention to adoption.

4.1.4 **Outliers**

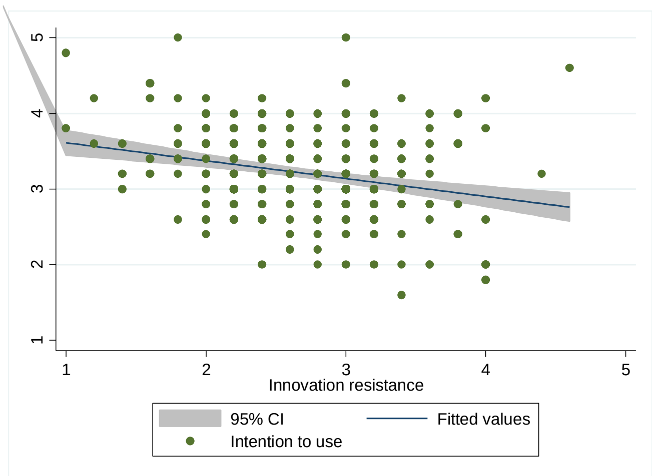

Figure 14. Regression graph how innovation resistance affects to intention to adopt.

The basic idea between innovation resistance and intention to adoption are known as reverse relationship evidenced by previous above studies. However, the graph showed outliers after regression results. One possible way of relationship between innovation resistance and intention to adoption are generally inversely related, but there are outliers for which this relationship does not exist. Based on our survey, there are lots of outliers dots which do not follow this linear relationship, and unexpected difference has revealed in this research.

4.2 Additional Analysis

In this study, this analysis method was executed by options for dividing potential consumers of self-driving car. After data processing, different four consumer group were identified based on innovation resistance level and intention to adoption level. Afterwards, particular groups that were specified in our analysis are LOW IR(Innovation resistance) & LOW IA(Intention to adoption) group and HIGH IR & HIGH IA group. Different analysis results were found depending on the customer group. According to Ram's previous research, result supported lowering the innovation resistance enabled to help increase intention to adoption by different customer groups.

4.2.1 **Customer group descriptions**

Innovation Resistance(IR) \ Intention to Adoption (IA)	High	Low
High	HIGH IR LOW IA	HIGH IR HIGH IA
Low	LOW IR LOW IA	LOW IR HIGH IA

Figure 15. Customer group

Customer were identified based on innovation resistance level and intention to adoption level after data processing. It had four different four groups which are HIGH IR & HIGH IA group, HIGH IR & LOW IA group, LOW IR & LOW IA group, and LOW IR & HIGH IA group.

HIGH IR & LOW IA group: High innovation resistance, low intention to adoption. It is based on relationship that is described by Ram(1987) which higher innovation resistance would lower intention to adoption. Because of the high rejection of autonomous vehicles, this rejection will lead to intention to adoption.

HIGH IR & HIGH IA group: High innovation resistance in the group with both innovation resistance and intention to adoption in IA, the resistance to autonomous vehicles is very high and the intention to adoption is also very high. Therefore, it is needed to concern significant variables, which are likely to lead to purchase.

LOW IR & LOW IA group: Innovation resistance is low, but intention to adoption is also low. Though people has any resistance or innovation resistance to autonomous cars, they don't want to buy a car. Because it does not have an innovation resistance, it encourages purchase through other variables that affect intention to adoption.

LOW IR & HIGH IA group: This group of potential consumers who have low innovation resistance and high intention to adoption. Autonomous vehicles are most likely to purchase autonomous vehicles, with low innovation resistance and high intention to adoption. If you see this analysis as marketer's point of view, this group that needs to focus most. Results of regression analysis with four different groups were shown in below table. The most significant groups are LOW IR and LOW IA group and HIGH IR and HIGH IA group. These groups are basically seen as a group contrary to the basic theories that Ram argue that innovation resistance and intention to adoption are generally inversely related, and that reducing innovation resistance increases intention to adoption. Therefore, in order to increase the high intention to adoption, we do not simply measure the variables that affect innovation resistance but compare it with low innovation resistance group to see how innovation resistance is correlated with different factors and what variables influence intention to adoption.

