

Why new technology and products diffusion is slow in Japan?

-Multimethod analysis of PEST+C(Culture)-

Tohoku University

Faculty of Economics

Department of Business Administration

Kim seminar 5th

TEAM iBurigakko

Shoya Otaka

Shimpei Kusuno

Momoko Sato

Misato Shudo

Takuma Chida

Tomoki Nonomura

Momoko Sato

Tel:090-8784-4167

E-mail:peachcandy.1031@gmail.com

Words:6475

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Abstract

Today, various innovative new technology is on the market. However, the penetration of these products in Japan is lower than that of other countries. In this study, we clarify the factors that are delaying the diffusion of new technology in Japan from the following two perspectives. The first is an explanation from the aspect of the macro environment using PEST framework. The second is to elucidate purchase intention of new technology from the aspect of national culture. As a result of the survey, "political factors" in the macro environment had a positive influence on the diffusion of smartphones. In addition, among the indicators representing national culture, consumer behavioral characteristics of "adoptive innovativeness" and "creative innovativeness" had a positive influence on acceptance of AI speakers and mobile payment. As an explorative attempt to understand the gap among countries in new technology adopt action, this study provides comprehensive insights and some persuasive answers.

Keywords:

Diffusion of innovation ,Technology acceptance, National culture, Hofstede index, PEST analysis

Table of contents

Abstract

1. Introduction

2. Literature Review

2-1. Diffusion theory by Rogers

2-2. Development and criticism of innovation diffusion study

2-3. Macro environment analysis

2-4. National Culture

3. Research subject and Methodology

3-1. Selection of research subject

3-2. Methodology

4. Analysis

4-1. PEST analysis

4-2. C analysis

5. Discussion

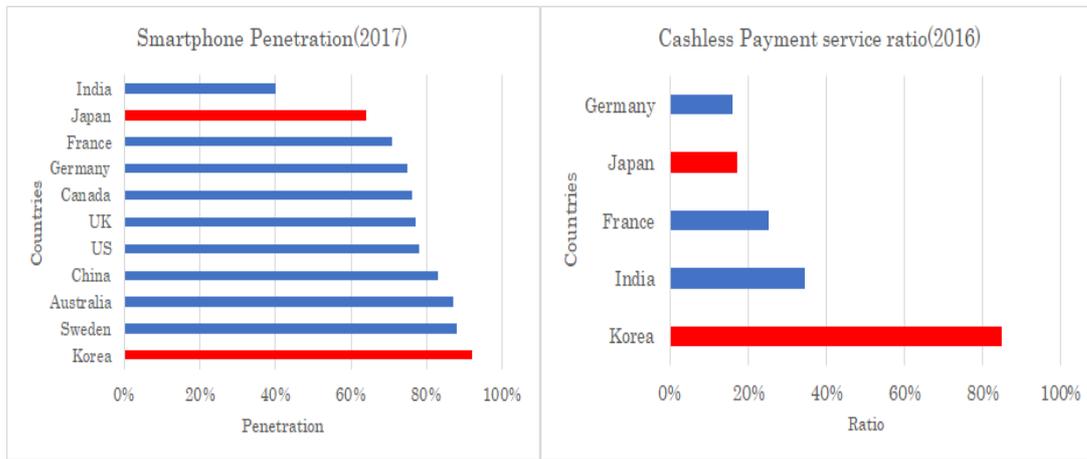
References

Appendixes

1. Introduction

The information revolution that has gone into full swing in the 1990s has produced many new technologies. Until currently, Japan has superiority in fundamental science and technology capabilities, leading the world in many fields. However, the diffusion of innovative new technology is slow compared to other countries. For example, the diffusion of smartphone has been very slow in Japan compared to other countries (Figure 1). The same can be said for the cashless payment service ratio (Figure 1). Whereas, Korea shows that the penetration of these products are overwhelmingly high compared to Japan and other countries. Why has this difference between Japan and Korea occurred? The purpose of this study is to answer this question, by comparing the macro environment of new technology in Japan and Korea, and clarifying which index of national culture influences the behavioral characteristics of consumers.

Figure 1: Smartphone penetration in major countries (2017) and Cashless payment service ratio in major countries(2016)



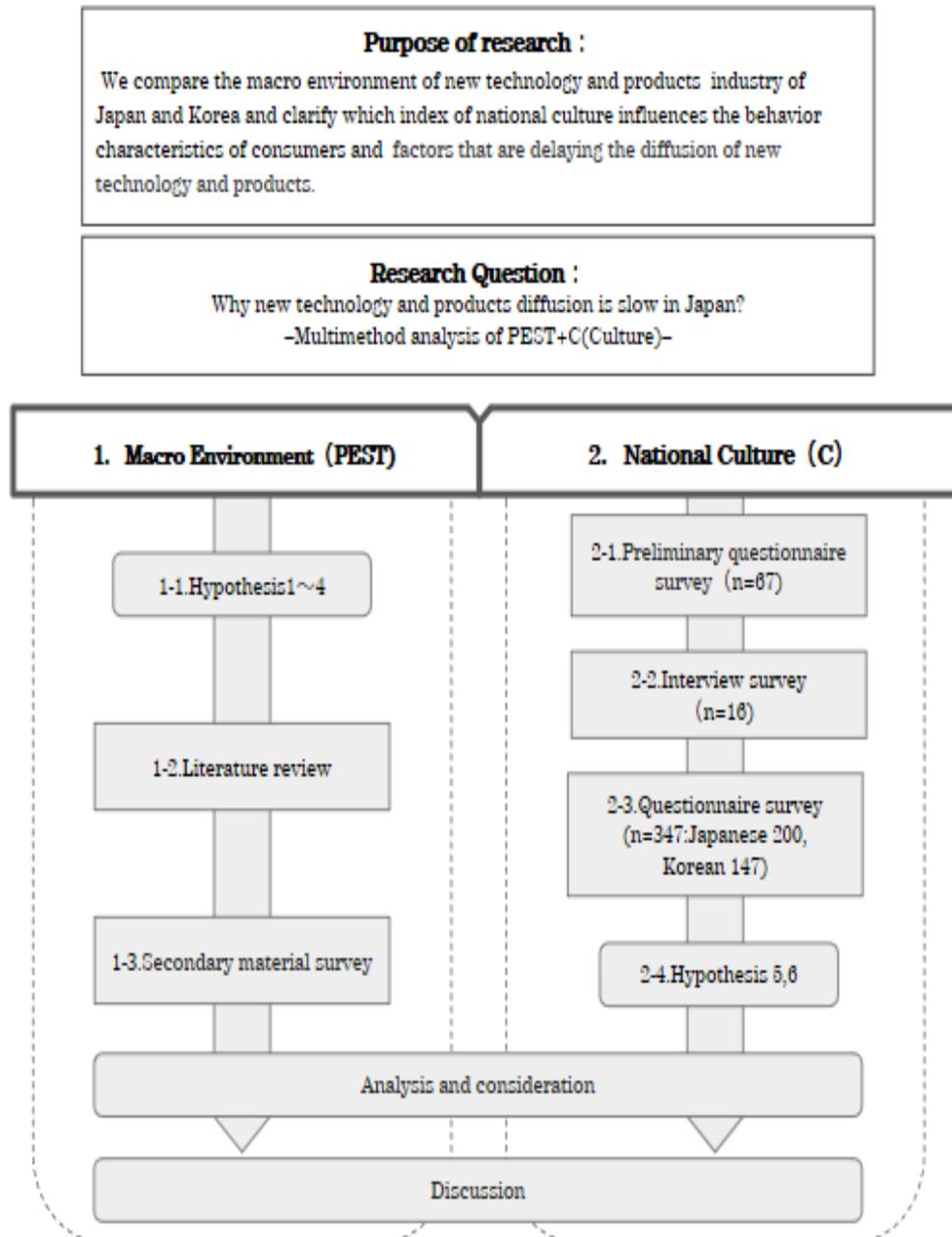
Source: Consumer barometer, Japan Credit Card Association.

