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A Study on the Factors Affecting Drone Use Intention -Comparative analysis of Korea and United Kingdom

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Abstract

As interest in drones controlled by remote technology rapidly increases worldwide, drones are used in many fields such as military, rescue, and transportation as future innovations in many countries. In particular, as the drone has been spotlighted as a new future strategic industry, it is also used for public purposes such as disaster relief and crime investigation. However, security concerns such as the penetration of major national facilities, collisions with aircraft, and the possibility of privacy infringement due to aerial photography are also being raised. Unlike the increased interest in drones, there have been few studies on drone use, drone safety, and public attitudes toward drone use. This paper analyzed the perceptions of drone attitudes, drone stability and policy support for drones for Korean and United Kingdom.

Key Words : Drone, Technological Innovation, Early Adopter, Personal Innovative, Policy Support, Drone Safety, Behavioral Intention.

1. Introduction

The key technologies of the Fourth Industrial Revolution include autonomous vehicles, robots, artificial intelligence (AI), big data, Internet of Things (IoT), blockchain, three-dimensional (3D) printing, mobile technology, virtual reality (VR), fintech, and drones. Of these, drones are unmanned aerial vehicles (UAVs) that autonomously fly in accordance with their own environmental judgment because they are equipped with a management system or AI that is remotely controlled from the ground rather than being operated by humans in the cockpit To increase the acceptability of drone policies, it is necessary to study the actual drone users' perceptions of and attitudes towards drones and drone use, particularly their perceptions of individual drones. Drone training and drone safety studies are thus urgently needed[5]. In general, the growth of the new technology ultimately means that the market for it is successfully expanding. In the case of high-tech products like drones, market expansion often fails due to the existing chasm, innovation resistance, etc. Therefore, to prevent market failure, it is necessary to induce the mainstream by identifying their technology preferences, with focus on the early adopters of the technology, and to reflect such preferences in the relevant technology development and policy establishment. This study was conducted for such purpose, and the results of the study showed that personal innovativeness, drone education, drone safety, and drone policy support have a significant effect on early drone users' perceptions of the usefulness and ease of use of drones, and on their

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intention to use drones. The impact of such results was then analyzed [1].

In general, consumer behavior and perception analysis uses revealed preference (RP) data or stated preference (SP) data. If there are not enough market data, however, such as on drones, it is difficult to utilize RP data, so SP data based on a questionnaire is used. In the case of SP, conjoint analysis, etc. can be used, but as this study did not intend to analyze the consumer preferences for the technical properties of drones but was about the acceptability of drones, the technology acceptance model (TAM), which is generally used for technology acceptance analysis, was used [2,3].

2. Drone Policy

The European countries are conducting R&D on UAV systems using their own strategies. First, in the case of Sweden, the Swedish company SAAB, known for its fighter aircraft like Vigen and Gripen, succeeded in realizing autonomous flight in August 2004 by producing SHARC and FILUR as miniature testers for technical research. SHARC and FILUR are currently under development as stealth machines. The tail wing and the fuselage air intake design were different depending on the stealth performance, but the so-called “modularization strategy” was applied, which aims to develop the same level of engine and autonomous navigation and flight capability. In addition, through a UAV-related technology based on a common platform, the HALE and MALE classes are used depending on the operational altitude, and UCAVs and tactical UAVs are used depending on the mission. Efforts were also made to improve the cost efficiency by integrating related technologies like unmanned reconnaissance aerial vehicles (URAVs), and by promoting their development[8,9].

The basic plan for drone industry development in Korea is as follows. The Korean government set the goals of raising the country’s current drone market size of making Korea the world’s fifth largest market in the world in terms of technology competitiveness, and of commercializing 5.3 million commercial drones by 2026. The government creates a business-oriented drone industry ecosystem and fosters an operating market based on public demand. It also plans to build a global-class operating environment and infrastructure to secure technological competitiveness so that the Korean The scenarios for each stage from the prediction of drone technology development are as follows. Five stages were derived by combining three technical variables: airplane technology (pilot flight → autonomous flight), transportation ability (cargo loading → human boarding), and flight area (population lean → dense area).

