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The Future of the Fair Trade Market in Japan: What motivates

consumers to purchase fair trade products?

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Abstract:

The purpose of this study is to identify factors that affect consumers' decision making regarding purchase of fair trade products in Japan. Fair trade is an approach that guarantees that producers of goods from developing countries are not economically exploited. However, few models have been tested in Japan. Therefore, in this paper, referring to Shaw et al. (2000), which analyzes factors to purchase fair trade products in the UK based on the Theory of Planned Behavior (TPB), we examine the effect of knowledge about fair trade and others on purchase intention in Japan.

The data used here is from a survey in Ibaraki Prefecture (males and females aged between 20 and 79; n = 213). The results showed that knowledge alone did not directly affect purchase intention. Rather, the more important factor influencing purchase of fair trade products was whether it was favorable or easy for consumers to do. Knowledge was related to the outcome evaluation that purchasing fair trade products would be important for society. Such persons did not only obtain the knowledge, but also conduct altruistic behavior frequently. They believed that altruism is socially important in daily life. Therefore, besides simply raising awareness about fair trade, education is important to understand the social significance of altruistic behavior.

We tested only models based on TRA and TPB in this study. On the other hand, there are many possible models to include factors that may explain consumers' decision making for fair trade products. In addition, in order to generalize the results as a model of fair trade products in Japan, it is necessary to carry out another survey targeting the whole of Japanese population.

Keywords

Fair Trade, Consumer Education, Decision Making, Theory of Planned Behavior, Japan

(1) Introduction

The purpose of this study is to identify

1. Fair Trade Market

factors that affect consumers' decision making regarding purchase of fair trade products in Japan. The development of international trade has raised various ethical issues. For instance, workers may be employed at low wages and be economically exploited in developing countries. The most important issue is that workers in developing countries often lack bargaining power against importers and producers of final products. Poverty also leads to child labor issues. One of the ways to solve these problems is the fair trade system. Now, business pays greater attention to fair trade because consumers and investors take more interest in corporate social responsibility than they did previously. Awareness of fair trade products is now more than 90% in the United Kingdom, Austria, and Ireland (Fairtrade International & GlobeScan, 2015). It has become one decision-making criteria when consumers choose a company's product. As of 2014, 1.5 million producers and workers had joined the Fairtrade International Certification system. Global sales of products with this designation reached 5.9 billion euros in total (JPY 830 billion).

The Fair Trade logo was introduced in Japan in 1993. However, awareness of the system in Japan was only 14.7% according to a result from the Cabinet Office's National Life Preference Survey in 2007. There are very few opportunities to find fair trade products in grocery stores. The market size in Japan is increasing and as of 2015 it reached about JPY 10.0 billion (Figure 1). This is equivalent to 0.53 euros per person. The market is still much smaller than those in other developed countries (Figure 2).

What are important factors to promote fair trade products in Japan? A key is consumer behavior because consumer preference develops a market. If we understand the consumers' decision-making process to buy fair trade products, tips to promote fair trade can be discovered.

In recent years, the relationship between consumption and self-identity is one







Note: The figures were calculated with information from Fairtrade International

Annual Report 2014-15 and United Nations World Population Prospects

of the drivers to promote consumption. According to Tamaki (2008), the formation of identity through consumption is a process "to find themselves among others, explain their own as a consistent presence, and to maintain a sense of self" (p. 52). Watanabe (2007) concludes that the awareness of fair trade influenced the development of fair trade markets in Western countries. In fact, since the mid-1990s, fair trade organizations and other related associations in European countries have launched awareness raising campaigns and then increased sales of designated products. Therefore, raising awareness through consumer education and increasing a sense of self-identity will be pillars of promoting fair trade products in Japan. Moreover, Watanabe (2007) also noted that the meaning of consumption has changed over time. Consumers choose products not only for economic value (prices) but also relating to social values. Therefore, we can interpret such consumer behavior as irrational behavior because consumers spend more money for "others," i.e., workers in developing countries. In this paper, we focus more on the effect of the preference for others and education on purchase intention of fair trade products, using survey data from Ibaraki, Japan.

2. The definition of Fair Trade

Three international fair trade organizations, the Fairtrade International (FLO), the World Fair Trade Organization (WFTO), and the European Fair Trade Association (EFTA), established the Fair Trade Network. The Network defined fair trade to be "a trading partnership, based on dialogue, transparency and respect, that seeks greater equity in international trade". The Network states that "(i)t contributes to sustainable development by offering better trading conditions to, and securing the rights of, marginalized producers and workers—especially in the South. Fair Trade Organizations, backed by consumers, are engaged actively in supporting producers, awareness raising and in campaigning for changes in the rules and practice of conventional international trade". According to the Fairtrade Label Japan, fair trade was begun by Ten Thousand Villages of America for purchase of embroidery in Puerto Rico in 1946.

In 2001, the Fair Trade Network decided its strategy as follows.

- 1. To work together so that marginalized producers and workers can break out of vulnerable conditions and obtain economic independence and security;
- 2. To empower the producers and workers to organize themselves and become significant stakeholders in a global market;
- 3. To actively play a wide variety of roles in international trade and make it fair. (Watanabe, 2007, p. 5)

Approved products with the fair trade marks follow the standards throughout the process from raw material production, import, manufacture, through shipment. For example, coffee prices fluctuated drastically in the international market. Even when the price increases due to drought, small coffee plant producers may not have any bargaining power and get enough income to cover their production costs. On the other hand, the fair trade standard sets minimum prices, regardless of the fluctuations of the international market prices (Figure 3). Importers must ensure that the minimum price is paid to producers' associations. The Japan Fair Trade Labeling mentions that the price of approved coffee beans should be more than USD1.40 per pound (454 g). If it is organic, USD0.30 is added. Moreover, importers should pay USD0.20 per pound as a premium (incentive) to producers' associations. The Fair Trade system works to support sustainable production and stability of the lives of the workers, and to facilitate trade on a more equal footing.

(2) Literature review

1. Behavioral model of fair trade products

The theory of reasoned action (TRA) is often used as a model explaining consumer behavior (Azjen & Fishbein, 1980). The theory of planned behavior (TPB) is another model to be used (Azjen, 1985; Azjen, 1991). According to the TPB, when a consumer wants to buy something, the consumer has an intention to buy before action. "Attitude toward the behavior," "subjective norm," and



Figure 3. The Framework of Fair Trade



Figure 4. Modified TPB Model (Shaw, et al., 2000)

"perceived behavioral control" affect intention. Attitude means whether one's evaluation toward the purchase is favorable. Subjective norm is measured by the question whether most people who are important to me think I should purchase the product. Behavioral control asks whether the purchase of fair trade grocery products is easy or difficult.

Shaw, et al. (2000) tested several models including TRA and TPB to interpret ethical consumer behavior to purchase fair trade goods. The data was from 1,400 fair trade magazine subscribers in the United Kingdom. It was more appropriate for the fair trade market to use the TPB model because it had more explanatory power than the TRA model. Shaw, et al. (2000) proposed to modify the TPB model (hereinafter "modified TPB model") to include ethical obligation and self-identity (Figure 4). Ethical obligation means that a respondent feels an ethical obligation to purchase fair trade products. Self-identity is a variable to measure if a person feels any concern about ethical issues. The results showed that ethical obligation and self-identity affected the behavioral intention to buy fair trade products.

Some research papers tested models to explain decision-making of environmentally friendly behavior and ethical consumption in Japan. For instance, Toyota (2008) examined several kinds of models for five types of ethical consumer behavior: the purchase of solar panels, the subscription of a magazine dealing with poverty issues, saving in a voluntary deposit, the boycott of disgraced corporate products, and socially-responsible decision-making for consumption. However, this paper didn't include fair trade products as one kind of ethical consumption. Because GFI and AGFI in all five cases were greater than 0.9 in the TPB model, it concluded that the TPB explained the consumer behavior more effectively than others. Among several factors, the paper found that the subjective norm had strong effects on consumers' decision making.

As shown above, a variety of types of ethical consumption models was discussed regarding the determinants of consumer behavior such as the TRA and the TPB. On the other hand, there is no study in Japan to test the TPB model or others for fair trade. In this study, referring to the modified TPB model in Shaw et al. (2000), we would like to explore what kinds of factors make effects on fair trade purchasing intention.

2. Personal factors

Consumption has various meanings to consumers. One important factor is attention to one's identity. Sugawara (1984) stated that, "when others look at you or you look at yourself in a mirror, you are conscious of yourself." He called this self-consciousness. In his paper, he developed a Japanese version of a self-consciousness scale based on those developed by Fenigstein et al. (1975). The results of a survey on 438 students show that there were two main factors for self-consciousness: public and private self-consciousness. Public self-consciousness means that a person paid attention to how others evaluate her. Private self-consciousness means that the individual asks her own mind who she is. We decided to include the self-consciousness scale to test the relationship between self-consciousness and consumers' decision making for fair trade.

One of the main objectives of fair trade is to help and protect producers and workers in developing countries. Therefore, the mindset of showing respect to others can be an important driver for fair trade. Psychologists measure this mindset as altruism or pro-social behavior. However, Koppel and Schulze (2013) posit, "while the determinants of altruism are well known, the specific mechanism that fair trade uses is still an under researched issue" (p. 370). Kikuchi (1988) define it as a behavior to try to enhance the relationship with others and desire it to become more appropriate. It may cause self-sacrifice and costs to the person who takes such pro-social behavior. He distinguished between pro-social behavior and behavior that expects returns or financial rewards from others. On the other hand, it includes behavior expected to get intrinsic rewards such as satisfaction and pride. Kikuchi (1988) developed a pro-social behavior scale based on the altruistic behavior scale developed by Rushton (1981). In his paper, he examined the correlation between selfconsciousness and pro-social behavior. The results showed no statistical correlation between them. He concluded that it happened because people behave socially when they do not expect to receive rewards but does respect others' situations.

The other important factor relating to fair trade can be education. The main aim of education is that people achieve the capacity to improve their lives. The capacity includes how people communicate and collaborate with each other to make society better. Knowledge is also important to understand why some issues would be a problem and how they can be solved. For instance, the Cabinet Office of Japan (2008) found that the longer a person had attended consumer education classes, the higher the test scores on environmental issues.

In our research, we will include three factors into our model: knowledge, self-con-

sciousness, and pro-social behavior (or altruism).

(3) Methodology

1. Hypothesis

In order to clarify what purchasing intention of fair trade products looks like in Japan and what kinds of factors make effects on decision-making to buy fair trade products, we follow the modified TPB model developed by Shaw, et al. (2000). Although this model was used to get the results in the United Kingdom, we selected it to determine whether the same results would be found in Japan.

Based on Shaw, et al. (2000), **H1** is if attitudes, subjective norms, behavior control, ethical obligation and self-identity affect behavioral intention directly. Behavioral belief and outcome evaluation affect attitude. Normative belief and motivation to comply affect subjective norm. Moreover, based on the findings about the role of education on consumer behavior by the Cabinet Office (2008), knowledge about fair trade can enhance behavior intention (**H2**).