According to Hirooka (1995 : 160), companies need to diffuse new technology to enhance international competitiveness. Also, in order to diffuse new technology, companies must understand the macro environment including national culture (Iriyama, 2012 : 188). However, surveys on national culture have not been conducted much (Iriyama, 2012 : 187). To fill these gaps in previous literatures, this study compare Japan with Korea in order to ascertain the significance of the macro environment and national culture.

This paper consists of five sections. In section 2, we confirm what kind of discussions have been made on the diffusion of innovation in previous study. In section 3, we describe the object of our data collection and study method in detail.

il. In section 4, by using PEST analysis and Hofstede index representing national culture analysis (hereinafter abbreviated as C analysis), we clarify the factors that delay the diffusion of new technology. We use secondary sources in PEST analysis. In the C analysis, we used multimethod approach including questionnaire surveys and interviews to examine behavioral characteristics of customers. In section 5, we comprehensively discuss the verification results, and find out the mechanism affecting the diffusion of new technology.

Figure 2: Research flow



Source: Authors

2. Literature Review

In this section, we clarify that what kind of discussions have been made on the field of innovation diffusion. This also applies to the previous study concerning the macro environment and national culture. As a result, it turns out that it is difficult to clearly explain the factors in the diffusion of innovation only by the previous study. Therefore, we present that there are gaps to be filled by studying the factors making it difficult to diffuse new technology in Japan (from a new viewpoint) .

2-1. Diffusion theory by Rogers

Diffusion theory was started by Rogers (Katsumata, et al, 2016 : 30). Diffusion is defined “the process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 1971 : 5). Rogers (1971 : 163-164) revealed “the innovation-decision process through which an individual (or other decision-making unit) pass from first knowledge of an innovation to confirm this decision about adoption.” Not only characteristics of the decision-making unit or perceived characteristics of the innovation, but also characteristics of the social system influences whether the decision-making unit adopts innovation or not.

2-2. Development and criticism of innovation diffusion study

The main theme of studies on the diffusion of innovation over 60 years is the development of diffusion models. Bass model (Bass, 1969) and various other models have been developed. After that, the focus of studies on the diffusion of innovation in the past 20 years is the heterogeneity of each country in the adoption of new technologies (Katsuyama, 2016 : 30). These studies have generally focused on differences in the parameters of the diffusion models, time to take off, and duration of the growth stage (Renana, et al, 2010). However, some of these studies' targets were only European countries, or there is a lack of qualitative discussion such as "which elements of culture have an influence on the diffusion.", so these studies can not answer our research question.

Table 1:Development of diffusion research

Development of diffusion models	Bass (1969)	Proposed Bass model which can predict the purchase rate of durable products at a certain point.
	Kalish (1985)	Suggested” the diffusion model including price and advertising.”
	Mahajan, et al (1990)	Criticized that adapter category by Rogers(1958) had some limitations ,and developed adopter categories using Bass model.
	Deffuant, et al (2005)	Proposed an individual-based model mixing social value and individual benefit.
International Comparison of the diffusion of innovation	Tellis, et al (2002)	Clarified that different countries had different times-to-takeoff. These differences cannot be explained by economic factors, but by cultural ones(object is only European countries).
	Van, et al (2003)	Demonstrated that national culture which composed of Hofstede index and Hall (object is only European countries) had a great impact on national adoption rate.
	Dwyer, et al (2005)	Revealed that national culture index of Hofstede had effect on parameter q of Bass model(object is only European countries).
	Kata, Ouchi (2015)	clarified that national culture index of Hofstede affected the diffusion between countries including Japan.

Source:Created by authors based on previous study

2-3. Macro environment analysis

Regarding of the macro environment analysis, we discuss the transition of the framework in that of environment and its necessity. Below, we describe those from three perspectives : ①Importance of PEST analysis ②PEST using expansion ③CAGE analysis

Table 2: Previous study of Macro environment analysis

<p>① Importance of PEST analysis</p>	<p>PEST analysis is an tools for seeing the situation in the external environment of a company, especially in the macro environment (Kotler,2006 : 48). The intention of using this analysis is to organize opportunities and threats in the macro environment, predict what they have on their company, and lead to marketing and strategy formulation with consideration of predicted impact. (Kotler,2006 : 50-51).</p> <p>The external environment in the strategic theory can be divided into a macro environment and a micro environment. In the macro environment, companies can not control those factors. In addition, Orikasa (2016 : 10) stated that “it is assumed that the macro environment affects companies”. There are many previous study which actually advocated that the macro environment affects the management of the company. For example, Chen (2013 : 37) mentioned the influence of the macro environment on corporate management strategies. Specifically, he assumed political factors as “opportunities for change”(2013 : 37). He also mentioned that “economic factors also directly affects the competitiveness of companies” (2013 : 38).</p>
<p>② PEST using expansion</p>	<p>The PEST analysis can also be used to organize the macro environment of your country and its analysis also fulfills the function in overseas strategic formulation (Xu & Lee, 2018). The firms need to analyze the environment surrounding themselves , because the macro environment overseas is always highly variable and uncertainty. Therefore, before going overseas, companies must conduct market research.. Specifically, companies organize information so as to minimize the threats that is given to your company by seeing the macro environment and to discover opportunities. Then you need to convert the information from that market into practical knowledge and share it throughout the organization. From this knowledge, you can embody innovative products and services. It causes innovation.</p>
<p>③ CAGE analysis</p>	<p>Although there is a framework to organize the macro environment like PEST analysis, recently CAGE advocated by Gemawat analysis has become mainstream. CAGE stands for Cultural, Administrative, Geographical, and Economical difference. Gemawat (2009) mentioned that the preference for something is far different from country to country. He hasn't accepted the traditional innovative global strategy and advocated an analysis focusing on the differences by a country as a framework. Characteristics of CAGE analysis is that can clarify the construct of “Distance” in the country unit, Yanagita (2016) stated when the firms went to the other market, they needed to deeply think about different cultures, religions, ethnic groups, institutions, population, geographical situation, income level, and etc.</p>

Source: Created by authors based on each citation source

As described above, PEST analysis and CAGE analysis are significant analysis tools in order to consider marketing strategy and management strategy formulation. This study conducted analysis using PEST analysis instead of CAGE analysis. The reason in that technical factors in PEST analysis was supposed to be an answer to our RQ "Why new technology and products diffusion is slow in Japan?" In fact, Oriyasa (2016) states that changes in the technical factors needed to be fully taken into consideration. The following table summarizes factors in each macro environment in PEST analysis(table 3).

Table 3: Overview of PEST analysis

PEST analysis	Definition
Politics	Political factors refer to regulations, government policies and trends of pressure organizations (Kusano, 2017 : 62)
Economy	Economic factors refer to economic trends, changes in income, trends in consumption expenditure and changes in savings rate (Kusano, 2017 : 62)
Society	Social factors refer to population dynamics, income distribution, changes in educational standards and lifestyles (Carry and Johnson, 1989 : 58)
Technology	Technical factors refer to R & D expenses, technology trade ratio, number of patents, GDP per worker, M & A (Yamanouchi, 2001).

Source: Created by authors based on each citation source

2-4. National Culture

Next, as another viewpoint of analysis in this study, we introduce national culture. The definition of culture and the connection between business administration, communication and culture are as follows (table 4).