Table 10. Regression results for level 4

	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA
Variables	Innovation resistance				Intention to adoption			
Rigidity	0.229***	0.307***	0.111	0.366***	-0.227***	-0.340***	-0.435***	-0.269***
	(0.0503)	(0.0967)	(0.0945)	(0.0505)	(0.0552)	(0.0539)	(0.0902)	(0.0459)
Complexity	0.0453	0.286***	0.0701	0.0585	0.0205	0.0560	0.0628	0.0149
	(0.0390)	(0.0729)	(0.0559)	(0.0413)	(0.0428)	(0.0407)	(0.0533)	(0.0375)
Fun	-0.155***	-0.249**	-0.235**	-0.188***	0.269***	0.361***	0.151	0.280***
	(0.0553)	(0.118)	(0.0986)	(0.0540)	(0.0608)	(0.0659)	(0.0941)	(0.0491)
Trust	-0.0895	0.190	-0.0843	0.0521	0.168**	0.0142	0.268***	0.109*
	(0.0718)	(0.130)	(0.0956)	(0.0621)	(0.0789)	(0.0723)	(0.0912)	(0.0564)
Convenience	-0.0327	0.0777	-0.170*	0.0323	0.0447	0.231***	0.120	0.172***
	(0.0569)	(0.115)	(0.0872)	(0.0552)	(0.0625)	(0.0643)	(0.0832)	(0.0502)
Physical risk	0.213***	0.195*	0.105	0.0278	-0.174***	-0.187***	0.0278	-0.0767*
	(0.0578)	(0.114)	(0.0737)	(0.0502)	(0.0635)	(0.0634)	(0.0704)	(0.0456)
Social risk	0.211***	0.198**	0.225***	0.324***	0.119**	0.0256	-0.0135	-0.0551
	(0.0423)	(0.0923)	(0.0630)	(0.0463)	(0.0464)	(0.0515)	(0.0601)	(0.0420)
Economic risk	0.111**	0.0938	0.154**	0.0722	-0.195***	-0.122**	-0.152**	-0.153***
	(0.0504)	(0.0968)	(0.0650)	(0.0545)	(0.0554)	(0.0540)	(0.0620)	(0.0495)

	Innovation resistance				Intention to adoption			
	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA
Functional risk	-0.0177	0.127	-0.0135	0.0704	-0.0151	-0.176**	-0.166**	-0.0620
	(0.0642)	(0.123)	(0.0863)	(0.0646)	(0.0705)	(0.0688)	(0.0823)	(0.0587)
System risk	0.0159	0.119	0.0976	0.00426	0.0191	0.0912	0.0338	0.0879*
	(0.0544)	(0.115)	(0.0754)	(0.0505)	(0.0597)	(0.0642)	(0.0720)	(0.0459)
Constant	1.966***	-0.553	1.767**	0.0552	2.385***	3.265***	2.811***	3.157***
	(0.542)	(1.062)	(0.798)	(0.489)	(0.596)	(0.592)	(0.762)	(0.444)
Observations	105	62	57	110	105	62	57	110
R-squared	0.779	0.575	0.807	0.738	0.780	0.905	0.859	0.812

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

4.2.2 **Level 4 self-driving car**

In all groups, this result implied how innovation resistance and intention to adoption get affect to variables was investigated. The most significant variables were rigidity and system risk. It seemed that variable of rigidity had a significant value in all areas except the group of low IR and low IA.

In table 10, it is explained regression result for autonomous vehicles for Level 4. This level is fully automated among whole levels in analysis. If the driver tells his or her destination to car, this full automated car will drop him or her off to the destination. For these autonomous vehicles, it highlighted that the largest gap from innovation resistance model to intention to adoption among groups.

In High IR & HIGH IA group, rigidity and system risk were significant to innovation resistance. In this group, it revealed that it was more likely to have greater innovation resistance when potential cousmer had higher system risk. In LOW IR & LOW IA group, economic risk was shown as significant variable to innovation resistance. The greater the economic risk, the greater the innovation resistance.

Depending on intention to adoption, rigidity, fun, convenience, physical risk and functional risk were found to be significant in HIGH IR & HIGH IA group. In Low IR & IA group, rigidity, trust, and functional risk were significant variables. These result showed that the focusing two groups are affected by some different factors, except for the variables of rigidity and functional risk. In the HIGH IR and HIGH IA group, Fun has the greatest impact on intention to adoption (0.361 ***). This meant that fun might be an important factor for people who have high innovation resistance to buy fully autonomous car. While trust was positively significant to intention to adoption in LOW IR and LOW IA group. In LOW IR & LOW IA group, trust is directly related to intention to adoption. Thus, increasing reliability and trust towards autonomous car could increase purchasing power of potential consumers.

4.2.3 Level 3 self-driving car

Level 3 autonomous is autonomous driving levels in which autonomous vehicles run only under special conditions such as expressways, and the driver drives in usual way. The variables that affect commonly to group HIGH IR & HIGH IA and LOW IR & LOW IA are rigidity, complexity, social risk, and system risk. In the case of Low IR, LOW IA group, variable of fun, trust and convenience had revealed that important significance to innovation resistance in LOW IR & LOW IA group compared to group of HIGH IR & HIGH IA. The variable of fun were exclusively significant in all groups except for group of HIGH IR, HIGH IA.

Trust had a positive significance relationship with innovation resistance within the LOW IR & LOW IA group. (0.232) The more trust consumers had in autonomous vehicles at this level, the lower resistance innovation resistance that consumer had. Moreover, it showed that convenience had negative significant relationship to innovation resistance in LOW IR & LOW group. (-0.158) It implied that it is more likely more consumers feel comfortable with this level of autonomous driving, the lower the resistance to innovation.

The relationship between convenience and innovation resistance were included when potential consumer has low innovation resistance.