Because fair trade is a framework to support workers in developing countries, consumers cannot obtain extrinsic rewards from them. As Koppel and Schulze (2013) noted the under-researched issue, we test the relationship between self-consciousness, pro-social behavior and purchase intention toward fair trade products. We expect that, if a person gets a higher score on the selfconsciousness scale and the pro-social behavioral scale, he or she is more likely to buy fair trade products (**H3**).

The hypothetical model is illustrated in Figure 5. To compare to this model, we would also test other models such as TRA and TPB. We used the logit model and structural equation modeling (SEM) to test the hypothesis.

2. Data

Data used in this paper is from the Second Life Condition Survey in Ibaraki Prefecture (hereinafter "second Ibaraki Survey"),



Figure 5. Hypothetical model

which was conducted by Yoshiaki Takahashi Laboratory Group, University of Tsukuba, from November to December 2015. A total of 2,000 people from 20 to 79 years old named on voters' lists in Ibaraki Prefecture (1,042 males and 958 females) were randomly selected as the sample of the first Ibaraki Survey. The first survey was conducted in November and December 2014. The respondents to the second Ibaraki Survey were persons who agreed in the first survey to cooperate again in the next survey. Students visited those 305 persons to ask questions in the second Ibaraki Survey questionnaire. A total of 213 persons accepted and sent the completed questionnaire back by post (response rate: 69.8%).

The respondents were asked the questions about intention, attitudes, and other subjects regarding fair trade products. Most of the measurements were applied from Shaw, et al. (2000). The knowledge was measured by 11 questions as a quiz (see Appendix. The correct answers are circled). For instance, we asked the respondents to choose the correct definition of fair trade. We also asked them to identify the logo mark shown on a package of fair trade products. We used several questions from a quiz developed by the Fairtrade Foundation in the United Kingdom. One question was if Fairtrade beauty products have ever been tested on animals. Self-consciousness was measured by the Japanese version of selfconsciousness scale developed by Sugawara (1984). When we measured altruism, we modified the pro-social behavior scale developed by Kikuchi (1988).

When we check if the sample is a representative sample of population in Ibaraki Prefecture in 2015, we found that the elderly was overrepresented (see Table 1). For instance, males and females aged 60-69 should be 7.58% and 7.71%, respectively, of the total samples. The percentages of male and female respondents in their 60s were 15.76% and 13.30%, respectively. On the other hand, males and females aged 20-29 comprised only 1.97% and 2.46%, respectively, of the respondents, though they should consist of 5.07% and 4.40% of the sample, respectively. Therefore, we must conclude that the data was not representative of demographics of the general population in Ibaraki. However, because there is not any research to examine consumer behavior for fair trade products in Japan, and the size of sample was sufficient to conduct statistical analysis, we decided to use it in this paper.

(4) Empirical Analysis

1. Opinions and attitudes to fair trade

A few of the respondents recognized what fair trade was. In Figure 6, two-thirds of the respondents in Ibaraki were not at all familiar with fair trade. Another 20% had heard of the term, but didn't know much about it. Further, 24% believed that most people who are important to the respondents thought that they should purchase fair trade products ("subjective norm"), and 33% said that it was easy for them to buy fair trade products in Japan ("perceived behavioral control"). Moreover, 36% agreed that they feel an obligation to purchase fair trade



Figure 6. Awareness about Fair Trade Source: The second Ibaraki Survey

Age group	Expected	sample	Ibaraki	Survey
_	male	female	male	female
20.20	10	9	4	5
20-29	(5.07)	(4.40)	(1.97)	(2.46)
20.20	13	12	7	10
30-39	(6.27)	(5.73)	(3.45)	(4.93)
40-40	15	14	11	21
40-49	(7.30)	(6.79)	(5.42)	(10.34)
50.50	13	12	18	26
50-59	(6.28)	(6.14)	(8.87)	(12.81)
00.00	15	16	32	27
60-69	(7.58)	(7.71)	(15.76)	(13.30)
70.70	11	12	25	17
70-79	(5.35)	(5.78)	(12.32)	(8.37)
T_{-+-1}	101	102	97	106
Iotal	(49.88)	(50.12)	(47.78)	(52.22)

Table 1. Evaluation of representativeness (gender and age)

Note: Expected sample is calculated with the percentage of population by age and gender in Ibaraki Population Survey in July 2015.

sidered themselves as a person who is concerned about ethical consumer issues ("selfidentity"). In this situation, only 28% was more likely to purchase fair trade products the next time they went to a grocery store("intention"). On the other hand, more than half (53%) of the respondents said that purchase of fair trade goods is favorable and only 10% considered that fair trade was not favorable ("attitude"). Finally, 56% said that fair trade was important for our society ("outcome evaluation").

2. Knowledge about fair trade



Figure 7. The distribution of test scores of fair trade Source: The second Ibaraki Survey





The mean score of the quiz about fair trade in the second Ibaraki Survey was 4.627 out of 11 (Figure 7). The highest score was 9 and the lowest was 0. Standard error was 2.016.

The percentage of correct answers is different for each of the 11 questions (Figure 8). The Appendix shows all questions in the quiz. Each correct answer is circled. The question with the most correct answers is Q7, asking about female ownership of land in Africa; 68.7% answered it correctly. The second question most correctly answered was Q5, which asked the effect of fair trade; 64.9% answered it correctly.

On the other hand, the question with the lowest rate of correct answer was Q9 about a product in which 100 million rural households in developing countries are involved. Only 17.7% chose the correct answer, cotton. That may be because there are a very few fair trade certificated cotton products in Japan.

The second lowest correctly-answered question was Q10 about the market share of fair trade cacao in the global cacao market: 27.3% answered 1% as the correct answer. The third lowest correctly-answered question was the fair trade sales values per capita in Japan (Q3). The correct answer was around JPY100 and 28.5% selected it correctly. In contrast, 33.1% and 24.6% chose around JPY500 and JPY1,500, respectively. Respondents may not have imagined that Japanese spend such a small amount of money on fair trade products.

3. Regression analysis

The results of the logit model for the proposed models are detailed in Table 2. For the TRA, attitude and subjective norm had significant effects on purchase intention for fair trade. However, when we added perceived behavioral control as the TPB model, subjective norm was not statistically significant. The pseudo R^2 (.204) was also improved. Moreover, when we added ethical obligation and self-identity as the modified TPB model shown in Shaw et al. (2000), the AIC and pseudo \mathbb{R}^2 were improved more. As a result, we are able to conclude that attitude and behavioral control were important factors for consumers in Japan when they decide to buy fair trade products. What we must note here is that, when we delete subjective norm and self-identity among the explanatory variables in the modified TPB model, the effect of

ethical obligation on intention was statistically significant at 10% level. Therefore, the results in this paper were slightly different from those in Shaw, et al. (2000), showing that attitude, behavioral control and ethical obligation had effects on the purchase intention.

We then tested the H1, H2 and H3 with the structure equation modeling (SEM) of full information maximum likelihood. The first results are shown in Figure 9. GFI and CFI were not above 0.9. However, RMSEA was lower than 0.1 (0.075). Similar to the results of the logit model, only attitude and perceived behavioral control affected intention to buy fair trade products. The behavioral belief and outcome evaluation influenced attitude. Normative belief and motivation to comply affected subjective norm. However, knowledge about fair trade, selfconsciousness, and pro-social behavior didn't seem to matter for fair trade at the 5% significant level.

In order to check indirect effects of knowledge and pro-social behavior on purchase intention, we developed an alternative model (model 2) shown in Figure 10. We assumed that knowledge had effect on outcome evaluation and pro-social behavior had effect on attitude. In addition, we deleted subjective norm because the results of logit model and SEM for the Model 1 didn't show any relationship between subjective norm and purchase intention. When we looked at the results, GFI was higher than 0.9. AIC was improved from Figure 9. However, CFI was not above 0.9. RMSEA was not also lower than 0.1 (0.174). According to the indicators, the model is not perfect. However, we can look at

	TRA	TRA		TPB		Revised TPB1		TPB2
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
(Intercept)	-5.487	(1.092) ***	-6.857	(1.278) ***	-7.718	(1.529) ***	-6.934	(1.272)
Attitude	0.670	(0.192) ***	0.504	(0.208) **	0.389	(0.214) *	0.478	(0.205) **
Subjective norm	0.260	(0.182)	0.230	(0.197)	0.182	(0.213)	-	
Behavioral control	-		0.526	(0.186) ***	0.526	(0.196) ***	0.556	(0.190) ***
Ethical obligation	•				0.208	(0.209)	0.325	(0.186) *
Self identity	-				0.314	(0.244)	-	
n]	144		144		140		140
AIC	15	53.03	1	46.00	1	43.62]	143.83
pseudo R2	0	.152	(0.204	(0.241		0.217

Table 2. The results of multivariable analysis (Logit model	Table 2	2. The	results of	f multiv	ariable	analysis	(Logit	model)
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Note: () shows standard errors. *** p< 1%, ** p<5%, * p<10%



Figure 9. The results of Model 1 (SEM)

the relationship between know knowledge, pro-social behavior, and attitude. Knowledge affected outcome evaluation at 1% significant level and then outcome evaluation affected attitude at 1% significant level. Prosocial behavior also influenced attitude at 5% significant level. Therefore, knowledge and pro-social behavior had indirect effects on purchase intention of fair trade products.

(5) Discussion and Conclusion

At first, H1 was partially supported. The results of the logit model and the structure equation modeling showed that it was important whether purchasing fair trade products would be desirable (attitude) or



Figure 10. The results of Model 2 (SEM)

easy to purchase (behavioral control). Therefore, the availability of fair trade products in shops mattered in Japan.

On the other hand, knowledge of fair trade and altruism did not directly affect purchase intention. Rather, knowledge was related to outcome evaluation which measured if purchasing fair trade products would be important for our society. Moreover, persons who want to buy fair trade did not only obtain knowledge, but also conducted pro-social or altruistic behavior frequently. They believed that altruism is socially significant in daily life. Therefore, we concluded that H2 and H3 were supported. Besides simply raising awareness about fair trade in promoting the purchase, education is an important measure to encourage understanding the social significance of altruistic behavior.

We only tested several models based on TRA and TPB in this study. On the other hand, there are many possible models to include factors that may explain consumers' decision making for fair trade products. For instance, referring to discussion by Basu & Van (1998), we can also understand that the promotion of fair trade is a form of subsidies to wage. The economics of child labor suggests that subsidies to wage cannot stop supplying child labor in developing countries. Rather the promotion may create a black market of child laborers if governments in developing countries are not able to regulate such black markets effectively. However, we could not take into account the relationship on consumers' decision-making in this study explicitly.

Lastly, the data used here was not a nationwide sample. The number of the sample was also limited. The percentage of elderly people among the respondents was very high. In order to generalize our results, it is necessary to carry out surveys targeting the whole population of Japan. We need further research to compare our models with other potential models in a nationwide survey.

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Appendix: Fair trade quiz in the Ibaraki Survey

Q1: The definition of fair trade is

① a trading partnership, based on dialogue, transparency and respect, that seeks greater equity in international trade;

2. a free trade by producers and vendors without government's intervention like customs duty;

3. financial aids that governments provide to assist economic development in developing countries;

4. loans without interest to contribute to economic development and welfare in developing countries.