Table 4: Previous study about culture

Taylor (1871)	culture is compound whole including knowledge, faith, art, morality, law, custom, and other abilities and customs acquired as members of society.
Kluckhohn, Kelly(1945)	culture is everything that was historically created for explicit, implicit, intelligent, irrational, or irrational human life, that is, always exists as a potential guideline for human behavior .
Triandis (1977)	culture is a part created by humans in the human environment.
Hofstede (1991:1)	Definition of culture as “collectively programmed as a program in human mind, the program differs depending on group or category.” Differences in culture at the national level are due to differences in values over differences in practice and cultural differences at the organization level are due to differences in practices over differences in values.
Edward T. Hall(1993)	He clarified the degree of context of the world people, analyzing the dimension from “High-context” to “Low-context” where their communication style is located. High-context communication is common in the collectivist culture, while low-context communication is common in the individualist culture.
Ghemawat (2004)	It is necessary to carefully consider how the national culture of the advanced country affects business in the field.

Source: Created by authors based on each citation source

There is Hofstede index to quantitatively identify national culture. Hofstede analyzed differences in national culture as four dimensions through investigating the differences of national culture against 116,000 IBM employees in various countries from 1968 to 1978 (Hofstede, 1980 : 43).

Bond, Michael.H revised the questionnaire for Asians at the end of the 1980s (Hofstede, 2010), because questionnaire in carried out by Hofstede in the 1980s was biased towards Westerners. As a result, they proposed a dimension which is long and short term(table 5). And also, Misho analyzed WVS database in more details. The result of the analysis generated the Indulgence Versus Restraint(table 5) of the culture dimension (Hofstede, 2010).

Consideration of national culture is necessary for considering about factors that affect innovation diffusion, but the relationship between the national culture and the innovation diffusion has not been clarified. We clarify the factors of new technology diffusion from the perspective of the macro environment and national culture.

Table 5: Definition of Hofstede index

National culture	Definition
Power Distance	“The extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally.”
Individualism and Collectivism	“Individualism stands for a society in which the ties between individuals are loose: Everyone is expected to look after him/herself and her/his immediate family only. Collectivism stands for a society in which people from birth onwards are integrated into strong, cohesive in-groups, which throughout people’s lifetime continue to protect them in exchange for unquestioning loyalty.”
Masculinity and Femininity	“Masculinity stands for a society in which social gender roles are clearly distinct: Men are supposed to be assertive, tough, and focused on material success; women are supposed to be more modest, tender, and concerned with the quality of life. Femininity stands for a society in which social gender roles overlap: Both men and women are supposed to be modest, tender, and concerned with the quality of life.”
Uncertainty Avoidance	“The extent to which the members of a culture feel threatened by uncertain or unknown situations.”
Long-Versus Short-Term Orientation	“Long Term Orientation stands for the fostering of virtues oriented towards future rewards, in particular, perseverance and thrift. Its opposite pole, Short Term Orientation, stands for the fostering of virtues related to the past and present, in particular, respect for tradition, preservation of ‘face’ and fulfilling social obligations”.

Indulgence Versus Restraint	"Indulgence stands for a tendency to allow relatively free gratification of basic and natural human desires related to enjoying life and having fun. Its opposite pole, restraint, reflects a conviction that such gratification needs to be curbed and regulated by strict social norms".
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Source: Hofstede (2001 : 98, 161, 225, 297, 359) : Hofstede(2010 : 98, 161, 225, 297, 35

9)

3. Research subject and Methodology

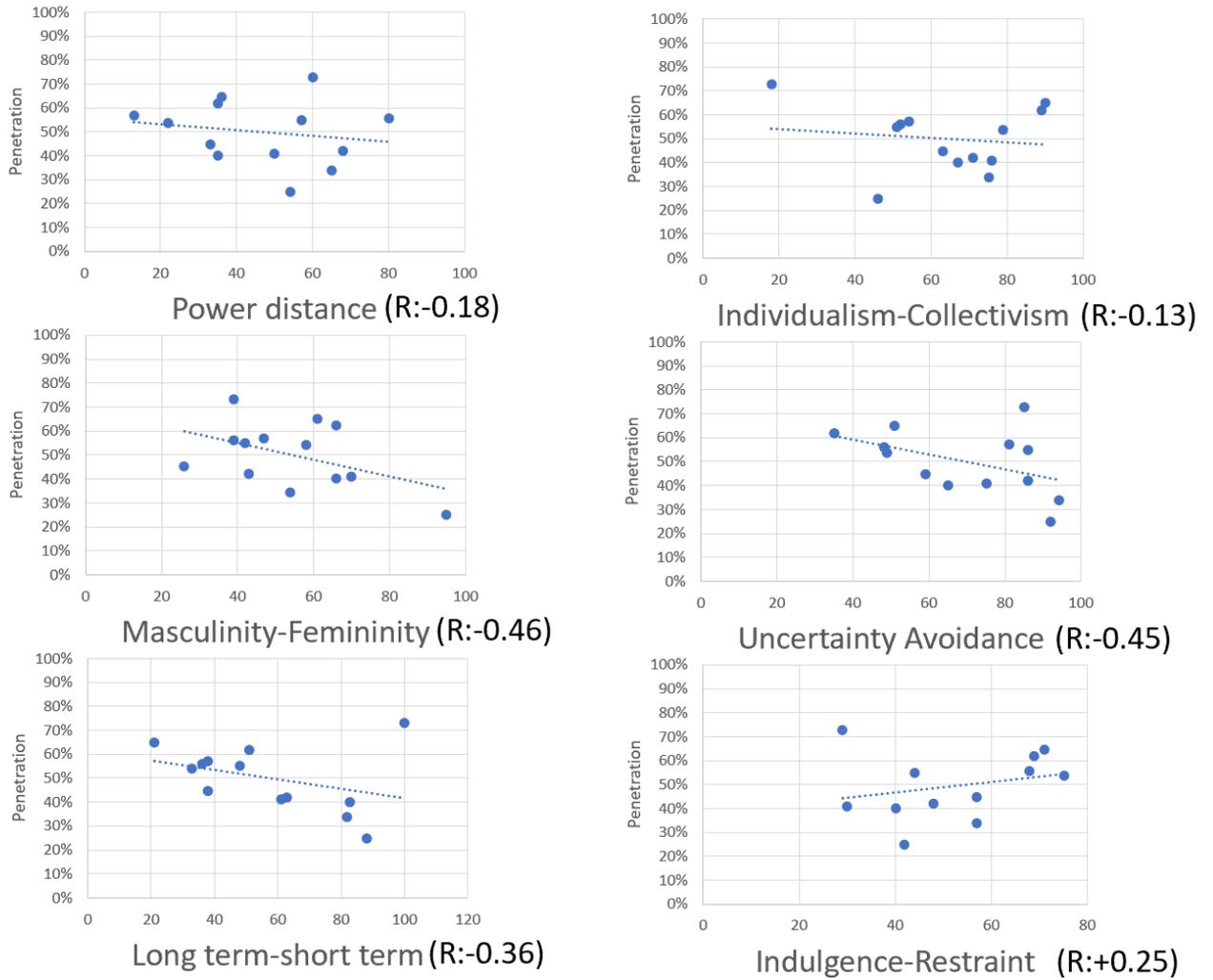
Based on previous study, this study adopts a multimethod approach that integrates quantitative and qualitative analysis to explore the answer to the question. In this section, firstly, we explain about the study objects which is investigated from the perspective of PEST and C (national culture). And we give reasons and criteria of the selection. Secondly, using the PEST and C analysis, we show the indicators and analysis methods used and describe the flow of study method.