According to intention to adoption, it revealed that significant variables to innovation resistance as rigidity, fun, trust and physical risk in both HIGH IR and HIGH IA group and LOW IR & LOW IR group. In the High IR and HIGH IA group, essential variables to intention to adoption is functional risk which had negatively significant to intention to adoption. (-0.122) In the group HIGH IR & HIGH IA, when there were a functional risk for an autonomous vehicle with functional abnormality, high possibility might be occurred that it reduced intention to adoption. Therefore, in order to increase the purchase intention, it could be conducted by minimizing the functional risk for potential consumers.

Table 11. Regression results at level 3

	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA
Variables	Innovation resistance				Intention to adoption			
Rigidity	0.317***	0.316***	0.253***	0.139*	-0.347***	-0.443***	-0.321***	-0.272***
	(0.0716)	(0.0897)	(0.0646)	(0.0758)	(0.0593)	(0.0540)	(0.0477)	(0.0582)
Complexity	0.0507	0.199***	0.160***	0.104**	0.0273	-0.0263	-0.0495	-0.0602
	(0.0520)	(0.0705)	(0.0463)	(0.0508)	(0.0431)	(0.0425)	(0.0342)	(0.0390)
Fun	0.191**	-0.0220	0.137*	-0.161**	0.118*	0.128*	0.171***	0.291***
	(0.0812)	(0.113)	(0.0692)	(0.0669)	(0.0672)	(0.0678)	(0.0511)	(0.0514)
Trust	0.0316	0.125	0.232***	0.171**	0.115*	0.224***	0.196***	0.109*
	(0.0786)	(0.113)	(0.0817)	(0.0759)	(0.0651)	(0.0678)	(0.0604)	(0.0583)
Convenience	-0.0808	-0.00514	-0.158**	-0.181*	-0.114*	-0.0443	0.0609	-0.0331
	(0.0795)	(0.100)	(0.0744)	(0.0957)	(0.0659)	(0.0603)	(0.0549)	(0.0735)
Physical risk	-0.0202	0.0194	0.0557	0.0804	-0.167***	-0.134**	-0.0988**	-0.156***
	(0.0672)	(0.0840)	(0.0616)	(0.0618)	(0.0556)	(0.0506)	(0.0455)	(0.0475)
Social risk	0.288***	0.314***	0.363***	0.275***	0.0145	-0.0694	0.0144	0.0734*
	(0.0592)	(0.0942)	(0.0482)	(0.0528)	(0.0490)	(0.0567)	(0.0356)	(0.0406)
Economic risk	-0.0259	-0.0268	-0.0574	0.0269	-0.0435	-0.0595	-0.123***	-0.0883**
	(0.0685)	(0.0891)	(0.0589)	(0.0577)	(0.0567)	(0.0536)	(0.0435)	(0.0443)

	Innovation resistance				Intention to adoption			
	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA
Functional risk	0.256***	0.0549	0.127	0.0167	-0.0810	-0.122*	0.0281	0.00389
	(0.0878)	(0.113)	(0.0800)	(0.0691)	(0.0727)	(0.0677)	(0.0591)	(0.0531)
System risk	-0.0439	0.190*	0.133**	0.0376	-0.0718	0.106*	0.0522	0.0698
	(0.0723)	(0.103)	(0.0655)	(0.0547)	(0.0599)	(0.0621)	(0.0484)	(0.0420)
Constant	0.688	0.123	-1.265*	1.067	4.311***	4.757***	2.802***	3.669***
	(0.629)	(0.856)	(0.663)	(0.694)	(0.521)	(0.515)	(0.490)	(0.533)
Observations	95	63	77	99	95	63	77	99
R-squared	0.499	0.521	0.722	0.571	0.684	0.826	0.874	0.723

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Moreover, system risk had positively significant relationship with intention to adoption. (0.106) In the group of HIGH IR & HIGH IA, this variable shows significance to innovation resistance and intention to adoption. System risk is considered as important factor whether to adopt conditional autonomous vehicle for potential consumer who has high innovation resistance and high intention to adoption. Even they have high innovation resistance and high system risk, they have high willingness to pay this level of car.

In the LOW IR & LOW IA group, the economic risk is a variable has significance to the intention to adoption. The lower the economic risk, the higher the intent to purchase for this group. Lower innovation resistance and lower intention to adoption require lower economic risks in order to increase consumer purchases.

4.2.4 **Level 2 self-driving car**

To assess level 2 self-driving by four different groups, it was conducted as regression result with dependent variable as innovation resistance and intention to adoption. As mentioned before, this analysis focused especially on two specific group which included in group HIGH IR & HIGH IA and group LOW IR & LOW IA. In High IR& HIGH IA group, rigidity, social risk, functional risk, and system risk were shown as significant variables to innovation resistance. In LOW IR & LOW IA group, rigidity, complexity, trust, social risk, and system risks were revealed as significant variables to innovation resistance.