Q2: The global sales values of fair trade in 2014 was JPY1. 8 billion2. 80 billion3 800 billion4. 8 trillion

Q3: Fair trade sales values in Japan per capita was around JPY1. 16221143. 5254. 1,621

Q4: The main product of fair trade in Japan was① coffee2. banana3. cosmetics4. chocolate

Q5: One of effects of fair trade is

- 1. cost-cutting to improve efficiency in business;
- 2. training technicians to convey technology in Japan to developing countries;
- 3. promoting competition in trade;
- ④ improving working conditions in developing countries.

Q6: Which of these is the Fairtrade mark?

1. the logo of Consumer Agency of Japan

2. the logo of foods for specified health uses

③ the logo of Fairtrade International

4. the Woolmark logo

Q7: Women produce 60-80% of the food in most developing countries, but how much land in Africa is owned by women?

1%
 2.9%
 3.16%
 4.21%

Q8: Smallholder farmers often receive low returns from their produce. According to a Fairtrade Foundation report in 2013, what percentage of the retail value of a chocolate bar are cocoa smallholders likely to receive?

1. 21-26% 2. 10-15% ③ 3-6% 4. 1%

Q9: These statements are all true for which fair trade product?

- Developing countries produce two thirds of this product
- 100 million rural households in developing countries are involved in its production
- West Africa produces about 4% of its total global production
- 1. rice 2. coffee ③ cotton 4. cacao

Q10: Close to 50 million people depend on cocoa for their livelihoods. What percentage of cocoa is sold on fair trade terms globally?

1%
 6%
 11%
 21%

Q11: Have fair trade beauty products ever been tested on animals?

1. Yes ② No

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Factor Analysis on Software Piracy

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Abstract

Many empirical researches of software piracy have focused on the domestic factors, such as corruption, democracy, economic freedom et al. However, this paper assesses the extent of the international factors contributing to software piracy. It is founded that Patent Cooperation Treaty (PCT) international applications have a significant impact on it. That means international intellectual protection is a good way to control the piracy. Additionally, corruption is not a significant factor on piracy as previously believed.

Keywords

software piracy, corruption, PCT International application.

(1) Introduction

It is well known that the issue of software piracy has been growing more severe worldwide in recent years. "software piracy" can be defined as the unauthorized use of computer software or the unauthorized distribution of copies of software without permission being given by the owner¹." According to the Software Alliance's Ninth Annual BSA (The Business Software Alliance) Global Software 2011 Piracy Study², in 2011 damages caused by piracy totaled USD63.456 billion worldwide and both piracy and the amount of related damages were in an increasing trend.

Software piracy affects economic growth. Greater piracy of computer software lowers economic growth. However, the relationship between piracy and growth is nonlinear the decrease in economic growth diminishes with piracy (Andrés and Goel, 2012).

While numerous previous studies have looked at the issue of software piracy, since it is a complex issue (Goel and Nelson, 2009; Lau, 2003; Reinig and Plice, 2011). It has not been elucidated fully. Studies that empirically analyze factors in software piracy from a macroeconomic approach do so using models based on one or more of the five following factors: economic factors, cultural factors, technological factors, legal factors, and educational factors (Gomes, Cerqueira and Almeida, 2014).

Gross Domestic Product (GDP) percapita often is used as an economic factor. Harbi, Grolleau and Bekir (2012) and Panas and Ninni (2011) find a relationship

¹ See Lau (2003).

² http://www.bsa.or.jp/

resembling a Kuznets curve between the two. If there is a Kuznets curve relationship between piracy rate and GDP per-capita, then protection of intellectual property (IP) rights should be conducted in accordance with the stage of economic development, but over the long term there would be a negative correlation between piracy rate and GDP per-capita.

Other studies such Gomes. as and Almeida (2014)Cerqueira have employed Hofstede's index³, developed to serve as an indicator of national character, as a cultural factor, indicating that national character do affect the piracy rate. Such as Rafee and Rouibah (2010) found that awareness treatment was significant factor in reducing intention toward digital piracy.

Of course, the level of technology is likely to impact the piracy rate. It is conceivable that strong protection of authorized software would increase the costs of piracy, and as the costs of piracy rise, the piracy rate would decrease. However, since protection of authorized software would decrease the number of users of the software, in some cases it would not be desirable to producers of authorized software ⁴. The number of Internet users is used as a technological factor. Bagchi, Kirs and Cerveny (2006) show that Internet users had partial influence on software piracy. Market size is another technology factor often be used in empirical analysis (Andrés and Goel,

2011; Goel and Nelson, 2009).

In analysis of legal or systemic factors, economic freedom and freedom of the press are used frequently. The concept is socially accepted that the higher the degrees of economic freedom and freedom of the press the lower the piracy rate. In addition, many empirical analyses use corruption as a systemic factor (Andrés and Goel, 2011; Bagchi, Kirs and Cerveny, 2006; Banerjee and Williams, 2013; Goel and Nelson, 2009; Reinig and Plice, 2011). Analysis of data on the piracy rate and indices of corruption shows a very high correlation between the two.

Regarding educational factors, a negative correlation has been identified between the literacy rate of people aged 15 and above and the piracy rate (Goel and Nelson, 2009). However, it also be argued that this result is unclear (Andrés and Goel, 2011).

Thus, each of the papers discussed above focuses solely on domestic factors when examining piracy. Certainly, a strong correlation has been demonstrated between domestic factors and the piracy rate, suggesting that improvement of domestic factors would be an effective way to reduce piracy. However, since the issue of software piracy is complex, it is conceivable that it cannot be resolved fully through domestic factors alone. The global age is characterized by all countries advancing in cooperation

³ Hofstede's index was developed in 1980 by the Dutch social scientist Geert Hofstede in order to measure quantitatively and index the national character of multiple countries. It consists of the following six indices: (1) Power distance index, (2) Individualism, (3) Uncertainty avoidance index, (4) Masculinity, (5) Long-term orientation, and (6) Indulgence versus

restraint.

⁴Since in general software involves network externalities, the more the number of users increases the more the value of the software rises. For this reason, producers of authorized software aim to increase the number of users of their software.

with others. When advancing in cooperation with other countries, it is possible to protect one's own country's rights through mutual recognition by countries of each others' rights. In general, Patent Cooperation Treaty (PCT) international applications play an important role in getting other countries to protect one's own country's science and technology. A producer can secure exclusive interests on a global basis through the exclusivity of PCT international applications. For this reason, the increase in the number of applications for PCT international applications by producers in a country can be considered to relate to strengthening that country's government's motivation to crack down on patent-related piracy. It is conceivable that recognizing each other's patents would have the effect of protecting IP rights. Accordingly, it can be considered important and meaningful to study the impact on the piracy rate of PCT numbers of applications for international applications.

Based on the above perspective, this paper analyzes the piracy rate through a regression model in which the explanatory power of technological factors in particular is strengthened, as one attempt at examining factors such as those above. In addition to independent variables related to the four factors used in Andrés and Goel (2011): systemic, economic, social, and technological factors, the model employs number of PCT applications for international applications as a new independent variable related to technological factors, developing a regression model to explain the piracy rate based on these and using it with real-world data to seek out variables with explanatory power. The reason this paper uses in its analysis the four factors other than cultural factors is because such analysis has been common traditionally (Andrés and Goel, 2011; Goel and Nelson, 2009), and because it is not easy to control the cultural factor of national character (Hofstede's index) through policy. The results show that our new variable of the number of applications for PCT international applications does have explanatory power with regard to the piracy rate. This can be considered to suggest the possibility that countries' recognition of each others' PCT international applications could be an effective way to reduce piracy.

The paper employs the following structure. Section (2) presents a literature review. Section (3) illustrates research data on software piracy. Section (4) describes the analytical method and models. Section (5) illustrates the results of empirical analysis. Section (6) provides some considerations. Section (7) concludes.

(2) Literature review

The issue of software piracy is a complex one to begin with, one impacted by numerous factors. Previous studies argue that it would not be possible to resolve piracy issues without improvements on all the factors of economic, systemic, social, and technological factors.

The following is a description of the specific indices impacting the piracy rate used as independent variables in the following regression analysis, along with the reasons for using them, for each of the above four factors and in accordance with a previous study (Andrés and Goel, 2011). Differences from Andrés and Goel (2011) are the facts that this study uses number of applications for PCT international applications, which it did not use, and that this study does not use the size of the software market, which had little impact on the piracy rate.

As systemic factors, this study uses the corruption index, freedom of the press, and economic freedom. It is likely that in a country with a high corruption index pirates would be able to secure a degree of toleration for their acts or piracy through means such as bribery of government officials, increasing the piracy rate at a result. That is, it is conceivable that there is a positive correlation between the corruption index and the piracy rate. On the other hand, there is likely to be a negative correlation between freedom of the press (Andrés and Goel, 2011; Salahodjaev Odilova and Andrés, 2016) and economic freedom (Bezmen and Depken, 2006; Fraj, 2015) on one hand and the piracy rate on the other. It is conceivable that improving these would increase social transparency, making it easier to uncover illegal acts by government and pirates and increasing the risks of piracy as a result, so that the piracy rate would decrease.

This study, like numerous previous studies, uses GDP per-capita as an indicator of economic factors. This is considered to have a negative correlation to piracy (Andrés and Goel, 2011; Chen, Chen and Yeh, 2010; Goel and Nelson, 2009). In fact, piracy is unlikely to decrease if authorized software and pirate software are identical in value and consumers expect the same benefits from both authorized software and piracy. On the other hand, if producers of authorized software were to adopt the strategy of adding to authorized software high-quality value capable of differentiating it from pirate software then consumers would be likely to demand high-quality authorized software as they enjoy greater returns from its use. This is thought to be the grounds for the above negative correlation.

As a social factor, this study uses the national literacy rate. Gomes, Cerqueira and Almeida (2013) show that more schooling years have the opposite effect to piracy. But Depken and Simmons (2004) have not identified a significant relationship between literacy rate and piracy rate. It is conceivable that the national literacy rate could have some impact on the piracy rate since as literacy increases the number of users of software (both pirate and authorized software) would increase. However, it is not necessarily possible to determine clearly whether this correlation would be positive or negative. Accordingly, this paper will determine the sign of the correlation based on the results of individual data analysis.

As a technological factor, this study uses number of Internet users. Goel and Nelson (2009) showed that internet users will mitigate the software piracy. It is conceivable that as this number increases the piracy rate would decrease because it would become easier to detect acts of piracy. In other words, there could be a negative correlation between the number of Internet users and the piracy rate.

The independent variables used in the regression model, reflecting consideration of previous studies, are as described above. This paper also uses the number of applications for PCT international applications as an independent variable related to technological factors. By taking out PCT international applications, a producer can secure exclusive interests on a global basis through the exclusivity secured by patents. For this reason, an increase in the number of applications for PCT international applications by producers in a country can be considered to relate to a of strengthening that country's government's motivation to crack down on patent-related piracy. At the same time, it also can be considered to raise awareness concerning elimination of piracy as the producers who apply for the PCT international applications attempt to protect the value of the technologies that they have developed themselves. For the above reasons, the number of applications for PCT international applications is expected to have a negative correlation to the piracy rate.