3-1. Selection of comparative research object

In this study, we selected Korea as the comparative country with Japan from the following reasons. Firstly, Korea has relatively high penetration of many innovative products. Korea belongs to OECD as Japan and nominal GDP per capita is closed to Japan(around US\$10.000). Secondly, Korea has a big difference with in

“masculinity” which means an effective index emerging in the preliminary analysis. As a preliminary analysis of national culture, this study examined the smartphone penetration and Hofstede index among 13 countries in order to predict the influence which national culture has on the diffusion of new technology (Figure 3). We chose these countries because they were members of OECD, those GDP per capita were similar to those of Japan ($\pm 10,000$ US\$), also data was available. As a result, we found that there was negative correlation between masculinity and smartphone penetration. Uncertainty Avoidance also had a negative correlation with smartphone penetration, however, Hofstede (2001 : 170) mentioned as follows, “Innovations welcomed but not necessarily taken seriously.” Because of this reason, we focused on masculinity. Also, when comparing Hofstede index of Japan and 12 OECD countries, Korea had a relatively huge divergence in masculinity and relatively small difference in other indexes between Japan. Thus, it can be said that Korea is valid as a object of this comparative study.

Figure 3: Scatter plot of Hofstede index and smartphone penetration , R stands for correlation



Source: Created by authors based on Consumer Barometer and Hofstede (2010).

Table 6: Hofstede index of Japan and Korea

	Power Distance	Individualism-Collectivism	Masculinity-Femininity	Uncertainty Avoidance	Long-term orientation - Short-term orientation	Irritability - Self-control
Japan	54	46	95	92	88	42
Korea	60	18	39	85	100	29

Source: Created by authors based on the basis of Hofstede(2010).

In addition, in PEST analysis, this study adopted a smartphone as study subject. The reason for this is that the smartphone is innovative in recent years and it is possible to observe posteriorly since they are widely diffused now. In C analysis, AI speakers and mobile payment are taken as examples of new technology. There are two reasons for this selection, first, study subjects need to be new technology as of 2018 and generally recognized. It is because qualitative surveys such as questionnaires are also conducted in addition to quantitative surveys on national culture so. It is necessary to have it. The second reason is that the data of two new technology mentioned above are obtained from the preliminary questionnaire survey and the possibility of acquiring significant results as a result of the analysis is high.

3-2. Methodology

In this section, we introduce the method of this study. PEST analysis and C analysis are adopted.

(1) PEST analysis

We reveal the relationship between “the diffusion of new technology” and “the macro environment” by using PEST analysis for smartphones chronologically. At first, we built hypothesis from the viewpoint of the diffusion and the macro environment, and we compare Japan with Korea from 2009 to 2012 to reveal delayed the diffusion of smartphones in Japan. We collected secondary sources of both countries to test hypothesis. According to Moore (2002 : 5), “When innovation was adopted among members belonging to a social system exceeding 16%, that innovation would be diffused.” Therefore, it is possible to set the period of innovation introduction as the period until penetration exceeds 16%. The smartphone penetration exceeded 16% between 2009 and 2010 in both Japan and Korea, we can explain that until the year 2010 is the introduction period of smartphones. Thus, it is reasonable that the target period is defined as 2009 to 2012.

(2) C analysis

As masculinity index showed significant differences in Japan and Korea, in order to extract operational elements from masculinity, we have conducted for 67 Japanese university students and graduates, because they are sensitive to new technology and will occupy a large part of the market in the coming decade. We have two main purposes of preliminary questionnaire survey. The first is to check whether

her or not masculinity has a negative influence on purchasing will of new technology. The second is to select the subjects of the interview survey which are necessary to confirm what features are characteristic of consumers with high or low masculinity. Questions asking about masculinity were quoted from the questions of Hofstede (1983). Questions asking about purchase intention were confirmed by asking some questions about the current use of new technology. We used the calculation method of Fujita(1999) to calculate scores of masculinity. After that, we executed logistic regression analysis to find the relationship between masculinity and purchase intention new technology.

Next, we conducted the interview survey based on the results of the preliminary questionnaire survey. The subjects were 16 people, 9 people with the high degree of masculinity calculated from preliminary questionnaire survey (over 60), and 7 people with low one (less than 35). Appendix 1 is the list of interviewees. By taking the form of an unstructured interview and asking about each purchasing behavior and private life, we have derived what kind of behavioral characteristics exist depending on the degree of masculinity.

As a next step, we derived constructs and hypotheses from the interview survey and previous study, and created questionnaire items to verify hypotheses. We

conducted Questionnaire survey of university students and graduates, with 200 Japanese and 147 Korean customers answered.

Given the results of the questionnaire survey, we decided to use 5 steps to verify what kind of element in masculinity affect the difference in technology acceptance (hereinafter abbreviated as TA) between Japan and Korea. The TA is to see whether people are easy to accept certain technology or not. The degree of acceptance is judged on the basis of whether or not people use the technology at the time of questionnaire execution, or whether people want to use it or not. We explain 5 steps below.

1. Confirming the relation between the acceptance of AI speakers and mobile payment which are representative of new technology and masculinity itself, by logistic regression analysis.

2. Determining whether the derived construct is available as a synthetic variable. By conducting reliability analysis on the response to the questionnaire, it is determined whether or not the answer has affinity.

3. To verify that the derived construct was cut out from masculinity, confirming whether there is a correlation between masculinity and synthetic variable that obtained reliability by reliability analysis.
4. Using logistic regression analysis to determine whether or not it affects the TA with synthetic variables that are reliable and correlated with male likelihood.
5. In Japan and Korea, we verify the reason why TA is different despite the close men's average of masculinity by paying attention to the national average difference of the construct that is cut out from masculinity and confirmed to have an influence on the aforementioned TA.

4. Analysis

In this section, firstly, from the viewpoint of PEST analysis and national culture, we generated hypotheses about the factors that create the difference between the penetration of new technology and the TA in Japan and Korea. Next, we analyze these hypotheses. As a result, it turned out that PEST factors partially affected the difference in penetration between Japan and Korea. In addition, we found that constructs correlated with masculinity affected the TA and that these are part of the factors that create differences in TA in Japan and Korea.

4-1. Macro environment – PEST analysis –

Here, we show hypotheses, verification of hypotheses, and results from the viewpoint of PEST analysis.

(1) Hypothesis

Our study made four hypotheses (Table 8).

Table 7: Hypotheses

Factors	Hypothesis	Basis of hypothesis
P	<p>Hypothesis 1 Compared to Korea, the diffusion of smart phones in Japan was delayed due to the fact that Japan did not implement policies more directly affecting the diffusion of smartphones than Korea.</p>	<p>To create an environment for the diffusion of new technology such as regulation and legislation, expansion of versatility and low price negotiation of products and services, it will affect the diffusion of innovation. (G7 academies' Joint Statements, 2017,)</p>
E	<p>Hypothesis 2 Compared to Korea, the diffusion of smart phones in Japan was delayed due to the fact that Japan has a smaller nominal GDP per capita than Korea.</p>	<p>· “The nominal GDP per capita was analyzed which the two countries with the upper and lower rankings of the internet penetration in each category. As a result, the internet had been diffused when the economy level of each country was improved” (Hoshino, Matsuno, Adachi, 2012 : 75). The diffusion of internet is the transition of the number of users of the internet. A state where the number of internet users is increasing due to the improvement of the economic level means that people are using the internet via devices such as smartphones and personal computers. Therefore, the difference in the smartphone penetration between Japan and Korea can be explained by nominal GDP per capita.</p>

S	<p>Hypothesis 3</p> <p>Compared to Korea, the diffusion of smartphones in Japan was delayed due to the fact that the number of elderly people is larger in Japan than in Korea.</p>	<p>Older individuals tend to perceive a reduction in their own cognitive capabilities to learn than younger individuals (Hertzog and Hultsch, 2000). Beliefs about self cognitive processing and its consequences are formed basis of accumulated experience (Clark, 2005). Thus, Older people who have less accumulated experience of new technology than younger people and have psychological barriers.</p>
T	<p>Hypothesis 4</p> <p>Compared to Korea, the diffusion of smartphones in Japan was delayed due to the fact that Japan was lower in R & D expenditure per R & D worker than in Korea.</p>	<ul style="list-style-type: none"> • R&D expenses contribute to the growth of companies and the economy through improvement of productivity and expansion of profitability. (Mizuho Research Institute, 2010) • Companies invest R & D expenses to improve their technical capabilities. Therefore, as enterprise input, R & D expenditure is one of the indicators of technical strengths (Hirooka, 1995). Many science and technology are used for new technology such as smartphones. In the process of diffusing products, it is important how to have technology. Therefore, the R & D expenditure which is the amount invested in technology has an influence on the diffusion of new technology.