For rigidity variable in customer attitude, it had impact to innovation resistance and intention to adoption significantly for all groups. This variable was considered as essential factor to both innovation resistance and intention to adoption. In group High IR & HIGH IA, and group of LOW IR & LOW IA, innovation resistance, it had commonly significant factors, which are rigidity and system risk. System risk was revealed as positively significant to innovation resistance for both two group. As system risk increased, innovation resistance to self-driving car had increased. It is more likely that potential consumer concerned about system risk like hacking or information spill towards self-driving car, and it persuaded them to hesitate to possess self-driving car eventually.

Table 12. Regression results at level 2

	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA
Variables	Innovation resistance				Intention to adoption			
Rigidity	0.0470	0.197***	0.154*	0.137**	-0.165**	-0.184***	-0.185**	-0.339***
	(0.0948)	(0.0571)	(0.0802)	(0.0676)	(0.0689)	(0.0556)	(0.0805)	(0.0634)
Complexity	-0.0284	0.0671	0.157***	0.0932**	-0.0378	-0.0475	-0.0464	0.00675
	(0.0581)	(0.0513)	(0.0569)	(0.0442)	(0.0422)	(0.0499)	(0.0572)	(0.0415)
Fun	-0.0294	-0.0653	-0.00868	-0.166***	0.224***	0.270***	0.210***	0.226***
	(0.0926)	(0.0555)	(0.0762)	(0.0617)	(0.0673)	(0.0540)	(0.0765)	(0.0578)
Trust	-0.143	-0.0416	-0.276***	-0.0950	0.0815	0.0287	0.0570	0.0272
	(0.0955)	(0.0640)	(0.0941)	(0.0599)	(0.0694)	(0.0623)	(0.0945)	(0.0561)
Convenience	-0.236***	-0.120	-0.0789	-0.0819	0.0539	0.306***	0.179**	0.0539
	(0.0766)	(0.0810)	(0.0830)	(0.0723)	(0.0556)	(0.0788)	(0.0834)	(0.0678)
Physical risk	-0.0860	-0.0278	-0.0556	-0.0825*	-0.0366	-0.00781	-0.0178	-0.0446
	(0.0792)	(0.0556)	(0.0668)	(0.0456)	(0.0576)	(0.0542)	(0.0670)	(0.0428)
Social risk	0.380***	0.511***	0.296***	0.435***	-0.104**	0.0978**	-0.0771	0.0729*
	(0.0643)	(0.0438)	(0.0623)	(0.0443)	(0.0467)	(0.0426)	(0.0625)	(0.0415)
Economic risk	0.0968	0.0549	0.121*	0.0853*	-0.0764	-0.122**	-0.0950	-0.0509
	(0.0710)	(0.0510)	(0.0607)	(0.0442)	(0.0516)	(0.0496)	(0.0609)	(0.0414)

	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA
	Innovation Resistance				Intention to Adoption			
Functional risk	0.374***	0.127***	-0.0311	0.0728	-0.180***	0.0450	-0.0138	0.0469
	(0.0791)	(0.0444)	(0.0588)	(0.0475)	(0.0575)	(0.0433)	(0.0590)	(0.0445)
System risk	0.106*	0.125**	0.108**	0.0885*	0.0322	-0.0607	0.0791	-0.0215
	(0.0618)	(0.0522)	(0.0527)	(0.0461)	(0.0449)	(0.0508)	(0.0529)	(0.0432)
Constant	1.891**	0.870*	1.329*	1.120**	3.288***	2.363***	2.278***	3.536***
	(0.853)	(0.498)	(0.676)	(0.436)	(0.620)	(0.485)	(0.678)	(0.409)
Observations	86	73	63	112	86	73	63	112
R-squared	0.676	0.877	0.760	0.765	0.696	0.751	0.670	0.619

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Followed by analysis for intention to adoption, result revealed that intention to adoption were varied according to different customer groups. Towards intention to adoption, main influential variables are showed as rigidity, fun, and convenience as whole group. In the group of HIGH IR& high IA, social risk and economic risk took affect to intention to adoption. It identified significant variables for intention to adoption in only HIGH IR & HIGH IA as social risk and economic risk. Remarkably, social risk had a great impact on intention to adoption. Unexpectedly, as social risk increased, intention to adoption increased. LOW IR and LOW IA groups showed a decrease in social risk and an increase in intention to adoption. As a result, overall social risk was noteworthy high in high IR and high IA group, but intention to adoption continued to increase due to characteristics of autonomous vehicles such as fun, rigidity, convenience and so on.

For another significant variable, it would be economic risk in High IR & HIGH IA group. It showed that economic risk had a negative relationship to intention to adoption. (-0.122) Potential consumers have increasing trend of intention to adoption which economic risk has lower value. If potential consumers feel that economic risk is low for a second-level autonomous vehicle with some added functions, intention to adoption would increase.

4.2.5 **Level 1 self-driving car**

In the case of level 1 autonomous car, the variables were shown significant variables in both groups of HIGH IR & HIGH IA and LOW IR & LOW IA as complexity and system risk. The essential variables in the LOW IR & LOW IA group were convenience and social risks for potential consumers. For these potential groups, it was markably considered convenience and social risk as major factor leading to innovation resistance. Firstly, convenience was revealed to be negatively significant relationship to innovation resistance. Compared to other customer group, the group of LOW IR & LOW IA was confirmed as the only group which convenience had negative significant value to innovation resistance.