This paper considers the final variable number of applications for PCT of international applications to be of particular importance. This is because since the number applications for PCT of international applications is related to technological progress, an increase in the number of applications for PCT international applications also involves aspects that make it possible to maintain sustained innovation. In fact. it is conceivable that if this independent variable does affect piracy then encouraging producers to increase the number of applications for PCT international applications would serve to make them more conscious of the need to demand an environment in which protection of IP rights strengthens, improving the piracy rate as a result. Accordingly, in the following analysis as well this paper focuses on this independent variable in particular.

(3) Research data

As described above, the regression analysis used in this paper employs the piracy rate as the dependent variable and variables included in four categories as seen and Goel (2011)in Andrés as the independent variables: systemic factors (indicators of corruption, freedom of the press, and economic freedom), economic factors (GDP per-capita), social factors (national literacy rate), and technological factors (number of Internet users, number of PCT applications for international applications). The sources and meanings of the data used in this analysis are outlined below.

1. Piracy rate (Piracy, abbreviated pir)

For piracy rate, data published by the Software Alliance (BSA)⁵ is used. This organization is considered highly credible, and the results of its studies on piracy and protection of IP rights have been cited in numerous papers. The piracy rate is calculated as shown below:

⁵ http://www.bsa.or.jp/index.html. The BSA measures the piracy of commercial software. These estimates are some of the most reliable ones and have been used largely in empirical papers (for instance Andrés, 2006;

Andrés and Goel, 2011; Goel and Nelson, 2009; Harbi, Grolleau and Bekir, 2012; Lau, 2003; Reinig and Plice, 2011), in spite of criticism that the data are unreliable.

piracy rate

= Quanitity of pirated PC software Total quanitity of PC software installed

The denominator above is derived by multiplying the number of PCs on which software is installed by the quantity of PC software per computer, while the numerator is derived by subtracting the quantity of authentic PC software from the denominator, or the denominator minus total units of PC software sold divided by the average price of PC software.

2. Corruption index (Corruption, adbreviated cor)

As an index of corruption, this study uses the estimated value of Control of Corruption⁶ published on the Web by the World Bank. This is an indicator of the governance ability of government, ranging in value from -2.5 to 2.5 points. This range corresponds to a 90% confidence interval for the trustworthiness of government, and the higher the score the lower the degree of corruption. These data are collected from with interviews numerous companies, citizens, and experts concerning their views on governance, based on data collected through research organizations, think tanks, nongovernmental organizations, international agencies, and private-sector organizations, among other sources.

3. Freedom of the press (Democracy, abbreviated dec)

This study uses data published by Freedom House⁷ concerning freedom of the press. The data range in value from 0 to 100 points, with a higher figure indicating a lower degree of media freedom. For this reason, this figure can be described as an indicator of lack of freedom of the press. This figure is made up of three elements: (i) influence of laws and regulations on the media (ranging from 0 to 30 points), (ii) political pressure and media internal control (ranging from 0 to 40 points), and (iii) economic impact of media (ranging from 0 to 30 points). A total score in the range of 0-30 is considered to indicate a state of freedom, while one in the range 31-60 indicates the presence of freedom to some degree and one in the range 61-100 indicates a lack of freedom.

4. Economic freedom (Freedom of Economic, abbreviated ef)

Data published by the Heritage Foundation⁸ are used to indicate economic freedom. Economic freedom is made up of 10 elements from the following four categories: (i) politics (property rights, freedom from corruption), (ii) constitutional politics (political freedom, government expenditure), (iii) regulatory efficiency (business freedom, labor freedom, currency freedom), and (iv) free markets (freedom of trade, freedom of investment, financial freedom). Each of these elements is graded as a score in the range 0–100, and the average of these scores is used as the value of economic freedom. The higher this value, the higher the assessed degree of economic freedom.

5. GDP Per-capita (GDP Per-capita, abbreviated gdp)

⁶ http://www.worldbank.org/

⁷ http://www.freedomhouse.org/report-types/freedom-

press

⁸ http://www.heritage.org/index/download

For GDP per-capita, this study uses the data published on the Web by the Center for International Comparisons at the University of Pennsylvania⁹. These data are considered the most trusted and most widely used data on GDP per-capita in macroeconomic analysis.

6. National literacy rate (Literacy, abbreviated lit)

Many previous papers on empirical analysis have used national literacy rate as an independent variable, and this paper follows their precedent. The data used are the latest data published on Wikipedia¹⁰. While for most countries these data cover ages 15 and older, for a few countries different ages are used.

7. Number of Internet users (Internet user, abbreviated net)

For number of Internet users, data published on the Web by the International Telecommunication Union¹¹ are used. These data indicate the number of Internet users in a country per 100 citizens.

8. Number of applications for PCT international applications (Patent, abbreviated pat)

Another independent variable used in this model is the number of applications for PCT international applications. While there are various methods of totaling patent applications by companies, since the number of applications for PCT international applications is considered to reflect the level of R&D in each country the higher this number the greater the incentive to protect its own IP rights is likely to be. For this reason, this paper focuses on the number of PCT for international applications applications. Furthermore, to eliminate the effects of population, for all countries the number of applications for PCT international applications are converted to the number per million population. The source for data on numbers of applications for PCT international applications is the World Intellectual Property Organization¹², while data published by the World Health Organization (WHO) were referred to for each nation's population¹³.

Data adjustments

Actually, the countries for which data on the above dependent variable (piracy rate) and seven independent variables are published vary by variable. For this reason,

Table	1.	Mea	ning	of	each	variable
			0			

Variable	Meaning
pir	Piracy rate
cor	Corruption index
dec	Freedom of the press
ef	Economic freedom
gdp	GDP Per-capita
lit	Literacy rate of population
	aged 15 and older
net	Number of Internet users
	per 100 population
pat	Number of PCT
	international applications
	applied for per million
	population

¹² http://www.wipo.int/pressroom/en/articles/2012 /article_0001.html

⁹ https://pwt.sas.upenn.edu/

¹⁰ http://en.wikipedia.org/wiki/List_of_countries_by_ literacy_rate

¹¹ http://www.itu.int/en/Pages/default.aspx

¹³http://memorva.jp/ranking/unfpa/who_2010_ population_total.php

the analysis in this paper is limited to the 86 countries for which data are available for all eight variables (see Appendix). Lastly, the table below reviews the variables used:

(4) Analytical method and models

This section will use the independent variables described at the end of the previous section in a regression analysis with piracy rate as the dependent variable. Table 2 shows the variation in size and other information for each variable.

Table 2. Range of variation in size of each variable

Variable	Mean	Max.	Min.
pir	0.58	0.93	0.20
cor	0.30	2.38	-1.27
dec	43.56	94.00	10.00
gdp	19250	136248	1247
ef	64.42	86.10	37.10
net	49.71	93.39	3.70
lit	0.92	1.00	0.56
pat	53.17	521.83	0.01

Notes: net is Number of Internet users per 100 population, pat is number of applications for PCT international applications per million population.

Regression analysis with the simplest model (All the coefficients in this paper are non-standardized coefficients).

$$\label{eq:pir} \begin{split} pir &= c_1 + b_1 \ cor + b_2 dec + b_3 ef + b_4 gdp \\ &\quad + b_5 lit + b_6 net + b_7 pat + u_1 \end{split}$$

The result will be as shown in Table 3 when remove the no significant independent variable by t-test (the absolute value of t test is less than 1.96).

The result shows that corruption is significant to piracy as many previously studies. But the correlation coefficient of independent variable and logarithmic value of independent variable to piracy is as shown in Table 4.

Ta	Table 3. The result of simplest model										
	Variables Estimated resul										
	constant	0.897									
	constant	(13.19)									
	2014	-0.090									
	cor	(-4.67*)									
	doc	0.002									
	uec	(2.62*)									
	net	-0.003									
	net	(-4.41*)									
	$\overline{\mathbf{R}}^2$	0.770									
. *											

Note: t-values are in parentheses. t- values aligned to the right* above are those for which estimates are statistically significant at the 1% significance level.

Table 4. The correlation coefficient of independent variable and logarithmic value of independent variable to piracy

	pir		pir
cor	-0.836	lcor	-0.836
dec	0.708	ldec	0.761
ef	-0.711	lef	-0.697
gdp	-0.639	lgdp	-0.788
lit	-0.425	llit	-0.412
net	-0.792	lnet	-0.698
pat	-0.663	lpat	-0.885

Note: Variables with 1 at the beginning denote the logarithmic value of variable.

The table indicate that the logarithmic value especially GDP and patent has a higher correlation than original data. Regression analysis with changing variable and logarithmic value of variable, three result of model with the best \overline{R}^2 value is the following.

$$pir = a_1 + a_2lcor + a_3dec + a_4lgdp$$
$$+a_5ef + a_6lit + a_7net + a_8lpat + u_1$$
(1a)

$$pir = b_1 + b_2 lcor + b_3 dec + b_4 lgdp$$
$$+ b_5 ef + b_6 lit + b_7 lnet + b_8 lpat + u_2$$

(1b) $pir = c_1 + c_2 lcor + c_3 dec + c_4 lgdp$ $+ c_5 lef + c_6 lit + c_7 lnet + c_8 lpat + u_3$ (1c)

Each of the coefficients $a_1 \sim a_8$, $b_1 \sim b_8$, $c_1 \sim c_8$ will be estimated using this model. The terms *lcor*, *lgdp* etc are abbreviations for the logarithms of the variables defined at the end of the preceding section, $\ln(cor)$, $\ln(gdp)$ etc, while u_1 , u_2 and u_3 are error terms. Estimation is conducted using the ordinary least squares (OLS) method. Since the values of the corruption index range from -2.5 to 2.5, this paper uses a revised corruption index in which 2.55 has been added to that value. All of the data used are for the year 2011.

(5) Results of empirical analysis

Table 5 shows the results of estimation using regression model (1a), model (1b) and model (1c). A look at the results of VIF for each independent variable in Table 5 shows that each is substantially below 10, so that there is nothing similar to multicollinearity between any of the independent variables, and for this reason the results for the regression coefficients can be surmised to be relatively robust to variations in data values. Next, judgment of the statistical significance of the explanatory power of each regression coefficient and each independent variable using t values shows that even at a significance level of 10% the explanatory po-

Variable	Model ((1a)	Model (1b)		Model	(1c)	
	Result	VIF	Result	VIF	Result	VIF	
constant	0.752		0.754		0.883		
	(4.284)		(4.422)		(2.084)		
dec	0.002	2.433	0.002	2.381	0.002	2.385	
	(3.983*)		(4.123*)		(4.113*)		
ef	-0.001	3.189	4.123	3.181			
	(-0.601)		(-0.543)				
\mathbf{net}	-2.87 E-04	3.915					
	(-0.417)						
lit	0.520	1.790	0.543	1.882	0.542	1.882	
	(4.755*)		(4.855*)		(4.843*)		
lcor	-0.007	6.764	-0.009	6.766	-0.013	6.707	
	(-0.110)		(-0.152)		(-0.220)		
lgdp	-0.065	4.593	-0.062	4.426	-0.062	4.481	
	(-3.385*)		(-3.329*)		(-3.322*)		
\mathbf{lef}					-0.043	3.056	
					(-0.431)		
lnet			-0.018	2.898	-0.018	2.922	
			(-0.904)		(-0.903)		
lpat	-0.043	5.627	-0.042	5.237	-0.042	5.234	
-	(-5.788*)		(-5.946*)		(-5.935*)		
\overline{R}^2	0.86	5	0.86	6	0.86	6	

Table 5. Results of estimation using regression model (1a), model (1b) and model (1c)

Notes: t-values are in parentheses, and t-values aligned to the right* above are those for which estimates are statistically significant at the 1% significance level.

wer of the three variables corruption, economic freedom, and Internet users could not be considered statistically significant.