Source: Authors

(2) Hypothesis verification

Political factors(H1)

Referring to following two tables, we verify H1.

Table 8: Policy Comparison between Japan and Korea

	Japan	Korea
Number of policies	4	12
Policy name	<ul style="list-style-type: none"> • e-Japan strategy (2001) • u-Japan strategy (2005) • Strategy for Achieving a Smart Ubiquitous Network Society (2009) • smart cloud strategy (2010) 	<ul style="list-style-type: none"> • Cyber Korea 21 (1999) • e-Korea vision (2002) • Broadband IT Korea (2003) • Broadband Convergence Network Infrastructure Project (2004) • The Basic Plan of Construction u-Sensor Network (2004) • u-Korea basic plan (2006) • National Information Plan (2008) • National information promotion basic law (2009) • mobile internet activation comprehensive plan (2009, March, 2009, April, 2010, April) • Promotion Plan (2010)
Policy content	<ul style="list-style-type: none"> • Promotion mainly utilization of ICT • Construction of cloud service 	<ul style="list-style-type: none"> • Improvement of information utilization ability of all citizens • Creating an environment where smartphones are easy to diffusion • Expansion of population of Internet users • Mobile Internet price cuts • Promote the diffusion of smartphones

Source: Created by authors based on Zhou (2012 : 92)

Table 9: Verification and Result for Hypothesis of Political factor

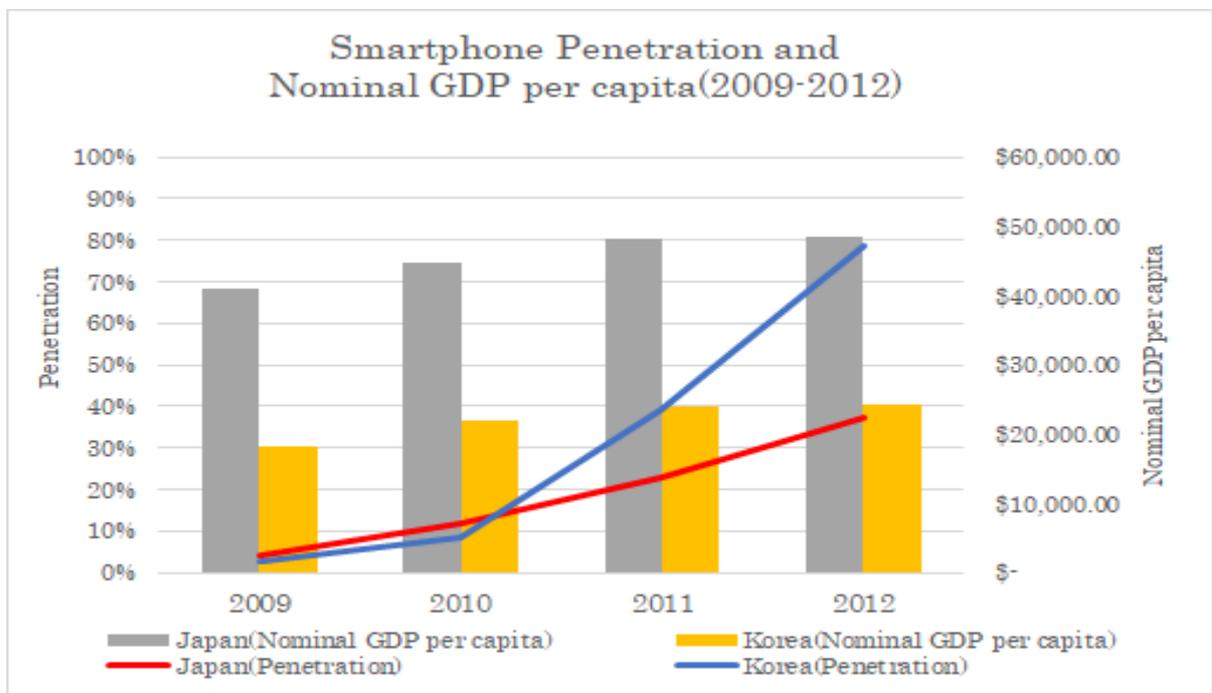
Verification	Result
<p>In Korea, the penetration of the mobile internet was delayed because of two reasons that the content market is difficult to develop due to the industrial structure of the mobile internet and the communication fee is high. This problem is delaying "to be ICT-oriented country" which is the purpose of Korea's policy. As a result, Korea has taken more policies that directly lead to the diffusion of smartphones as a means to diffuse the mobile internet than Japan. (Table 7)</p>	<p>By conducting verification, H1" Compared to Korea, the diffusion of smartphones in Japan was delayed due to the fact that Japan did not implement policies more directly affecting the diffusion of smartphones than Korea" is unsupported.</p>

Source: Authors

Economic factor (H2)

Referring to following two tables, we verify H2.

Figure 4: Transitions in smartphone penetration and per capita nominal GDP in Japan and Korea (2009 - 2012)



Source : WorldBank, Impress, Ministry of Internal Affairs , and KISA

Table10:Verification and Result for Hypothesis of Economic factor

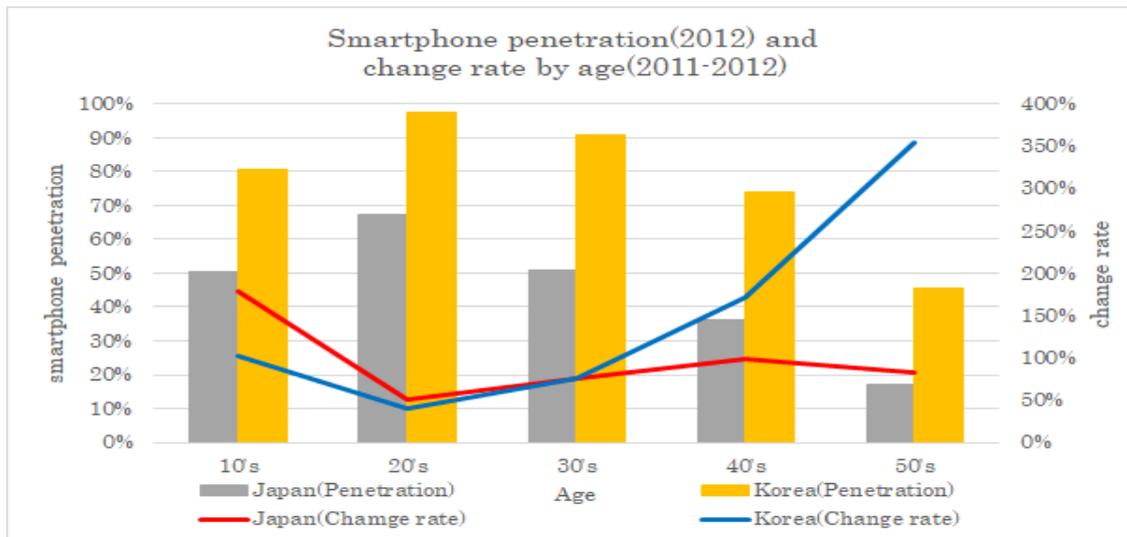
Verification	Result
The growth of nominal GDP per capita from 2009 to 2012 in both countries had increased slightly (Figure 5). Korean penetration surpassed Japanese one since 2010.	By conducting verification, H2 “Compared to Korea, the diffusion of the smartphones in Japan was delayed due to the fact that Japan has a smaller nominal GDP per capita than Korea” is unsupported.