Table 13. Regression results at level 1

	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA
Variables	Innovation resistance				Intention to adoption			
Rigidity	0.0663	0.178	0.188***	0.198**	-0.277***	-0.331***	-0.366***	-0.315***
	(0.0957)	(0.117)	(0.0680)	(0.0891)	(0.0923)	(0.0487)	(0.0946)	(0.0551)
Complexity	0.119	0.291***	0.126***	0.246***	0.00504	-0.122***	-0.197***	-0.0278
	(0.0718)	(0.106)	(0.0463)	(0.0493)	(0.0693)	(0.0441)	(0.0645)	(0.0305)
Fun	-0.168*	0.0683	0.0217	-0.0569	0.300***	0.151**	0.142*	0.0231
	(0.0979)	(0.146)	(0.0553)	(0.0689)	(0.0945)	(0.0608)	(0.0769)	(0.0426)
Trust	0.0677	-0.131	-0.0387	-0.0802	0.116	-0.0920*	0.0942	0.142***
	(0.0932)	(0.129)	(0.0631)	(0.0671)	(0.0900)	(0.0537)	(0.0878)	(0.0415)
Convenience	0.00753	0.132	-0.127*	0.0973	0.0556	0.421***	0.254**	0.318***
	(0.102)	(0.166)	(0.0750)	(0.0857)	(0.0982)	(0.0692)	(0.104)	(0.0530)
Physical risk	0.0174	0.0503	-0.0204	-0.116**	-0.119*	-0.0995**	-0.0841	0.0106
	(0.0666)	(0.0931)	(0.0565)	(0.0515)	(0.0642)	(0.0387)	(0.0786)	(0.0318)
Social risk	0.388***	0.145	0.265***	0.147***	0.0199	0.120**	-0.00110	0.0200
	(0.0755)	(0.130)	(0.0462)	(0.0509)	(0.0729)	(0.0540)	(0.0643)	(0.0314)
Economic risk	0.151*	0.129	0.173***	0.110**	-0.0858	0.00417	0.0382	-0.0680**
	(0.0871)	(0.0940)	(0.0481)	(0.0552)	(0.0840)	(0.0391)	(0.0670)	(0.0341)

	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA	High IR, LOW IA	HIGH IR, HIGH IA	LOW IR, LOW IA	LOW IR, HIGH IA
	Innovation Resistance				Intention to Adoption			
Functional risk	-0.0501	-0.103	-0.0227	0.0310	-0.0724	0.0487	0.0592	-0.0555*
	(0.0942)	(0.104)	(0.0589)	(0.0530)	(0.0908)	(0.0434)	(0.0819)	(0.0328)
System risk	0.217**	0.370***	0.140***	0.102**	0.0470	-0.0620	-0.0493	0.0422
	(0.0887)	(0.109)	(0.0460)	(0.0504)	(0.0856)	(0.0452)	(0.0641)	(0.0312)
Constant	0.804	-0.186	0.352	0.159	2.548***	3.070***	2.621***	3.043***
	(0.784)	(1.017)	(0.489)	(0.541)	(0.756)	(0.423)	(0.681)	(0.335)
Observations	68	87	72	107	68	87	72	107
R-squared	0.704	0.567	0.753	0.593	0.621	0.860	0.614	0.802

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In the next section, intention to adoption was considered as dependent variable under different customer groups. It showed that influential variables both the HIGH IR & HIGH group and the LOW IR & LOW IA group were rigidity, complexity or convenience, and fun. However, it highlighted variables that affect only in HIGH IR & HIGH IA group as trust, physical risk, and social risk. Trust had a negative impact on intention to adoption. For potential consumers who had high innovation resistance, but also had high intention to adoption, if they trust less and lose their reliability to innovation resistance, It is more likely to purchase level 1 of car by them.. Although trust had positive significant to intention to adoption in all other groups except HIGH IR& HIGH IA, trust were shown as essential variable which negatively affect to intention to adoption in HIGH IR & HIGH IA group. As we expected, the higher the confidence of this level of automobiles, intention to adoption has increased consequently. Therefore, it showed that there might be other primary factors to offset intention to adoption even if the trust is low.

Another significant variable was physical risk driven as negative relationship with intention to adoption. For all group, physical risk had noticeably low value in high IR & high IA group. Given that, potential consumers are probably have higher intention to adoption even they have lower intention to adoption due to low value of physical risk. For Level 0, the interpretation was omitted because its result is similar to the previous level and is an automobile that does not include the function of an autonomous vehicle at all.

Chapter 5. Conclusion

In conclusion, meaningful influential factors toward self-driving cars were identified according to level of autonomy and showed that representative dynamic influences differed by level of autonomy. The results of this work were based on the innovation resistance model which Ram (1987) first proposed. As we explored the significant, important factors of innovation resistance and the intention to adopt, the results provide useful implications for the marketing of self-driving car. As implication of reducing innovation resistance toward self-driving car, out study provided managerial way how corporations use effective marketing strategies regarding the different levels of autonomy proposed by the NHTSA.