In addition, drones are a core technology of the future aviation industry (e.g., the personal air vehicle or PAV, which will realize future transportation innovation) and make use of the common core technologies of the Fourth Industrial Revolution: AI (for autonomous flight), IoT (for communication between drones), sensors and nano (for composition/miniaturization), and 3D printing (for gas production). They can also be used as an optimal test site (test bed) for the core technologies of the Fourth Industrial Revolution (“skyway traffic light,” drone traffic control system, UTM-introduced expanded drone park, the built drone flight information system, and improved pilot qualification and gas registration criteria) according to the drone performance classification.

3. Research Model

3.1 Innovation Adoption Theory

The Innovation Acceptance Theory suggested another consumer's psychological characteristics, innovation intention, as another factor that can explain innovation adoption. The propensity for innovation, defined as "the degree to which new ideas are adopted relatively quickly," is evaluated based on the relative time taken to adopt them. The theory of innovation acceptance categorizes members of society based on this tendency to innovate in five groups: 1. innovators, 2. early adopters, 3. early majority, 4. late majority, 5. laggards The characteristics of each group were presented (Figure 1).

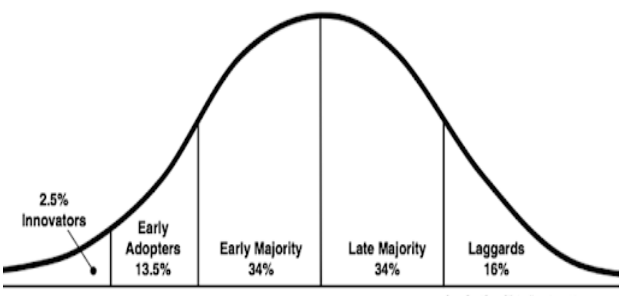

Figure 1 Adopter Classification
(Source: Rogers, 2003)

Rogers' adoption curve for innovation keeps it in mind that it is useless to quickly convince controversial new ideas to the public. It's a much better way to start with confidence in the innovator and early adopter. Alternatively, the category and composition ratio of prisoners can be used as basic data for estimating target groups for communication purposes. This study aims to focus on the adoption rather than the diffusion of innovation, and the initial stage of acceptance rather than the entire stage of acceptance[21].

3.2 Technology Acceptance Model

TAM is a reasonable behavior theory (TRA) information-system-specific acceptance model (Davis, 1989). It can analyze the causes of an external variable's actual use of the system as the relationships among ease of use, usability, attitude, and intention to use, as shown in (Figure 2).

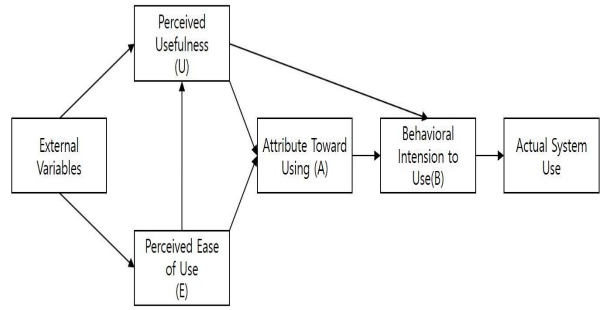

Figure 2 Technology Acceptance Model (TAM)
(Source: Davis, 1989)

The main purpose of TAM is to describe the user's behavior to explain the determinants of technology acceptance by analyzing the effects of a person's internal beliefs, attitudes, and external influences on his or her intentions. Davis (1989) presented a TAM which was later developed by Veneskath and Davis (2000) into TAM2, and by Venkatesh and Bala (2016) into TAM3. TAM explained the causal relationship in which external variables actually lead to the use of a technology, and analyzed the relationship between perceived usability and perceived usefulness and its effect on intention to use.

Venkatesh and Davis (2000) proposed TAM2 as an extension of TAM, where the general determinants of perceived usefulness are subjective norm, image, job relevance, output quality, and result demonstrability. The overview of TAM2 shows the addition of experience and voluntariness as control variables so that social impact (subjective norm, voluntariness, and image) and the perceived instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use) could be more clearly seen to be the determinants of the intention to use a technology[24].