Source:Authors

Social factor (H3)

Referring to following two tables,we verify H3.

Figure 5:Smartphone penetration(2012) and change rate by age (2011-1012) in Japan and Korea



Source:Impress,Ministry of Internal Affairs , and KISA

Table11: Verification and Result for Hypothesis of Social factor

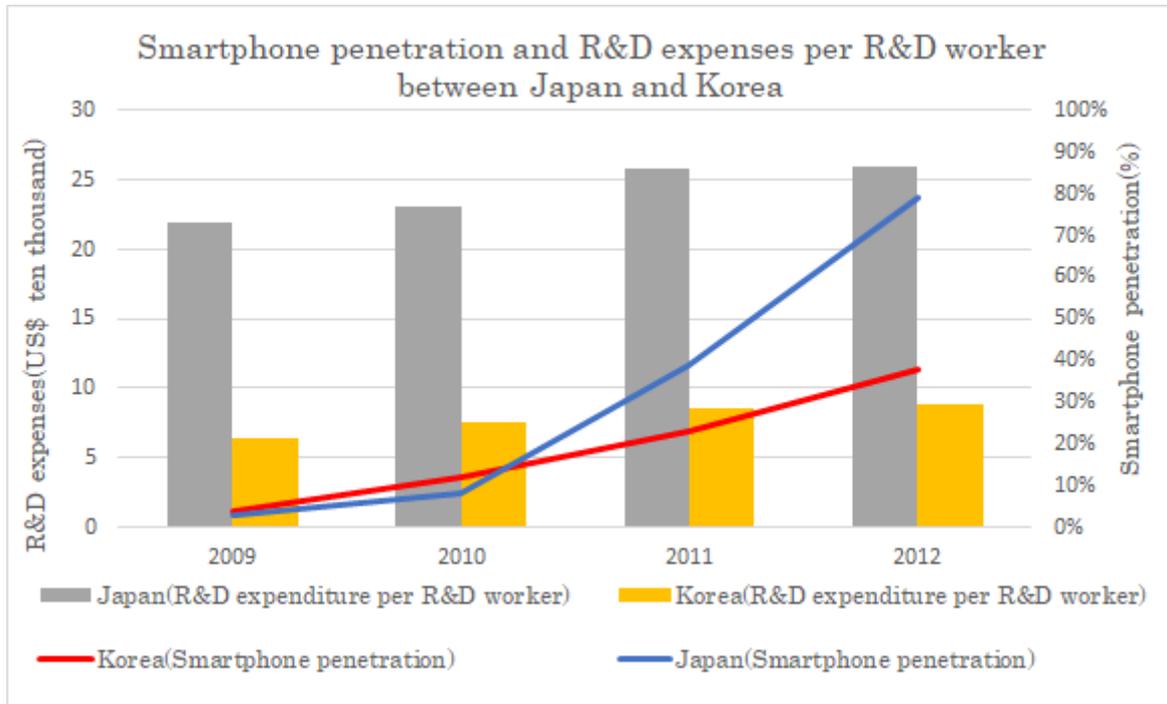
Verification	Result
<p>The percentage of elderly people in Japan is 23.3% and Korean one is 11.4%(OECD, 2012).</p> <p>Korean smartphone penetration explodely increased from 2011 to 2012(Figure 6).</p> <p>From change rate of smartphone penetration by age in Japan and Korea (Figure 6), although there is not great gap in change rates of 10-30' s, the change rates of 40, 50' s in Korea are much higher than Japan. This fact clarifies that above explosion in Korea arose from beginning of use smartphone by 40, 50' s. In addition, smartphone penetration of Japan is lower than Korea in all ages.</p>	<p>H3 is unsupported.</p> <p>By conducting verification, hypothesis 3 “Compared to Korea, the diffusion of the smart phones in Japan was delayed due to the fact that the number of elderly people is larger in Japan than in Korea” is unsupported</p>

Source: Authors

Technical Factors (H4)

Diffusion is influenced by important technology in the process of innovation being generated(Rogers, 1971). According to Hirooka (1995), Technical power is dominant in the early stage of the product diffusioning stage. Referring to following two tables, we verificate H4.

Figure 6: Smartphone penetration and R & D expenditure per R & D worker between Japan and Korea (2009–2012)



Source: KISTEP, Impress, Ministry of Internal Affairs , and KISA

Table 12: Verification and Result for Hypothesis of Technical factor

Verification	Result
Compared with Japan, R&D expenditure per R & D worker in Korea has been lower for four years(Figure 6). Nonetheless, the smartphone penetration in Korea has been rising sharply.	By conducting verification, H4” Compared to Korea, the diffusion of the smartphones in Japan was delayed due to the fact that Japan was lower in R & D expenditure per R & D worker than in Korea” is unsupported.

Source: Authors

(3) Conclusion

As a results of above analysis,we clarified the factors of the diffusio
n of smartphones and summarize the hypotheses and verification results.

Table 13: verification results of the PEST analysis

P	Hypothesis 1 Compared to Korea, the diffusion of the the smar tphones in Japan was delayed due to the fact tha t Japan did not implement policies more directly affecting the diffusion of smartphones than Kore a.	supported
E	Hypothesis 2 Compared to Korea, the diffusion of the smartpho nes in Japan was delayed due to the fact that Ja pan has a smaller nominal GDP per capita than Ko rea.	unsupported
S	Hypothesis 3 Compared to Korea, the diffusion of the smartpho nes in Japan was delayed due to the fact that th e number of elderly people is larger in Japan th an in Korea.	unsupported
T	Hypothesis 4 Compared to Korea the diffusion of the smartpho nes in Japan was delayed due to the fact that Ja pan was lower in R & D expenditure per R & D wor ker than in Korea.	unsupported

Source: Authors

PEST analysis revealed that only political factors are affecting the diff
usion of smartphone. As a result, it was impossible to make a clear answer to the

question only by PEST analysis. From the next section, we analyze from the view point of the national culture.

4-2. C analysis

(1) Hypothesis derivation

In this part, we will describe each of the five steps explained in 3-2 (2) in detail. According to the result of preliminary questionnaire survey, logistic regression analysis was conducted on masculinity and the purchase intention of new technology. As a result, masculinity had a negative influence on purchase intention of new technology.

Next, as a result of the interview survey, the plural questions showed unity in masculinity and answers. After that, we divide the reliable question in unity into three, and derived three provisional constructs. (Questionnaire items and responses, interview details and answers can be disclosed at any time.)

Table 14: Interview Results and Emerging Constructs

Interview Items	Interviewee	Quotes	constructs
About AI speakers	8	I do not need AI speakers, because I can do anything without relying on machines.	Self Trust
	15	I do not trust AI speakers.	
About mobile payment	10	I am concerned about security.	
About use of money	13	Since I spend money on my hobbies, I do not spend as much money on things I do not feel need for.	Concern at the time of product purchase
About fitting	1	I do not try it on clothes because it is troublesome.	
About hobby	2	My hobby is collecting sneakers.	Intangible consumption
	16	My hobby is climbing.	

Source: Authors

The following is the definition of these constructs.

- Self trust: Comparison of practicality and self-performance assumed by consumers

when purchasing

goods.

- Concern at the time of product purchase: Anxiety and concerns based on subjective risk assessment

ive risk assessment

that consumers feel when purchasing goods and services.

• Intangible consumption: Consumers' trend that finds value in the obtainable experiences

when using products and services.

To use this provisional construct as a reliable one, we increased the number of questions that constitute the construct. In addition, from the previous study (Ichikouji, 2013), we extracted constructs of adoptive innovativeness and creative innovativeness. Therefore, these five constructs; self-trust, degree of concern at the time of product purchase, intangible consumption, adoptive innovativeness and creative innovativeness are extracted, which are thought to be related to masculinity by the preliminary questionnaire survey and the interview survey.