In managerial perspective, innovation resistance toward self-driving cars is highly related to social risk, and to reduce this, a good brand image through mass-media advertising is needed. Through this and SNS service, people will continue to hear about autonomous vehicles, and so they may not care about other people's negative perceptions. Therefore, innovation resistance toward autonomous vehicles may be lowered. Second, economic risk is a highly significant variable to innovation resistance. Consumers tend to hesitate before buying automobiles as their economic burden increases. Therefore, if the economic risk is reduced by automobile companies, they will increase the intention to adoption by consumers and create higher profit than other companies. Consequently, government subsidies are essential to promote self-driving cars with the focus on implementing government subsides strategies for early-adopter and innovator groups.

It is essential to configure how potential consumer perceive negatively when they go through the decision process to purchase, or how they feel about the complexity of using an autonomous vehicle. Attitude is unique for each consumer. thus marketers need to conduct long-term efforts to change them. For consumers who feel that the complexity of an autonomous car is an issue, automobile corporations should give the opportunity to experience self-driving cars as a trial service to make them used to the concept of a self-driving car.

In academic perspective, our research provided framework that included both innovation resistance and intention to adoption. It is considerable progress of threshold and admitted that there is possibility as consumer who have both high innovation resistance and intention to adoption. Our investigations into this area will be progressed further. From our result, result was shown various according to customer group based on innovation resistance and intention to adoption. It has proved that it might be possible to manage both innovation resistance and intention to adoption driven by customer attitude and perceived risk.

However, our study limitation lies on survey question. It was used same questions framework for whole level, so there would be possibility that respondents replied to question insincerely. Future work should aim at analysis to perceived risk focused.

Different functions are included for each level of autonomy, therefore it is needed to figure each level of risks and function towards innovation resistance.

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Appendix 1: Survey questions conducted in this study

※ 소비자 기본 정보란

1. 귀하의 성별은 어떻게 되십니까?

   □ 남성 □여성

2. 귀하의 나이대를 체크해주세요

   □ 만 20-29세 □ 만 30-39세 □ 만 40-49세 □ 만 50-59세 □ 만 60-69세

3. 귀하의 현재 결혼 여부를 체크해 주십시오 (기혼에 체크하셨다면, 문항 3.2로 가주시고 미혼에 체크하셨다면 문항 4로 가주세요)

   □ 미혼 □기혼

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?

   □ 네 □아니오

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, 아니면 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 먼저 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 목적지까지 주행하는 자동차를 말합니다.

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

단계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추가된 기능
1	비자동 (No-automation)	운전자	운전자	운전자	O	-
2	운전자 부분 자율주행 (Functioned automation)	운전자	운전자/자동차	운전자	O	네비게이션, 자동속도 조절 장치, 주차 보조 장치 등
3	부분 자율주행 (Combined function automation)	운전자	자동차	운전자	O	자동속도조절 시스템.차선이탈 경보장치, 충돌예방장치, 자동주차장치, 교통표지판인지 장치 등
4	조건부 자율주행 (Limited Self-Driving Automation)	자동차	자동차	자동차	O	자율주행모드 (특정조건 안에서)
5	완전 자율주행 (Full Self Driving Automation)	자동차	자동차	자동차	X	완전자율주행

※ 1단계 : 비자동(No-automation)

본 설명을 읽고, 생각나는 대로 응답해주세요.

단계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추가된 기능
1	비자동 (No-automation)	운전자	운전자	운전자	O	-

운전자가 모든걸 스스로 조절해야 하는 레벨. 실제적인 자율주행자동차의 기능이 전혀 들어가지 않음. (네비게이션을 쓸 수 없음.)

예) 지도를 이용해서 길을 찾고, 주차할때 사이드 미러를 이용하여 주차를 한다.

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

   ☐ 네 ☐아니오

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

   ☐ 네 ☐아니오

문항	전혀 아니다	아니다	보통이다	그렇다	매우 그렇다
1. 귀하는 1단계(비자동:No-automation)의 차를 운전해보고 싶습니까?					
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 생각하십니까?					
6. 귀하는 1단계의 차를 사용할 때, 주행 중 돌발상황(기상 악화 및 낙석 등)시 발생할 수 있는 사고에서 안전하다고 생각하십니까?					
7. 귀하는 1 단계의 차를 사용할 때, 주변 사람들이 귀하에 대해부정적으로 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 않을까봐 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 느끼십니까?					

※ 2단계 : 운전자 부분 자율주행(Function specific Automation)

본 설명을 읽고, 생각나는 대로 응답해주세요.

단계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추가된 기능
2	운전자 부분 자율주행 (Functioned automation)	운전자/자동차	운전자/자동차	운전자	O	자동 브레이크, 네비게이션, 자동속도 조절 장치, 주차 보조장치

자동 브레이크나 앞차와의 간격유지 같은 기본적인 운전 보조 기능 적용. 대부분의 자동차가 이에 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 있습니까?