4. Empirical Analysis

4.1 Hypotheses

TAM analyzes the factors influencing consumer acceptance when new technologies are introduced to the market through route analysis. Through TAM, implications that can facilitate the adoption of a new technology can be obtained, and as such, it has been utilized in various fields. TAM3 is an external determinant of perceived usability and perceived usefulness, and presents four factors: individual differentiation, system characteristics, social influence, and promotion conditions (Venkatesh & Bala, 2008). In this study, reflecting this, Personal Innovativeness (PI) was considered based on the individual's discrimination and Education perception (EDU) considering the national drone use qualifications, the Safety of the drone (SAFE), and the promotion conditions referred to as social impact. Policy Support (PS) was considered a factor affecting behavioral intention of use (BIU). Additionally, this study used Perceived Ease of Use (PEU) and Perceived Usefulness (PU) as parameters in (Figure3).

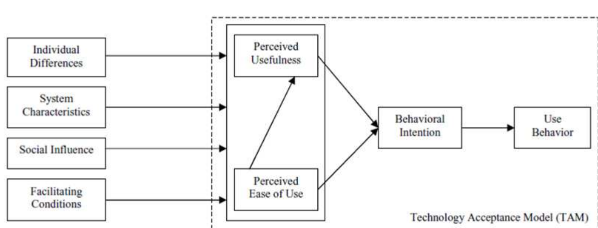

Figure 3 Theoretical Framework
(Source: Venkatesh and Bala 2008)

In this study, early adapters of drones were surveyed, and based on their survey responses, their attitudes towards and perceptions of drone use were analyzed. For this, a research model based on TAM was used.

For the theoretical background of TAM3, personal characteristics (Personal Innovativeness), system characteristics (Education), social impact (Safety), and promotion conditions (Policy Support) (TAM3; Venkatesh et al., 2008), which are external determinants, affect Behavior Intention in <Figure 3>. This refers to the belief that the use of technology will increase one's work performance and work ability. In general, the Behavior Intention to use a new technology is increased by the awareness of the fact that it will be helpful to one's life and work, or by its Perceived Usefulness (Venkatesh et al., 2012). Perceived Ease of Use, on the other hand, is the recognition that one can use and enjoy a technology without any difficulty. In general, the higher the technology's perceived usability is, the higher the intention to use the technology[26].

4.1.1 Personal Innovativeness

Personal innovativeness refers to an individual's tendency to use new technologies or systems before others actively accept them. Personal innovativeness is a major variable that has an important influence on the adoption of new technologies, and there have been several previous studies. In general, the higher personal innovativeness the individual have, the more they actively utilize the new technology, persevering to uncertainty, and having an active intention to use (Lu et al 2008)[15]. The higher personal innovativeness have, the more they form positive cognition and have high intention to use.

Consumers with high individual innovation are individuals who tend to accept new technologies relatively quickly than other members, and are opinion leaders of young, high-education and high-income members (Lee, 2006)[14]. There was a study that early users had a more positive influence on innovation acceptance (Yoon and Hwang, 2019)[28], and a study that analyzed the tendency of early adopters of digital cables showed that early adopters quickly accepted new products by those with innovative tendencies. (Park and Kang, 2007)[19]. In the study on the intention to use the mobile payment service, the higher personal innovativeness the individuals have the higher the availability and intention to use increased . Results have a positive impact. There was a research result that personal innovativeness has a positive effect on usability and usability in smart phone usage intention (Kwon, 2013)[11].

Based on these prior studies, this study assumed that Personal innovativeness will positively affect perceived easy of use and usefulness.

Hypothesis 1-1 Personal Innovativeness will have a positive effect on perceived ease of use.

Hypothesis 1-2 Personal Innovativeness will have a positive effect on perceived usefulness.

4.1.2 Policy Support

Policy support means "an informal or formal activity or function that helps us use the new system effectively."(Venkatesh et al, 2008)[25]. “Technology policy aims to achieve the national goal of improving the quality of life of all citizens, competitive economic growth and national security by making the most of technology,” said Allan Bromley. Quality support, financial environment, efficient technical infrastructure, legal and regulatory environment, government, industrial and academic cooperation are all supported by policy (Allan Bromley, 2004)[1].

Policy support refers to government support, education, and budget investment from external organizations. The stronger the idea that new technology users have organized and systematic support from the government, the higher the intention to use technology. In general, the organizational infrastructure of new technologies affects the intention to use technologies (Venkatesh et al., 2012)[21]. Therefore, policy support acts as a major variable in the use of new technologies. (Lee and Cha, 2016)[14]. In software quality research, policy support was the most important factor[14].