By eliminating the lowest t value of variables, the result is as the following in Table 6 (the result is the same by eliminating a variable at a time).

Table 6. Results of regression analysis after

eliminati model (1a	ing the lowest a), model (1b) a	t values from nd model (1c)
Variables	Estimated	VIF
	result	
Constant	0.710	
Constant	(4.748)	
daa	0.003	1.727
uec	(5.354*)	
lada	-0.071	3.344
Igap	(-4.518*)	
1:4	0.536	1.675
III	(5.226*)	
1	-0.045	4.505
ipat	(-7.050*)	
\bar{R}^2	0.869	

Note: t-values are in parentheses, and t values aligned to the right* above are those for which estimates are statistically significant at the 1% significance level.

Comparison of Table 5 and Table 6 shows that the adjusted coefficient of determination (\bar{R}^2) remains largely unchanged and there was no difference in the fact that the explanatory power of corruption, economic freedom and Internet users. These variables are not statistically significant. Accordingly, a regression model analysis was conducted after eliminating the variables corruption, economic freedom and Internet users as well. The results are shown in Table 6 (There was no change in the results of the F test and the χ^2 test between the case of eliminating both variables at the same time).

A look at the results in Table 6 shows that the values of all regression coefficients are statistically significant at the 1% significance level and that the corresponding independent variables have explanatory power vis-à-vis the dependent variable. Comparing with the results ahead, \overline{R}^2 has been greatly improved, so the latter model is a superior model. Additionally, the common explanatory variable is democracy only. Other variable will be shuffled all. Notably, corruption is not remained as independence variable. As a result, this model combines the original data and replaced logarithmic data. In this model, corruption index will be deleted by using lgdp and lpat. That and means lgdp lpat are better independence variables than corruption.

Incidentally, it is known that in the case of regression analysis using cross sectional data as used in this study, the t value often does not necessarily function correctly as an indicator of statistical significance due to a lack of uniformity in distribution (Matsuura and McKenzie, 2012). Accordingly, a check for such lack of uniformity in distribution in this case was conducted.

A White χ^2 test with a null hypothesis of uniformity of distribution yields a χ^2 statistic of 11.352, for which the p value is 0.658, so that the null hypothesis of uniformity of distribution is not rejected.

(6) Consideration of results

The results above can be summarized as follows: First, the statistical significance of each independent variable's explanatory power will be verified. A look a Table 6 shows that all four of the independent variables of index of freedom of the press, GDP percapita, national literacy rate, and number of applications for PCT international applications had statistically significant explanatory power with regard to the piracy rate, indicating that all did affect piracy. While this finding is consistent with those of previous studies, it should be noted that consideration based on t value in particular shows that the independent variable of PCT of applications for number international applications, introduced for the first time in this paper, had the highest degree of statistical significance.

First of all, with regard to the national literacy rate, it should be clear that reducing this rate even below its current level in order to reduce the piracy rate would not be appropriate from economic considerations, because it would lead to a decrease in the number of users of software-not to mention ethical reasons. It is conceivable that the reason the piracy rate increases with an increase in the literacy rate is because of the resulting increase in the number of consumers using pirate software, as individuals gain access to methods of evading the regulatory net. Realistically, the national literacy rate is high in most countries, so that the national literacy rate's impact is not likely to be very pronounced.

The index of freedom of the press and GDP per-capita used in this paper both have been used as variables explaining the piracy rate in previous studies as well, and such studies have identified them as having statistically significant explanatory power. However, it must be said that realistically speaking it would in fact be difficult to control piracy through improving these variables, since they involve large-scale issues.

This paper showed that the number of PCT for applications international applications, which was not addressed in studies. is previous an important explanatory factor with regard to the piracy rate. What's more, controlling this variable does not involve unnatural issues with social ethics like those above and is effectively correlated with social innovation, so that it can be considered extremely significant. In fact, it is conceivable that as economic globalization advances incentives will act on countries and companies that have few patents, encouraging them to obtain PCT international applications, and the resulting increase in awareness of protection of patents (and copyright) could lead to stronger crackdowns on piracy. Accordingly, progress on creating an environment that would encourage companies to apply for PCT international applications can be considered as an effective means of decreasing the piracy rate.

On the other hand, this study showed that corruption, economic freedom, and number of Internet users had little influence on the piracy rate. While there is no problem with this finding with regard to the latter two because previous studies also showed that they had no influence, it does conflict with the results of most previous studies that showed that corruption had a strong influence. Some previous studies on corruption itself show that it can be explained by factors such as freedom of the GDP per-capita, and economic press. freedom (with coefficients of determination

of 82% or above). While correlation between indices of corruption and the piracy rate are very high, and as a result an index of corruption alone can show a high degree of explanatory power regarding piracy rate, the addition of numerous independent variables as in this study results in the elimination of the explanatory power of the index of corruption. In light of these considerations, indices of corruption, considered important in many previous studies, like piracy rate, be dependent variables explained by variables such as freedom of the press and GDP percapita rather than causes of piracy rate.

(7) Conclusion

The main purpose of this paper is to effect verify the of the number of for PCT applications international applications on the piracy rate. Using data from 2011, it analyzed the factors impacting piracy while adding the number of PCT for applications international applications as a variable for the first time. The results showed that GDP per-capita, index of freedom of the press, national literacy rate, and number of applications for PCT international applications affect the piracy rate. These findings are summarized below:

1. The piracy rate decreases with an increase in GDP per-capita.

2. The piracy rate decreases with a decrease in the index of lack of freedom of the press (i.e., an increase in freedom of the press).

3. The piracy rate increases with an increase in the national literacy rate. It is conceivable that this is because an increase in the literacy rate increases the number of consumers using pirate software, as individuals gain access to methods of evading the regulatory net.

4. The number of PCT international applications applied for per million population also affects piracy. An increase in the number of patent applications leads to a decrease in the piracy rate. It is conceivable that this is because governments and producers become more conscious of protecting IP rights and more strongly motivated to protect their own property. Results of each of the analyses in this study showed that the number of applications for PCT international applications had a strong degree of explanatory power vis-à-vis the piracy rate, and it is conceivable that increasing the number of applications for PCT international applications would be meaningful in both economic and policy terms because it enables a country to carry out sustainable innovation.

5. This paper showed clearly that corruption, considered an important factor in many previous studies, is not a factor.

Consideration of the number of PCT applications for international applications, introduced for the first time in this study, showed that if countries with low PCT numbers of applications for international applications put effort into such factors related to technological progress they would be able to address piracy more efficiently, and such efforts also would facilitate the long-term technological progress of such countries. Accordingly, into putting effort the number of applications for PCT international applications would be recommended for such countries. It is hoped that these findings will

prove useful in policymaking.

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Albania	Algeria	Argentina	Armenia	Australia
Austria	Azerbaijan	Bahrain	Bangladesh	Belarus
Belgium	Bosnia	Botswana	Brazil	Bulgaria
Cameroon	Chile	China	Colombia	Costa Rica
Croatia	Cyprus	Czech Republic	Denmark	Dominican
Ecuador	Egypt	Estonia	Finland	France
Georgia	Germany	Greece	Guatemala	Hungary
Iceland	India	Indonesia	Ireland	Israel
Italy	J apan	Kazakhstan	Kenya	Korea
Latvia	Lebanon	Libya	Lithuania	Luxembourg
Malaysia	Malta	Mauritius	Morocco	Nicaragua
Nigeria	Norway	Oman	Pakistan	Panama
Peru	Poland	Portugal	Qatar	Romania
Russia	Saudi Arabia	Serbia	Singapore	Slovakia
Slovenia	South Africa	Spain	Sri Lanka	Sweden
S witzerland	Thailand	Tunisia	Turkey	UAE
United Kingdom	United States	Uruguay	Venezuela	Vietnam
Zambia				

Appendix: Countries for which data were used in this paper

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Open Innovation University-Industry Collaboration: Student

Idea Contests and Exit Strategy in Japan

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Abstract

Open Innovation in the University-Industry Collaboration (OI-UNIC) is increasingly important globally for researchers and practitioners. As a coupled-type OI, students contests have become one of the most important elements for the creation of regional business in Japan. OI-UNIC, lab teams of university students from all over Japan, use patents from large firms, exchange knowledge, brush the ideas up with the help of SMEs and regional institutions, and compete to commercialize their product. However, the existing literature has not revealed how the collaborative team stakeholders can promote an "exit strategy" and commercialization through knowledge exchange channels. This study fills in the gaps. Applying creative problem solution theory, intellectual property management, patent management, and exit strategy methods, this study extends the concept of OI to the research frame. The survey method is a qualitative analysis based on observations by the author, reflections by the students, and interviews with the stakeholders. The research result shows that the team that commercialized their product had properly used the multiple channels adequately, but the teams that created only prototypes, while they understood the importance of the channels, did not take full advantage of them. The main conclusion of this study is formulated as a hypothesis and suggests further study of the effectiveness of innovation education and the possibility of small-scale innovation of regional revitalization.

Keywords:

Open Innovation University-Industry Collaboration, Creative problem solving, Patent, Exit strategy, Student idea contest

(1) Introduction and Overview

1. Open Innovation University–Industry Collaboration

Open Innovation University-Industry Collaboration (OI-UNIC), which is oriented toward student contests, is recognized as one of the most important elements for the creation of regional business in Japan. Many relevant initiatives and knowledge channels that support innovative activities in various ways have been developed. The student idea contest (2015/2016), "Fostering student' ideas using published patents and the OI platform,"¹ aimed to develop a physical and virtual environment for generating, developing, and commercializing university students' innovative ideas through relevant training and mentoring. Following the entrepreneurial or open innovation route, it fosters collaboration between universities and enterprises, enhances the employment potential of graduates and promotes innovation in companies.

2. The rising role of university in the

¹ Detail information: http://opi.innovations-i.com /idea/report/

knowledge-based society²

As Peter Drucker noted about innovation and entrepreneurship³ in the mid-1980s, the pervasiveness of information and communication technologies, globalization, and the development of knowledge society have led to the growth of knowledge and its redistribution and supply of knowledge-absorbing worker. In the era of continuous development of the knowledge–based society, where the value of university-industry collaboration (UNIC) gained a greater recognition⁴, the UNIC consequently became a more significant subject of study⁵.