We conducted the questionnaire survey as the next stage where five constructs were derived and we analyzed the results (N=347). Firstly, the logistic regression analysis confirmed that masculinity had a negative influence on the acceptance of mobile payment. As a result, there are no significant results for AI speakers, and it can not be asserted that masculinity affects them. Secondly, we conducted the reliability analysis to determine whether or not the derived five constructs were available as the synthetic variables. As a result, since the index Cronbach's alpha, which shows affinity, exceeds .70, it turned out that we can use fol

lowing constructs as synthetic variables; self-trust, adoptive innovativeness, thinking innovation. Thirdly, in order to prove that the derived construct was extracted from masculinity, correlation coefficients were obtained by three synthetic variables and the male likeness obtained above. As a result, the correlation between masculinity and the self-trust was hardly seen as .101, the correlation with adoptive innovativeness was -.211 correlation with thinking innovation was -.311, confirming that there was a weak negative correlation. From this, the two constructs of adoptive innovativeness and thinking innovation correlated with masculinity. Finally, the logistic regression analysis was performed on the above two synthetic variables correlated with masculinity and TA. As a result, it was revealed that both adoptive innovativeness and creative innovativeness positively influenced TA. we summarize three results in Table 12.

Through the above process, adoptive innovativeness and creative innovativeness, which are two constructs negatively correlated with masculinity, have a positive influence on TA. In other words, masculinity is indirect but has a negative influence on the diffusion of new technology. Returning to the original point here, there is a big difference in the TA despite the fact that the national averages of Japanese and Korean masculinity are about the same at this stage. Based on t

his fact, we propose the following hypothesis about the factors that greatly differ in TA in Japan and Korea.

Hypothesis 5: The acceptance rate of AI speakers and mobile payment in Japan is lower than those in Korea due to the smaller national average of adoptional innovativeness in Japan than in Korea.

Hypothesis 6: The acceptance rate of AI speakers and mobile payment in Japan is lower than those in Korea due to the smaller national average of creative innovativeness in Japan rather than in Korea.

Table 15: Analysis results of the five constructs

	Reliability analysis	Correlation with Masculinity	Influence on TA
Self Trust	○ .739	Little Positive Correlation .103	○
Concern at the time of product purchase	×	—	—
Intangible consumption	×	—	—
Adoptive Innovativeness	○ .853	Weak Negative Correlation -.211	○
Creative Innovativeness	○ .767	Weak Negative Correlation -.311	○

Source: Authors

(2) Verification

National Culture H5

National average of adoptive innovativeness that has a positive influence on TA and negative correlation with masculinity is 2.8 in Japan in contrast with 3.1 in Korea. In other words, it mentions Japanese average is smaller than Korean average in the adoptive innovativeness. Therefore, hypothesis 5 is supported.

National Culture H6

National average of creative innovativeness that has a positive influence on TA and negative correlation with masculinity is 3.3 in Japan in contrast with 3.6 in Korea. In other words, Japanese average value is smaller than Korean value in creative innovativeness. Hypothesis 6 is therefore supported.

From the above, taking the national average of two constructs, Japanese value of adoptive innovativeness and creative innovativeness are lower than those of Korea. Therefore, the low value of adoptive innovativeness and creative innovativeness which is also the element of masculinity are part of factors delaying the diffusion of new technology in Japan.

Table 16: Numerical comparison between Japan and Korea

	Masculinity average	TA (%)		Adoptive innovativeness	Creative innovativeness
		AI speakers	Mobile payment		
Japan	50.6	17.4	41.8	2.8 Low	3.3 Low
Korea	48.2	44.9	87.0	3.1 High	3.6 High

Source: Authors

(3) Conclusion

As a result, masculinity is one of the factors of new technology's diffusion.

Table 17: verification results of C analysis

C	Hypothesis 5 The acceptance of AI speakers and mobile payment in Japan is lower than those in Korea due to the smaller national average of adoptive innovativeness in Japan than in Korea.	supported
	Hypothesis 6 The acceptance of AI speakers and mobile payment in Japan is lower than those in Korea due to the smaller national average of creative innovativeness in Japan than in Korea.	supported

Source: Authors

C analysis shows that the acceptance of AI speakers and mobile payment in Japan is lower than in Korea due to the fact that Japanese are lower in the national average of adoptive innovativeness and creative innovativeness than Korean. In addition, we found that factors such as adoptive innovativeness and creative innovativeness had an influence on masculinity in Hofstede index.

5. DISCUSSION

In this study, we aimed to clarify the factors that delay the diffusion of new technology using innovative technology in Japan from the perspective of PEST and C analysis. Through the first analytical framework, we tried to analyze the macro environments which might affect the diffusion of smartphones. As a result, the political factors had positive effect to the diffusion of smartphones, while other factors of PEST had none. At the same time, we took into the cultural factors, we adopted Hofstede index and examined the relationship between the indexes and the diffusion of new technology. As a result of qualitative and quantitative efforts of analysis, firstly, masculinity emerged as the distinguished index possibly affecting the diffusion of new technology. Then, we found that three elements of masculinity ; self trust, adoptive innovativeness, and creative innovativeness had a positive influence on the diffusion of new technology. The higher t

he masculinity score is, the lower the score of these three elements is. In other words, the national averages of these elements of Japan were lower than those of Korea, this is thought to be the cultural background giving a reason why Japanese acceptance of AI speakers and mobile payment is lower than that of Korea.

The academic implication of this study can be summarized as the two points below. Firstly, while existing studies such as diffusion innovation, macro environment analysis and national culture studies, our study integrate these perspective to understand the factors new technology diffusion. While our findings in PEST and C analysis point out only a part of the national differences and various speed of that diffusion. In that sense, our study proposes one possible and promising approach while providing many further questions to be answered. Secondly, as an additional finding, the attempt of this paper identified the masculinity score of university students in Japan and Korea, it's interesting as the score of our study is far different from that of previous score (Japan:95, Korea:39) which was revealed by Hofstede(1983). At this presence, the masculinity score which we found was respectively 50.6 and 48.2 in Japan and Korea. our sample indicate that masculinity score of Japan is greatly decreased, while that of Korea is slightly increased. the result might indicate that masculinity score in other countries is different from previous ones and the other score of Hofstede indexes as well.

Additionally, we also suggested one clear point as practical implication of this study. As shown in PEST analysis in chapter 4, the political factors have obviously driven fast the diffusion of smartphone in Korea, compared Japan, same as an internet, a smartphone nowadays can be said a critical infrastructure for development of other related industries such as IoT, web contents, app development, cashless service, etc. thus, speedy diffusion of such products and technologies can further encourage and boost following innovative industries, which can be a new driving engine of economic development of a country. This means Japanese government should have had a more powerful policy in the diffusion of smartphones with strategic attitude. This finding might be applied not only the case of smartphone, but also concurrently diffusing new technological changes such as cashless service, artificial intelligence, automotive deriving, etc. that means, when there seems strategic importance for next industrial wave, government should purposefully encourage to diffuse the technology with attractive policies.

Despite of the above mentioned academic and practical implications, there are lots of works to be done for further generalization of our findings. Firstly, while we adopt PEST analysis and Hofstede index as representative framework, it is hard to say that the two include every necessary factors to be considered when analyzing macro environment and national culture. More comprehensive factors need to

to be incorporated to further develop the findings of this study. Secondly, while our samples have valid reasons to be chosen within limited time and resources, more countries with various products need to be examined to draw out more generalizable understanding of national gaps in innovation diffusion. For example, comparative studies of smartphone diffusion in OECD top 10 countries would suggest another factors explaining the gaps. Thirdly, regarding AI speakers and cashless payment, PEST analysis can show another interesting results. However, the two products are in ongoing process of diffusion, there needs more time to measure the difference of national gaps of diffusion. Our study is an explorative attempt to understand national gaps in technology diffusion among even neighbouring countries like Japan and Korea. While national culture may persist, our findings emphasize political efforts with the intentional strategy. We are now in a huge turbulence of dramatic technological changes, and responses toward these changes might strongly influence the future of Japanese economies. Our findings cast questions about what Japanese market need to do now.