□ 네 □아니오

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

□ 네 □아니오

문항	전혀 아니다	아니다	보통이다	그렇다	매우 그렇다
1. 귀하는 1단계(비자동:No-automation)의 차보다 2단계(운전자 부분 자율주행:Function specific Automation)의 차를 더 운전해보고 싶습니까?					
2. 귀하는 2단계의 자동차를 사용이 복잡하다고 생각하십니까?					
3. 귀하는 2단계의 자동차를 사용하는 것이 귀하에게 즐거움을 준다고 생각합니까?					
4. 귀하는 2단계의 자동차가 신뢰할 만하다고 생각합니까?					
5. 귀하는 2단계의 자동차를 사용하는 것이 편리하다고 생각하십니까?					
6. 귀하는 2단계의 차를 사용할 때, 주행 중 돌발상황(기상 악화 및 낙석 등)시 발생할 수 있는 사고에서 안전하다고 생각하십니까?					
7. 귀하는 2단계의 차를 사용할 때, 주변 사람들이 귀하에 대해부정적으로 인식한다고 생각하십니까?					
8. 귀하는 2단계의 차를 사용할 때, 경제적으로 많은 부담(보험, 유지 비용 등)을 느끼십니까?					
9. 귀하는 2단계의 차를 사용할 때, 기능이 원활하게 작동되지 않을까봐 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 느끼십니까?					

※ 3단계: 부분 자율주행(Combined function automation)

단계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추가된 기능
3	부분 자율 주행 (Combined function automation automation)	운전자/자동차	자동차	운전자	O	자동속도조절시스템.차선이탈 경보장치, 충돌예방장치, 자동주차장치, 교통표지판인지장치, 경사로주행제어장치, 전기차 주행경고음장치

운전자가 운전을 하지만 자동차가 속도 조절이나 방향 조정 등 일부 자율기능 수행. 운전자가 편안하고 안전하게 운전할 수 있도록 지원하는 첨단운전시스템(ADAS)를 갖추고있음. 예) 그녀는 고속도로에서 주행 시 앞 차량과 사고가 날 만한 상황에서도 충돌예방장치시스템의 도움으로 충돌을 피했다.

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 생각이 있습니까?

□ 네 □아니오

문항	전혀 아니다	아니다	보통이다	그렇다	매우 그렇다
1. 귀하는 2단계(운전자 부분 자율주행:Function specific Automation)의 차보다 3단계(부분 자율주행:Combined function Automation)의 차를 더 운전해보고 싶습니까?					
2. 귀하는 3단계의 자동차를 사용한다면, 사용이 복잡하다고 생각하십니까?					
3. 귀하는 3단계의 자동차를 사용하는 것이 귀하에게 즐거움을 준다고 생각합니까?					
4. 귀하는 3단계의 자동차가 신뢰할 만하다고 생각합니까?					
5. 귀하는 3단계의 자동차를 사용하는 것이 편리하다고 생각하십니까?					
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 대해부정적으로 인식한다고 생각하십니까?					
8. 귀하는 3단계의 차를 사용할 때, 경제적으로 많은 부담(보험, 유지 비용 등)을 느끼십니까?					
9. 귀하는 3단계의 차를 사용할 때, 기능이 원활하게 작동되지 않을까봐 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 느끼십니까?					

※ 4단계: 조건부 자율주행 (Limited Self-Driving Automation)

본 설명을 읽고, 생각나는 대로 응답해주세요.

단계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추가된 기능
4	조건부 자율주행 (Limited Self-Driving automation)	자동차	자동차	자동차	O	자율주행 모드 (특정조건 안에서)

고속도로와 같이 특정한 환경에서 차선 변경, 추월, 장애물 회피 등을 모두 할 수 있는 수준으로 상황에 따라 운전자가 전방에서 눈을 뗄 수도 있음

예) 그는 고속도로에서 자율주행 모드를 눌러 차가 자율적으로 주행하도록 했다. 그리고 고속도로가 끝나는 지점에서 자율주행 모드를 해제하고 다시 운전을 했다.

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

□ 네 □아니오

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

□ 네 □아니오

문항	전혀 아니다	아니다	보통이다	그렇다	매우 그렇다
1. 귀하는 3단계(부분 자율주행:Combined function Automation)의 차보다 4단계(조건부 자율주행:Limited Self-Driving Automation)의 차를 더 운전해보고 싶습니까?					
2. 귀하는 4단계의 자동차 사용이 복잡하다고 생각하십니까?					
3. 귀하는 4단계의 자동차를 사용하는 것이 귀하에게 즐거움을 준다고 생각합니까?					
4. 귀하는 4단계의 자동차가 신뢰할 만하다고 생각합니까?					
5. 귀하는 4단계의 자동차를 사용하는 것이 편리하다고 생각하십니까?					
6. 귀하는 4단계의 차를 사용할 때, 주행 중 돌발상황(기상 악화 및 낙석 등)시 발생할 수 있는 사고에서 안전하다고 생각하십니까?					
7. 귀하는 4단계의 차를 사용할 때, 주변 사람들이 귀하에 대해부정적으로 인식한다고 생각하십니까?					
8. 귀하는 4단계의 차를 사용할 때, 경제적으로 많은 부담(보험, 유지 비용 등)을 느끼십니까?					
9. 귀하는 4단계의 차를 사용할 때, 기능이 원활하게 작동되지 않을까봐 불안하십니까?					
10. 귀하는 4단계의 차를 사용할 때, 정보보안 및 시스템 해킹에 대해 걱정하십니까?					
11. 귀하는 4단계의 자동차를 구매할 생각이 있으십니까?					
12. 귀하는 4단계의 자동차의 사용에 대해서 거부감을 느끼십니까?					