For large sized firms that are looking to enhance and maintain their competitiveness, knowledge has become a decisive factor. The foundation of competitiveness in the world is now more dependent on valuable knowledge resources that are widely distributed across the globe, across the value chains, across R&D and across individuals with high knowledge absorption in multi organizations. Against this situation, the paradigm of open innovation (OI) has emerged as a new response to manage the increased amount of boundary-knowledge flows both in and out of the innovation process.

To overcome the limitations of closed innovation processes, such as increasing R&D costs, insufficient resources, and unsatisfactory levels of competence, companies may choose to outsource their innovation work and invite external contributors to develop ideas or solutions to specific, predefined problems.

3. Dilemma of innovation education and corporate strategy in Japan

Japanese regional open innovation is the

results of a complex interaction of various actors and institution. Universities (students' idea), large firms (licenser), SMEs (licensee), City industry policy divisions and financial institutions ("Shinkin" credit bank or local bank) play crucial roles in accelerating innovation. Technological innovation is a result of interaction and feedback among all elements within the system, rather than an occurrence in a complete linear system (OECD, 1977)⁶.

The core of the UNIC system is corporations and universities, which manages and organizes knowledge channels accessing the source of external knowledge. However, several factors can lead to the failure of collaboration projects. Universities emphasizes not only research, but also human resource development and the significance of knowledge transfer and application to a large extent. Corporations, however, emphasize patent exit strategies.

However, while many innovation education programs have focused on proposing creative ideas, the methodology of innovation education in an "OI" is still controversial. Innovation education plays a crucial role in developing "creative problem-solving skills⁷" and "collaborative behaviors⁸"for students to create a new path towards a desirable future.

On the other hand, companies evaluate utility that is intended to create profits rather than education. Japanese firms have external novelty and fresh knowledge sources for their IP exit strategy. According to the Survey on R&D Collaboration by RIETI⁹, the share of firms with R&D collaboration with other firms, universities, or public research institutions have increased in the past five years, and is expected to increase in future as well. (RIETI, 2004)¹⁰.

omy, Trade and Industry refers to as fundamental competencies for working persons and what the Ministry of Education Culture, Sports, Science and Technology refers to as bachelor's competencies and "21st century skill.

² P.F.Drucker(1985).*Innovation and Entrepreneurship Principles and Practices*, pp.58-80.

³ Ibid.

⁴ Studies increased in development of industry academic society, Japan Society for Intellectual Production, etc.

⁵ Region creation policy by METI, etc.

⁶ OECD, 1977 innovation report.

⁷ This skill is manifest in what the Ministry of Econ

⁸ Ibid.

 $^{^9}$ RIETI Research Institute of Economy, Trade and Industry)

¹⁰ Motohashi (2011), p16, p.23.

The study of open innovation has primarily focused on the benefits and consequences of inbound or outbound innovation exchange between firms; however, increasingly firms may be engaged in simultaneous inbound and outbound exchange forming a "coupled¹¹" approach.

Furthermore, firms increasingly collaborate with university and regional SMEs as sources of innovation, but how does such coupled open innovation affect idea create, information flows, commercialization? Is a coupled open innovation applicable as a formal university education program?

Through an exploratory study of student idea contest, this paper shows how this approach incorporates not only the patent and idea but also the provision of technology and market information using multiple knowledge channels.

For the above reasons, the author believes that incorporating the practice of collaborations between Japanese universities and industries into the open innovation literature is important from the aspect of firm patent exit strategies and the aspects of university education for innovation, both theoretically and practically can lead to regional economic development.

Section 2 of this paper reviews the relevant literature about the concept of outbound, inbound and coupled types of OI, success factors, university-industry collaboration, and patent exit strategy. Section 3 presents an analytical framework of the OI-UNIC. Understanding the knowledge channels in the UNIC context of the entire innovation process requires a framework for understanding the structure of team's innovation activities. Section 4 explains the methodology: A) CPS project; and B) OI-UNIC project with qualitative analysis of knowledge channels. Finally, this paper conclude and discusses the managerial and educational implications.

(2) Literature review

In this section, I briefly review the literature on the open innovation evolutionary approach, the success factors, the openness of intellectual property, and collaborative innovation

1. Open innovation evolutionary approach

Innovation¹² is defined here as "creating new value by adding values through new ideas, methods, directions, opportunities, and solutions that meet new needs through more effective products, processes, services, and business models up to commercialization¹³". Innovation also, means not only conventional technology-driven innovation, but also "human-driven¹⁴" innovation, which focuses on creating products that people want to use.

The concept of "open innovation" is defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation, respectively" (Chesbrough, 2003,p1; Chesbrough, 2006a)¹⁵. Open innovators have a specific mindset and disposition to co-evolve ideas and co-create new products and services in innovation elaborate ecosystems (Chesbrough, Vanhaverbeke and West, 2014)¹⁶. Open innovation requires a supportive environment. (Salter, Crscuolo, and Ter Wal, 2014)¹⁷. It was observed that, although an organization may encourage its staff to be more open, individuals often shy away from these efforts (Salter, Crscuolo, and Ter Wal, 2014). In addition, a recent em-

 $^{^{11}}$ One of Open innovation modes. Section 2 discusses more details.

¹² Schumpeter presented the following five types as innovation, rather than innovation, (neue Kombination)"new combination" in the first edition of his great classic, The Theory of Economic Development (1911).
¹³ The definition here means an innovation is the result of the successful commercialization of an invention.

 $^{^{14}}$ One of the core of the innovation approach, and it focuses on human experience.

¹⁵ Chesbrough(2003).Open Innovation: The new imperative for creating and profiting from technology.

 $^{^{16}}$ Chesbrough, Vanhaverbeke and West(2014)

¹⁷ Salter, Crscuolo, and Ter Wal (2014)

pirical research implies that students theoretically understand the advantage of openness, but do not apply it to their own behavior (Oganisjana, 2015)¹⁸.

Following these initial insights, more research from different settings arose, causing the definition of OI to be refined. Following the original and more recent conceptualizations (Chesbrough, 2003 p.43, 2006a; Gassmann and Enkel, 2004; Dahlander and Gann, 2010; West and Bogers, 2014), Chesbrough and Bogers (2014) define OI as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model. These flows of knowledge may involve knowledge inflows to the focal organization (leveraging external knowledge sources through internal processes), knowledge outflows from a focal organization (leveraging internal knowledge through external commercialization processes), or both (coupling external knowledge sources and commercialization activities). The latter perspective of coupled OI has recently been used to also connect the literature on OI with research on user innovation (Piller and West, 2014), a stream in the literature focusing on the contributions of users and customers for the innovation process.

Open innovation means that valuable ideas can come from inside or outside the company and can go to market from inside or outside the company as well. This approach places external ideas and external paths to market on the same level of importance as that reserved for internal ideas and paths (Chesbrough, 2006, p.1).

2. Three types of OI

Figure 1 shows the three archetypes of open OI.

As firms collaborate with universities, there are three different ways in which they



Figure 1. Three Archetypes of Open innovation processes¹⁹

Source: Towards a Theory of Open Innovation: Three Core Process Archetypes by Gassmann & Enkel (2004), author applied

may engage with them—which the open innovation literature has termed inbound, outbound, and coupled processes. (West and Gallagher, 2006a; West and Lakhani 2008; Vanhaverbeke et al., 2008; Enkel et al., 2009; Tucci et al., 2016).

Through the inbound process, firms import external knowledge or resources to develop internal innovations. This is, the most commonly researched process (West and Bogers, 2014) building on related bodies of work such as absorptive capacity (Cohen and Levinthal, 1990). In the outbound process, firms' patent license or transfer internally developed innovations outside the firm (Chesbrough, 2003). Finally, the coupled process is defined as "coupling the inbound and outbound processes by working in alliances with complementary partners" (Gassmann and Enkel, 2004). That is, it has been assumed students idea contest assumed as Coupled innovation mode.

3. Success factors of OI

Systematically reviewed the success factors of the open innovation process as

¹⁸ Oganisjana (2015). A study at Riga Technical University in Latvia, p.1.

¹⁹ Gassmann & Enkel(2004), p7. Gassmann & Enkel (2001). According to the research 'Towards a Theory

of Open Innovation: Three Core Process Archetypes' done by Gassmann and Enkel, University of St. Gallen, Switzerland.

derived from the empirical research literature (2003-2012)²⁰. These success factors are grouped into nine factors: 1) the people involved in the process, 2) partners relationship aspect, 3) facilitators, 4) supplies and equations of resources, 5) Leadership, 6) process management, 7) culture, 8) governance, 9) IP patent management.

4. Discussion on published patents for exit strategy

Intellectual property rights²¹ (IPRs) are generally designed to exclude others from using a firm's ideas and inventions. Hall (2010) argued that, at first glance, open innovation and IPR protection are irreconcilable. Open innovation implies a willingness to allow knowledge produced within the firm to spill over to others (possibly with the expectation of receiving knowledge spillovers from others in return) whereas IPR protection enables a firm to exclude others from using that knowledge (Hall 2010, p1).

Despite this contradiction, some of Japan's largest patent holders, including Fujitsu, Panasonic, and Osaka Gas, have embraced the open innovation model. Motohashi (2006)²² investigated the role of patent system in innovation at the firm level, and found that open strategy firm with active licensing spends more on R&D.

Some SMEs doubt that the IP being given up by these large firms is very valuable to them. Indeed, the technology they offer to the OI will not be their most valuable. Instead, it will be a technology for which they have no further development plans but that they think can be developed by others in a manner that may ultimately benefit them via knowledge spillovers or increased demand for the firm's own goods and services.

Intellectual property managing can be used in two ways to help manage open innovation. First, the necessary codification of an invention or technology which occurs when a patent application is successful, helps to structure collaboration agreements (Hall, 2010, p.4). Although, uncertainty and imprecision are inherent in the definition and scope of any piece of knowledge or technology that is to be licensed to another party, this imprecision can be mitigated if the description is already subject to the standards imposed by patent offices. In addition, because the patent is a legal document, in principle the language of the document is already suitable for use referenced in a different legal document, such as a license. Second, IP rights can be used defensively to negotiate cross-licenses with others in the industry that hold complementary technologies, thus avoiding mutual litigation. Many firms in the semiconductor and computing hardware/software industries pursue this strategy (Hall, 2010, p.5).

5. Creative Problem Solving²³ and Analogical Thinking²⁴

Fisher argued that creative problem solving is a proven model for driving innovation when implemented as an organization wide business process (Basadur, 2001; Basadur & Gelade, 2003). Figure 4 is an adaptation of Basadur's Simplex model²⁵ (Basadur, 2001). In the Simplex framework, creative problem solving follows three distinct phases: problem formulation, solution find

²⁰ To determine the current research status and answer the research question, the criteria for inclusion and exclusion was selected. The inclusions were published in 2006-2017 as empirical papers and peer reviewed ProQuest ABI/Inform, Web of Science and EB-SCO were accessed, and searched for materials using the keywords "open innovation process," "open innovation activities" "open innovation," combined with "University–Industry collaboration" or patent". This was done from June 2016 to January 2017.

²¹ Source: Japan Paten Office Asia-Pacific Industrial Property Center, JII

²² Motohashi (2006), p.1.