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Appendixes

Appendix 1: Target for interview survey

番号	性別 (M:男性、F:女性)	学年	男性らしさ
1	M	学部3年	23.6
2	M	学部4年	27
3	M	学部3年	28.2
4	M	学部3年	29.2
5	M	学部3年	31.6
6	M	学部4年	32.4
7	M	学部3年	34.6
8	F	学部3年	60
9	F	学部2年	61.8
10	F	学部3年	62.2
11	M	学部4年	62.2
12	M	学部2年	62.4
13	M	学部4年	63.4
14	F	学部3年	66.6
15	F	学部3年	66.8
16	M	学部2年	67.8

Appendix 2: Questionnaire item

質問意図	設問番号	設問	参考文献
ホフステッド指数の導出	Q1	個人的に達成感を得られる仕事に挑戦できる。	Hofstede, Geert H. (2001)
	Q2	あなたや家族の望ましい地域に住むことができる。	
	Q3	高い収入を得られる。	
	Q4	人と協力しながら働くことができる。	
	Q5	技術向上や新技術の習得の機会がある。	
	Q6	良い付加給付が得られる。	
	Q7	良い仕事をした時にそれに値する評価が得られる。	
	Q8	程よい換気、照明、十分なワークスペースなど、物理的な環境が良い。	
	Q9	自分なりのやり方で仕事をできる自由がある。	
	Q10	働きたいと思う限り働ける保証がある。	
	Q11	昇進の機会がある。	
	Q12	上司との関係が良い。	
	Q13	自分のスキルや能力を十分に発揮できる。	
	Q14	自分個人の時間や家族のために十分な時間がとれる。	
新技術受容度の導出	Q15	現在AIスピーカーを使用していますか。	Davis, et al (1989)、高田、藤田(2013)を参考に作成
	Q16	(Q15で「いいえ」と回答した者のみ) 今後AIスピーカーを使用つもりである。	
	Q17	現在モバイル決済を使用していますか。	
	Q18	(Q17で「いいえ」と回答した者のみ)	

		今後モバイル決済を使用つもりである。	
商品購入時の懸念度合いの導出	Q19	1000円未満の商品を購入する際、価格や品質などについて色々な商品や店を十分に比較検討していますか。	ヒアリングを元に質問項目を設定
	Q20	衝動買いをしますか。	
	Q21	買い物で失敗したと覚えることはありますか。	
	Q22	買い物で失敗しないように心掛けていますか。	
セルフトラストの導出	Q23	「最初の設定にコストがかかるが、その後の作業が楽になる製品」を積極的に使用したいと思いますか。	ヒアリングを元に質問項目を設定。
	Q24	「自分でも出来るが機会にも出来ること」を積極的に使用したいと思いますか。	
コト・トキ消費性の導出	Q25	衣服や電化製品、化粧品などを購入する「モノ消費」と、ライブや旅行などにお金を使う「コト消費」のどちらに、より多くのお金を使いますか。	アイザワ証券「～モノからコトへ～『増え続ける体験型消費』」(2017)を参考に作成
	Q26	宝くじで100万円があったとしたら、最も優先順位の高い使い道はなんですか。以下の選択肢から選んでください。 (モノを買う、生活費、貯蓄、旅行、習い事・趣味・資格取得、飲食、エステ・マッサージ、その他)	
	Q27	あなたの一番の趣味は何ですか。以下の選択肢から選んでください。 (買い物やコレクション、ゲーム、ダーツ・麻雀・カラオケなどの娯楽、映画・動画・音楽などの鑑賞、読書・漫画を読む、体を動かすこと、アイドル・アーティスト・クリエイター等のライブやイベントに足を運ぶこと、旅行・レジャー施設へ行くこと、グルメ、散歩・街歩き、その他)	
	Q29	欲しいモノが1つでもパッと思い浮かぶ。	
	Q30	家にモノが溢れていてこれ以上持ち物を増やしたくない。	
採用革新性の導出	Q31	私は新しい技術・製品について周囲の中では始めに使いがちである。	Schillweart, et al(2005)を元に

	Q32	私は新しい技術・製品について周囲の中では最初に発見しがちである。	van Raaji&Scherpers (2008)が改良した項目、日本語訳は一小路(2013)を参考に作成
	Q33	私は新しい技術・製品について受容度が高いと思う。	
	Q34	私は新しい技術・製品について聞いたとき、それをなんとか試そうと思う。	
	Q35	私は一般的に新しい技術を試すことにためらいがある。	
思考革新性の導出	Q36	私は新しいやり方を経験するのが好きだ。	一小路(2013)を参考に作成。
	Q37	私は新しいアイデアについて考えをめぐらすのが好きだ。	
	Q38	私は新しかったり、異なったりすることに挑戦するのが好きだ。	
	Q39	私は新しい製品を見つけたとき、それがどのようなものであるか知るためにその製品を購入する。	
	Q28	新しく購入したモノを人に紹介したり自慢するなどして、共感を得ようとしていますか。	

Appendix3. Relationship between TA and constructs.

AI Speaker Acceptance and Self Trust	Explanatory variable	B	Standard error	Wald	Degree of freedom	Significance level	Exp(B)	95% confidence interval of Exp (B)	
								lower limit	upper limit
	Self Trust	-0.104	0.173	63.137	1	0	0.253	0.18	0.355
	Constant	2.758	0.445	38.376	1	0	15.762		
AI Speaker Acceptance and adopti	Explanatory variable	B	Standard error	Wald	Degree of freedom	Significance level	Exp(B)	95% confidence interval of Exp (B)	
								lower limit	upper limit

ve innovativeness	adoptive innovativeness	1.051	0.158	44.497	1	0	2.86	2.1	3.894
	Constant	-4.138	0.524	62.353	1	0	0.016		
AI Speaker Acceptance and Thinking innovation	Explanatory variable	B	Standard error	Waid	Degree of freedom	Significance level	Exp(B)	95% confidence interval of Exp (B)	
								lower limit	upper limit
	Thinking innovation	0.67	0.157	18.271	1	0	1.954	1.437	2.656
	Constant	-3.222	0.572	31.69	1	0	0.04		
Mobile Payment Acceptance and Self Trust	Explanatory variable	B	Standard error	Waid	Degree of freedom	Significance level	Exp(B)	95% confidence interval of Exp (B)	
								lower limit	upper limit
	Self Trust	-0.543	0.112	23.519	1	0	0.581	0.467	0.724
	Constant	2.077	0.36	33.29	1	0	7.98		
Mobile Payment Acceptance and adoptive innovativeness	Explanatory variable	B	Standard error	Waid	Degree of freedom	Significance level	Exp(B)	95% confidence interval of Exp (B)	
								lower limit	upper limit
	adoptive innovativeness	0.786	0.138	32.382	1	0	2.195	1.675	3.894
	Constant	-4.138	0.524	62.353	1	0	0.016		
Mobile Payment A	Explanatory vari	B	Standard error	Waid	Degree of freedo	Signific	Exp(B)	95% confidence int	
						ance lev		erval of Exp (B)	

acceptance and Thinking innovation	able				m	el		lower limit	upper limit
	Thinking innovation	0.579	0.141	16.873	1	0	1.784	1.353	2.352
	Constant	-1.487	0.48	9.586	1	0.002	0.226		