Hypothesis 2-1 Policy support for drones will have a positive effect on perceived ease of use.

Hypothesis 2-2 Policy support for drones will have a positive effect on perceived usefulness.

4.1.3 Behavior Intention

The perceived ease of use means "the extent to which a person believes that there will be no difficulty in using a particular system." Recognized usability is related to system use and perceived usefulness. Perceived ease of use is directly or indirectly related to behavior through its impact on perceived usefulness. Perceived usefulness means "the extent to which a person believes that using a particular system will improve his or her performance." (Davis, 1989)[3].

Behavior Intention of use is a measure of the intensity of an intention to perform a particular action. (Fishbein and Ajzen 1975)[2]. Behavior Intention of use indicates the willingness to take a particular action and the degree of system use. In other words, it is a measure of the intention and likelihood of using a particular system. Intention to use and behavior refers to the user's intention to use, frequency of use, and time of use. Intention of use is a key factor in determining the use behavior of consumers in using technology[17][18].

Hypothesis 3-1 The perceived ease of use for drones will have a positive effect on perceived usefulness.

Hypothesis 3-2 The perceived ease of use for drones will have a positive effect on the behavior intention of use.

Hypothesis 3-3 The perceived usefulness of a drone will have a positive effect on the behavior intention of use.

4.2 Sample and Procedure

4.2.1 Korean Sample

The survey was conducted in Korea for 21 days, from May 15 to June 6, 2019. It was conducted online for initial drone users who had never encountered a drone before. The target respondents were 271 early drone users who either used drones as a hobby or used them in their jobs. Twenty of the target respondents did not respond to some questions and were thus considered missing. As such, the data obtained from only 251 respondents were used for the analysis. In general, path coefficients are estimated using partial least square (PLS), but AMOS22 was used in this study for such purpose. shows the basic statistical data of the survey respondents.

4.2.2 United Kingdom Sample

The survey was conducted in the UK for 21 days, from January 15 to February 6, 2019. It was conducted online for initial drone users who have never encountered a drone before. The respondents either used drones as a hobby or were early drone users (330) who used drones in their jobs. In general, path coefficients are estimated using PLS, but AMOS22 was used in this study for such purpose[22].

4.3 Measures

In this study, the effect of the independent variable of personal innovativeness on the intention to use drones was measured. Drone awareness education, perceived risk, and policy support were also selected as independent variables, perceived usability and perceived usefulness were selected as parameters, and intention to use was selected as the dependent variable. The questionnaire items included items that were used in the previous studies using TAM: personal innovativeness (3 items), drone policy support (4 items), perceived usability and perceived usefulness.

4.4 Data Analysis

4.4.1 Analysis of Korea

In this study, the reliability of the items constituting each variable was measured using the Cronbach's alpa, and the Cronbach's alpha value Discriminant validity can be verified by analysis through correlation analysis.

First, Hypothesis 1-1 (CR = 3.975, $p < 0.001$) on has been personal innovativeness influenced on perceived ease of use, and hypothesis 1-2 (CR = 0.483, p = 0.629) did not significantly affect the perceived usefulness. Second, the hypotheses 2-1 (CR = 10.625, $p < 0.001$) and 2-2 (CR = 10.625, $p < 0.001$) for policy support for drones were adopted, which were positive for the perceived easy of use and usefulness. It was confirmed to have an effect. Fifth, hypotheses 3-1 (CR = 3.786, $p < 0.001$) and hypotheses 3-2 (CR = 10.625, $p < 0.001$) for perceived ease of use and usefulness for drones were adopted and were significant for behavior intention of use them.

4.4.2 Analysis of the United Kingdom

First, while hypothesis 1-1 (CR = 0.671, p = 0.502) on Personal innovativeness was rejected and did not affect perceived easy, recognition of hypothesis 1-2 (CR = 3.399, $p < 0.01$). It was found to have a significant Hypothesis 2-1 (CR = 3.115, $p < 0.01$) and Hypothesis 2-2 (CR = 5.617, $p < 0.001$) for policy support for drones are adopted, which are positive for the perceived ease of use and usefulness. Fifth, hypothesis 3-1 on perceived ease of use for usefulness (CR = 5.936, $p < 0.001$)and hypothesis 3-2 on perceived ease of use on behavior intention df use(CR = 3.010, $p < 0.01$) is adopted. Hypothesis 3-3 (CR = 10.442, $p < 0.001$), perceived usefulness is adopted, so that the relationship between usefulness and intention to use has a positive (+) effectpositive (+) effect on perceived usefulness.