²³ Fisher (2011),p.71

²⁴ Kima &Horiia (2016). A Study on an Assessment Framework for the Novelty of Ideas Generated by Analogical Thinking. Their research method was three workshops and a questionnaire survey.

²⁵ This model has been used successfully in hundreds of innovation workshops at Procter & Gamble's innovation studio; the GYM.

ing, and execution (Fisher, 2010).



Figure 2. Creative Problem Solving

Source: Basadur, Basadur's Simplex model 2001. Adapted by author.

Each phase includes a divergent step (in which all options are explored) followed by a convergent step (in which the most promising options are carried forward to the next step in the process). Basadur's research shows that organizations with a culture of continuous problem finding, problem solving, and implementation — along with requisite attitudinal, behavioral, and cognitive skills — have the greatest long-term innovation success (Basadur and Gelade, 2003). Kima and Horiia argued that as an ideation tool, analogical thinking enables conceptual change, which is seen as a crucial aspect of creativity. In this regard, the use of analogy can be an important instrument to facilitate novel idea generation (Kima and Horiia, 2016, p.201).

6. Research questions

Previous theoretical and experimental literature lead the following questions.

- To what degree do university students use knowledge channels of collaboration in OI-UNIC? OI? (Knowledge channels are places where internal or external ideas or knowledge flow)
- •To what degree do the students think knowledge channels of collaboration in OI-UNIC are valuable for innovation elaboration with open innovation?

The goal of this research was to determine if certain teaching and learning methods and approaches-students not only create ideas and write business plans but also make prototypes of new products, and test the prototypes with potential business partners-can be applied to university study practices.



Figure 3. Research framework

Source: Author illustrated and adapted the concept of coupled type innovation to the student idea contest. "Three Archetypes of Open innovation processes" (Gassmann & Enkel, 2004) and Chesbrough's Open Innovation Model (2003a, 2003b, 2006) to the OI-UNIC.

(3) Research framework

Figure 3 shows the research framework for study of the knowledge exchange channels between students and collaborators.

Japanese regional open innovation is the results of a complex interaction of various actors and institutions. Universities (students) large firms (licenser), SMEs (licensee), City industry policy divisions, and financial institutions ("Shinkin" credit bank or local bank) play crucial roles in accelerating innovation. Human-driven innovation using ICT and patent is a result of interaction and feedback among all elements within the system rather than an occurrence in a complete linear system (OECD, 1977). Project (A) 2015-2016: University –Industry collaboration was an innovation teaching including creative problem solving and anathinking. Then logical Project (B) 2015/2016: Open Innovation- University-Industries collaboration was an innovation training: knowledge channels, performance exit strategy and commercialization

(4) CPS Project 2013-2016²⁶

1. Overview

The CPS project was implemented from 2013 to 2016 under the theme "Welfare business and ICT²⁷". The CPS project provided training in innovating the design of products, services and other systems using the Creative Problem Solving model, analogical thinking, and innovation management approaches developed collaboratively TUC University and private companies or public institutions.

2. How CPS series work²⁸ 2016

CPSs began with class instruction (1 class), followed by lectures about ICT (4 lectures), CPS lectures and workshops using the Active Learning method (10 lectures/workshops). The participants were Sophomore enrolled in TUC and auditors.



Figure 4. The 5 steps of CPS Source: Author (2016,p.74)

Step 1: A pre-task given to participants one week before. The pre-task consisted of answering questions about a current issue related to the innovator's business mode, viewing YouTube videos and searching for information on websites.

Step2: During group discussions about the business mechanism, small teams of students (five or six students) absorbed information and opinions from others.

Step 3: The innovation tried to visualize the sophisticated complex issues inherent in their business and explained the path to solutions incorporating the viewpoints of various users. A method of designing a product or service system with the latest technical system that provides new functions from creative problem solvers were presented. In some classes, the Innovation Project Leader explained the management of complex and mediumsized projects with the stakeholders. In order to cope with uncertainty and high-liquidity environment and social problems, innovative business system development was explained.

Step 4: After each lecture, the students

 $^{^{\}rm 26}$ "CPS" project started in 2013 and ran for 4 years.

²⁷ ICT means Information Communication Technologies

²⁸ The CPSs implemented at the Takasaki University of Commerce, during the months of April-July in the

years 2013-2016 (Number of Participants were including auditor of class who registered from high school etc. N=80 in 2013, N=80 in 2014, N=190 in 2015, N=160 in 2016). 2 credit course, 15 hours classes for 2nd year students and above.

submitted self-assessment and reflection sheets.

Step 5: As a final assessment, students selected one topic, identified the problem, and proposed a new business utilizing the CPS method and analogical thinking.

3. Proposal of a new business solution by analogical thinking

As shown in Table 1., CPS examined innovation examples in three area: 1) products and processes (anti-aging cosmetics, pharmaceuticals, automobiles and equipment, AED, biotechnology, etc.); 2) operation system (efficient production management by tablet, cabin service, smartphone security); and 3) social issues (such as disaster / emergency medical care, tablet education, entertainment, communication, and food in space development, forest management, etc.).The final task for the students was to apply analogical thinking, creative problem solving skills, and the proposed business solutions. Data was collected from the 60 to 80 participants who participated in this study.

4. Method and results

Data was collected from the student's reflection sheets and final test according to the 5-steps. The qualitative contents analysis was based on the CPS learning model (Figure 4).

The following four questions were used to evaluate the students in the course.

• Did you fully understand the issue?

• Did you improve your ability to find and resolve problems?

• Did you actively work on the CPS task?

 Did you create an idea using information technology?

The student reflection papers received

Table 1. Innovators/Themes/ 2015-2016 ²⁹						
2016	Innovators	Theme				
May 9	IPA, Mr. Komon	Smartphone security				
May 18	Nomura HD, Mr.Sa-	Net equity invest-				
	kai	ment				
May 23	Dentsu	Digital PR& Social				
	PR ,Dr.Kitami	Media Flames				
May 30	System alfa,	Cognitive elderly				
	Mr.Okada	wandering with GPS				
Jun 6	Nihon Kohden,	Automatic external				
	Mr.Tanaka	defibrillator R&D				
Jun 13	Yomiuri, Mr. Orita	Newspaper new Tech- nology				
Jun 20	JAXA, Dr.Nakazara	Space food & Satellite Communication				
Jun 27	Maebashi red cross	Disaster, Life Saving				
	hospital, Dr.Naka-	by Doctor Heli				
	mura	0				
July 4	Fujitsu, Mr. Mizu-	Sensor system in au-				
-	tani	tomobile				
July 11	ANA, Ms.Kawamoto	Cabin Service				
2015	Innovators	Theme				
May 11	Cyber Police agt. ex-	Cyber Criminal				
	pert					
May 18	Senior Life Associa-	Web platform of Sen-				
	tion, Mr.Hirai	ior Life				
May 25	Gain, Mr.Miura	Internet Business				
		risk & chance				
Jun 1	Panasonic, Mr.Take-	New Business Model				
	yasu					
Jun 8	Shiseido, Dr. Amano	Anti-aging cosmetics				
Jun 15	NARO, Mr. Hayashi	Automated Agricul-				
		ture Machine with				
		GIS				
Jun 22	LINE Mr. Eguchi	Communication &				
		security				
Jun 29	Maebashi red cross	Emergency, Life Sav				
	nospital, Dr.Naka-	ing by Doctor Heli				
Inda C	mura	Tanan and 1 1				
July 6	r ujitsu, Mr. Kou-	tion				
July 19	Ketsu Mitauhiahi UET	Forest Pusi-				
July 13	Longo & Crushy For	Forest Business				
	est Management					
	Mr Kizuka et al					
L		l				

. . . 01 F 001 000

Source: Author.

high scores (4 or 5 on a 5-point scale). However, they chose problems that were closely related to everyday life experiences because it was difficult to apply an analogy to business problems in areas where they lacked

"social media analysis" by "NTT Comware".

²⁹ Themes in the past: 2014 Cases: Regeneration of regional economy by comedy project of "Yoshimoto Kogyo". A robust solution for cybercriminal by IPA. Promotion of local souvenirs by "International Tourism Association". "NARO" solution of agricultural business with GPS equipped agricultural machines, World Heritage and tourism policy of Tomioka City. Doshisha University exercise for anti-aging. Medical efficiency by SAP Japan. Tourism insight solution by

²⁰¹³ Cases: TV commercial data transfer system by "IMD Japan". Operation of doctor helicopter in case of disaster. Hospital network system by NEC, user experience value products by "LION Corp.", production management with WIFI tablet by EXE, large-scale data analysis of smart society by OKI, information security system of Canon MJ, regenerative medicine of Advanced Medical Ltd. etc.

business knowledge and experience.

(5) OI-UNIC 2015/2016 1. Overview

Open innovation in the university-industry collaboration is one of the most important elements for fostering innovation in regional economies. Many initiatives exist to support these activities in different ways.

This section presents OI–UNIC cases in Japan, in 2015 and 2016. It presents the idea, published patent, multiple channels of knowledge flows and first results in open collaborative innovation particularly those related to student' contests.

2. Innovation's-i³⁰" idea platform

The core idea behind the idea contest project is to create innovative ideas by proactively exploiting the company's published patents and the student's intellectual potential. "Innovations-i" office launched the Open Innovation Gateway (OIG) for the Student Idea Contest on the website in 2015. The OIG is a platform where organizations as patent license), student' teams (as idea creators), and SMEs (as entrepreneurs) utilize patent information and applied product.

3. Interview with Fujitsu mission and patent division exit strategy

Author: What is the mission of Fujitsu, specifically, the patent division?

Fujitsu: Through the OIG, Fujitsu Inc.³¹ works to activate innovative drivers faster, both inside and outside the company, and, based on collaborations between internal and external partners, verifies and transforms them into practical businesses. We are

promoting 'co-innovation' using our open patents selected among from own holding approximately 95,000 patents³² to support new businesses through the SMEs"³³.

Author: What is the significance of using patents?

Fujitsu: The mission of the Fujitsu Limited Business Development Department is to develop the business of the SMEs through patent licenses as an published patent that are not utilized within our company, or newly use her own business model.³⁴

Author: How far can you offer support?

Fujitsu: Even without introducing new technologies, small businesses can create highly competitive products and services in the market with innovative concepts. Nonetheless, the use of new technology increases the possibility of creating innovative products and services that are not in the world, and if the new technology is patented as a patent, the market competitiveness of the product is markedly improved. Therefore, it is possible to prevent a competitor from entering the market in an uncontrollable way³⁵"

Author: What is different from technology transfer?

Fujitsu: We consistently support what we need for commercialization until commercialization. Such a technology transfer method is distinguished from an act of simply selling patent licenses and placing a list of published patents on the public shelf³⁶.

Author: Can the business plans of university students be commercialized?

Fujitsu: Business proposals and consistent

³⁰ Its' role was context organizer and intermediary. Interview with Mr. Kudo, innovation director (January, 4, 2017)

³¹ Fujitsu Inc. headquarter is located in Kawasaki city, is a leading ICT total-solution company in Japan that provided a published patent. Fujitsu Ltd. launched Open Innovation Gateway (OIG) in Kawasaki city in Japan. It is a platform to connect and grow ideas, and based on the collaboration of internal and external partners, to verify and transform them into practical businesses.