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

본 설명을 읽고, 생각나는 대로 응답해주세요.

단계	정의	운전 상황 모니터링	제어 (운전, 주차 등)	안전에 대한 책임	운전자 개입 여부	앞단계보다 추가된 기능
5	완전 자율주행 (Full Self Driving automation)	자동차	자동차	자동차	X	완전자율주행

운전자가 목적지와 주행경로만 입력하면 모든 기능을 스스로 제어하는 레벨

예) 그녀는 차에 올라타 목적지와 주행경로를 입력하고, 차가 알아서 안전하게 목적지에 데려다 줄 때까지 개인 업무를 보았다.

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

□ 네 □아니오

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

□ 네 □아니오

문항	전혀 아니다	아니다	보통이다	그렇다	매우 그렇다
1. 귀하는 4단계(조건부 자율주행:Limited Self-Driving Automation)차보다 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 준다고 생각합니까?					
4. 귀하는 5단계의 자동차가 신뢰할 만하다고 생각합니까?					
5. 귀하는 5단계의 자동차를 사용하는 것이 편리하다고 생각하십니까?					
6. 귀하는 5단계의 차를 사용할 때, 주행 중 돌발상황(기상 악화 및 낙성 등)시 발생할 수 있는 사고에서 안전하다고 생각하십니까?					
7. 귀하는 5단계의 차를 사용할 때, 주변 사람들이 귀하에 대해부정적으로 인식한다고 생각하십니까?					
8. 귀하는 5단계의 차를 사용할 때, 경제적으로 많은 부담(보험, 유지 비용 등)을 느끼십니까?					
9. 귀하는 5단계의 차를 사용할 때, 기능이 원활하게 작동되지 않을까봐 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 느끼십니까?					

Abstract (Korean)

자율주행자동차는 운전자 대신 로봇과 인공 지능 시스템에 의해 구동 되는 인공기술(AI)중 하나이다. 본 연구는 최첨단 기술인 자율주행자동차를 바탕으로 하여, 잠재적 소비자들의 자율주행의 레벨 별로 다른 혁신저항을 살펴보았다. 자율주행자동차는 미국 NHTSA가 발표한 레벨 0의 비 자율(No-automation) 주행 차에서 완전 자율주행 차량(Full-atuomation)까지 5가지의 레벨로 구분되었다. 각 단계가 높아질수록, 자율주행의 기능이 추가 되며 마지막 레벨에선 완전 자율주행 자동차로 인간의 개입이 불필요하다. 본 연구에서는 이러한 자율주행자동차의 레벨에 따라 달라지는 혁신저항을 잠재적 위험 요소와 소비자 태도가 미치는 영향을 중심으로 연구하였다. 혁신에 관한 이전 문헌에서 TAM 모델은 기술 측면만을 강조하고 혁신의 긍정적인 측면만 강조했던 한계가 있었다. 따라서, 혁신저항의 모델에서 혁신 저항과 그 요인을 분석하고, 또한 고객 태도와 잠재적 위험 요소가 혁신저항과 혁신 수용에 미치는 영향을 비교 분석하였다.

데이터는 온라인 설문 조사에서 수집되어 335명의 표본을 이용하여, 20대에서 60대까지 각 나이대별로, 그리고 성별로 균등하게 실시되었다. 다중 회귀 모델로 분석이 이루어졌다. 잠재적 리스크가 혁신 저항에 긍정적 영향을 미친다는 것을 보여 주지만 고객의 태도는 혁신 저항에 부정적인 영향을 미치는 것으로 보여졌다. 또한, 고객 태도와 잠재적 위험 요소가 혁신저항과 혁신 수용에 미치는 영향이 다름을 알 수 있었다. 혁신저항에서는 사회적 리스크와 신체적 위험의 리스크가 영향을 미쳤지만, 혁신수용에서는 경제적 위험, 즐거움, 변화를 싫어하는 엄격한 태도 등의 소비자 태도가 더 많이 영향을 미쳤다. 따라서, 기존의 주장과는 반대로 혁신저항을 낮출수록 혁신수용이 높아지는 것이 아닌 서로 각기 다른 요인들을 변화한 결과로서, 혁신저항의 연구에 새로운 시사점을 제공하고자 한다.

주요어 : 자율주행자동차, 혁신 저항, 소비자 태도, 지각된 위험, 혁신 수용

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