5. Comparative Analysis of Korea and U.K

Therefore, this study analyzed the attitude toward drones, safety of drones, and drone education and policy support for early adoptor. To this end, we analyzed the UK and Korea for the early drone adoptor's perception using a technology acceptance model (Table 1).

Table 1 Comparative analysis of results on Korea and U.K

Path			Korea	U.K.
PI	⇒	PEU	*Adopted*	*Rejected*
PI	⇒	PU	*Rejected*	*Adopted*
PS	⇒	PEU	*Adopted*	*Adopted*
PS	⇒	PU	*Adopted*	*Adopted*
PEU	⇒	PU	*Adopted*	*Adopted*
PEU	⇒	BIU	*Adopted*	*Adopted*
PU	⇒	BIU	*Adopted*	*Adopted*

With this system in place, drones using telecommunication networks can prevent take off itself. Rather than seeing that the drone industry is not revitalized because of regulations, positive policies like UTM should be applied sooner. It can be seen that the perceived usefulness has a great effect on the intention to use the drone. The perceived usefulness has a great effect on the intention to utilize. It was found that policy support had the greatest effect on perceived usefulness. It was found that drone policy support had the greatest influence on perceived usefulness.

Total effect, indirect effect, and total effect were analyzed to confirm the causal relationship of the revised model through route analysis (Table 2).

Table 2 Modified model Total effect

Path			Korea	U.S
PI	⇒	BIU	0.146	0.029
PI	⇒	PEU	0.234	0.151
PS	⇒	PEU	0.174	0.260
PS	⇒	BIU	0,282	0.066
PEU	⇒	PU	0..134	0.264
PEU	⇒	BIU	0.264	0.178
PU	⇒	BIU	0.656	0.193

6. Conclusion

6.1 Concluding Remarks

Drones, one of the core technologies of the Fourth Industrial Revolution, are a new technology of the future that should be of national interest. Whenever a new technology appears, empirical verification is attempted to determine the characteristics of the technology and the behaviors and attitudes of its users, and the research focuses on the theories of innovation diffusion and of expected value. The Korean government has released a roadmap for its becoming the world’s fifth largest drone powerhouse, is establishing a future drone transportation department, and is preparing to commercialize the drone transportation system. Therefore, despite the importance of examining the drone users’ perceptions of the use of popular and commercial drones, the related empirical studies that have so far been conducted are very insufficient. As such, this study analyzed the attitudes of the early adopters of drones towards drone use, and determined the effects of *Personal Innovativeness,* and *Policy Support.* Towards this end, the attitudes towards and perceptions of drone use by British and Korean early adopters of drones were analyzed using the technology acceptance model (TAM) to improve drone acceptance, and their implications on drone policy were suggested.

This study proposed a drone acceptance model to examine the factors determining the acceptance To this end, we analyzed the attitudes and perceptions of British and Korean early adopters drones using the technology acceptance model to improve drone acceptance and suggested implications in drone policy.

This study proposed a drone acceptance model to examine factors determining the acceptance of drones and to identify the relationship between factors used in the process of accepting them. The technology acceptance model sets various external factors as independent variables, affects the parameters of perceived usefulness and perceived ease of use, and the parameters form a causal relationship affecting drone utilization attitude.

6.2 Limitation and Future Research

This study has some limitations as follows. First, there are other factors that can be considered as variables affecting drone utilization. For example, comprehensive research is needed on various factors such as price value, hedonic motivation, and social influence. In addition, the effects of individual socio-economic characteristics on drone use also require further analysis. Second, in this study, it can be seen that the drone's safety is a parameter, not an independent variable, so research on drone's safety needs to be further progressed from a different perspective. In order to securely implement the future drone traffic management system such as commercialization of drone taxis in the future, more research is needed to establish a drone safety system.

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