³² Intellectual Property Report for FY 2014.

³³ Author Interviewed Masatoshi Nishida, Vice President, (January 4, 2017) Intellectual Property innovation Division, Headquarters of Fujitsu Legal, Compliance and Intellectual Property Unit.

³⁴ Ibid.

³⁵ Author Interviewed Masatoshi Nishida, Vice President, (January 4, 2017)

³⁶ Ibid.

support are products rather than patent licenses. By utilizing Fujitsu's patents to create a business plan for university students, universities, local governments, financial institutions jointly create a place to create new businesses that are not bound by existing concepts. I believe that human resources can be raised through social learning.^{37"}

4. Contest start



Figure 5. Participants Location of the Open-UNIC 2016

Source: The author edited data from <u>http://opi.in-</u>novations-i.com/idea/purport/

Figure 5 shows images of the location of participants and the TUC University, SMEs in Maebashi City of Gunma Prefecture in the northern Kantō region of Japan.

5. Rules of contest

Six requirements and problems to solve were given to each team.

1) To create idea from the viewpoint that you want to purchase yourself, or you want to use (useful / interesting / surprised).

2) To identify differentiation from similar products.

3) To add ideas as patents are a part of the information on some products and services. 4) To propose the following related ideas leading to the business of the SMEs. *Product or service must be related to: a) Revitalization support. b)Tokyo Olympic Games, Paralympic Games 2020. c) To contribute to the regional economy.

5) To utilize one of the six Fujitsu patents.

6) To assume an annual turnover of about 10 million yen to 100 million yen.

6. Type of patent

The OI-UNIC 2015 began in June with a total of 71 student teams from around Japan and 12 types of published patents offered by three organizations (JAXA, NHK E.S., and Fujitsu³⁸), and finished the national competition in January of the following year. The OI- UNIC 2016 project started in June with19 types of published patents offered by five organizations (Fujitsu, NHK E.S., AIST, Fujitsu-ten, and Panasonic³⁹, and ended in December 2017 in Tokyo. Table 2 and Table 3 list the available types of patent and team selections.

7. OI gate, knowledge route and knowledge exchange channels



Figure 6. OI 6 gate and assessments Source: Author.

Figure 6 describes the gates and assessment of the OI. During the kick-off mee-

 $^{^{37}}$ Ibid

³⁸ Formal name is as follows. Fujitsu = Fujitsu Limited, HKE E.S.= NHK Engineering System Inc.,

JAXA= Japan Aerospace Exploration Agency ³⁹ AIST =National Institute of Advanced Industrial Science and Technology.

		L	
	Time of published notant	License	Numbers of
•	Type of published patent	Provider	Teams
1	Sales support technology using transmission type liquid crystal and half mirror	Fujitsu	9
2	Screen display control technology of vending machines according to users	Fujitsu	5
3	Product suggestion technology considering remaining budget	Fujitsu	11
4	Capture and play equipment technology	Fujitsu	8
5	Article inspection technology by hammering analysis	Fujitsu	8
6	Contact sensor technology using air bag	Fujitsu	6
7	Metallic coloring technology without paint	Fujitsu	14
8	CG character control technology	NHK E.S.	1
9	Image retrieval technology by drawing requested image using image ele- ments in database	NHK E.S.	1
10	Tactile presentation technology to convey diagrams and graphs	NHK E.S.	0
11	Flexible solar cell	JAXA	5
12	Two-dimensional actuator	JAXA	3
	Total	3	71

Table 2. Number of Team and Published Patents in 2015

Source: Author edited data from http://opi.innovations-i.com/idea/purport/

Table 3. Number of team & Published Patents in 2016	able 3. Number of team & Publish	ed Patents in 2016
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	Type of published patent	License	Numbers
	Type of published patent	Provider	of Teams
1	Code embedding technology using light emitting diode: LED	Fujitsu	28
2	Gaze detection technology	Fujitsu	24
3	Behavior state detection technology	Fujitsu	11
4	Direction guidance technology	Fujitsu	5
5	Temperature difference power generation technology	Fujitsu	11
6	Advertisement related technology	Fujitsu	19
7	Three-dimensional sound reproduction technology with headphones	NHK E.S.	0
8	Television system applying the AR (Augmented Reality) technology "Augmented TV"	NHK E.S.	0
9	CG character animation production technology	NHK E.S.	0
10	Inflection conversion technology	NHK E.S.	0
11	Two-dimensional code easy to understand with dot picture	AIST	1
12	Two-dimensional actuator	AIST	3
13	Switchable light control mirror with gas	AIST	0
14	Photo synthesis system considering size	AIST	1
15	Electric switched dimmer mirror	AIST	1
16	Door auto-lock technology	Fujitsu-ten	0
17	Door unlock warning technology	Fujitsu-ten	0
18	Mike picking up tweets	Panasonic	0
19	Super directional speaker	Panasonic	3
	Total	3	107

Source: Author edited data from http://opi.innovations-i.com/idea/purport/

ting (Gate 1) the team carefully chose a published patent, defined the current problem, created and brushed up an idea (Gate 2), proposed a business model (Gate 3), created a prototype and tested it with users (Gate 4), further brushed up the idea (Gate 5), and presented their plan in the business contest (Gate 6). The team can work with their collaborators through multiple knowledge route (Figure 7) based on their business model through the project.



Figure 7. Kowledge Route with Collaborators Source: Author.



Figure 8. OI- UNIC licensing 2016

Source: Author illustrated (2016) and adapted Chesbrough's Open Innovation Model (2003a, 2003b,2006) to the OI-UNIC students idea contest.

Figure 8 ilustrates team innovation performance on OI process. Blue marked team ~ Top Winner team has exit.

8. Methods and results

8.1. RQ 1 methods and results The first research question, "To what

Table 4. Knowledge Exchange Channels

	Knowledge	Type of collaboration (Ba)
	multi-chan-	
	nel	
1	within team	Kick off, brushing up, select-
		ing published property. Stu-
		dents divided their responsi-
		bilities for product concept.
		design solution finance
		market research by exchang-
		ing findings and discussing
		further activities with their
		teammate.
2	student-	Teacher open to discuss, ad-
	teacher	vice and facilitate students
		learning theory and practice
		both at individual and team
		level. (encourage)
3	team other-	Kick off, brush up, interme-
	team	diate phase. Team present
		their idea done and discuss
		the challenges faced with the
		other teams.
4	team-men-	Coordinator visiting, tele-
	tor coordina-	phoning, or meeting at city
	tor outside	office. recommending partic-
		ular SMEs to realize and
		need specific experience and
		knowledge.
5	team-firm 1	Presentation, discuss, advice
	engineer	regarding hardware
6	team-firm 2	presentation, discuss, advice
-	engineer	regarding software
8	team-firm 3	Presentation, discuss, advice
Ŭ	partner	regarding business model
	1	marketing
9	team-staff-	Brash up, intermediate
-	licenser	phase. Team present their
	,	idea done and discussed the
		challenges faced with the li-
		cense
10	team-staff	Advice regarding contact to
	city admin-	SMEs, scheduling.
	istrator	, B.
11	team-staff	Advice regarding financial
	investor	information
12	team-	Interview, questionnaire, ob-
	final users	servation

Source: Author's observations⁴⁰ (2016)

degree do university students use multiple channels of collaboration in OI-UNIC?" was explored based on qualitative analyses (author's observations, student reflection papers, and interviews with potential partners

⁴⁰ Author researched type of collaboration channels are researched, revised, and modified based on the work of Oganisjana (2015).

outside the university), according to the knowledge exchange channels (Table 4), OI-UNIC steps (Figure 6) and the knowledge route (Figure 7). Figure 8 compares winner team.

Results of R1: Partly applicable but not all (Table 5). The proposed assessment framework for collaborative behavior is inapplicable to the "one size fits all" type of students. It does overcome some of the limitations of current evaluation methods.

Table	5.	RQ1:	Result	⁴¹ 2015	and	2016
				1.097		

	collaboration channel	2015 Team A N=16	2016 Team B N=12	2015 Top Winner Team	2015 2nd Winner Team	
1	within team	100	60	-	-	
2	students-teacher	100	60	-	-	
3	team-team	5	5	-	-	
4	team-mentor coordinator outside	50	10	-	-	
5	team-firm 1 engineer	50	5			
6	team-firm 2 engineer	20	5	linenas	than 11	
7	team-firm 1 partner	20	5	ncense		
8	team-firm 2 partner	40	10	contract	partners	
9	team-staff licenser	60	0			
10	team-staff city administrator	40	5	-	-	
11	team-staff investor	10	0	contract	high	
12	team-final users	200	10	full use	-	

Source: Author's observations⁴² (2016).

8.2. RQ 2 methods and results

The second research question, "To what degree do the students think multiple channels of collaboration have value for their practical studies of OI," was explored according to the Value List (Table 6).

Unlike in previous studies (Oganisjana, 2015), the author considered technical information about the published patent. Although Oganisjana (2015) categorized (IN, OUT,

		2015 Team A. N=16			2016 Team B. N=12		
	Value List	category			category		
		in	out	in-out -in	in	out	in-out -in
1	Experience		40		45		
2	Knowledge		30		39		
3	Othr idea		30		12		
4	Advice		5		30		
5	Problem solving		3		7		1
6	User view			4	16		
7	Motivation	3	3	30	6	6	14
8	Creating	9	9	30	9	4	12
9	Support	4	4		7	4	
10	Business thinking	16			12		
11	New opportunities	16			12		
12	Critical thinking	6	2	4		6	
13	Creating	12			8		
14	Information patent	16	8	4	11		

Table 6. Value Lists and Categories

Source: Author $(2016)^{43}$.

IN-OUT-IN) as a "fragment of the qualitative content analysis and labeling of the categories," the author included technology information about the published patent and redesigned the study.

The qualitative content analyses accounted for the three possible categories of action.

- A) IN (inflow): students get an idea (they judge useful) from collaboration partners related to the category.
- B) OUT (outflow): students give an idea (they judge useful) to collaboration partners related to the category.
- C) IN-OUT-IN (inflow-outflow): students exchange ideas (they judge useful) with collaboration partners related to the category. The student reflection papers and

⁴¹ The 2015 top winner was Showa Women's University team-"Small Drone Gate Passing Game supported by Showa Shinkin (Tokyo). Team A created a prototype and just won at regional stage. http://opi.innovations-i.com/feature/idea/re/20151217/. The 2016 top winner was university of Shizuoka team-"Spot with spots!" supported by Seishin Shinkin. http://opi.innovations-i.com/idea/report/. Team B lost game at the regional competition.

 $^{^{42}}$ Type of collaboration channels revised and modified the work of Oganisjana (2015).

⁴³ Compared Team A (prize) with Team B (no prize). Team A was participated in CPS Project (innovation training), value information patent, and critical thinking more than team B.

the author's observations of student behaviors revealed that the students highly value the potential for intergenerational collaboration outside formal university frames.

However, the student reflection also revealed that while some students are aware of the value of studying in collaboration channels, they did not active and full use the open channels.

(6) Findings

In this section, we present the findings from the systematic review.

Management point of view:

- ① Reliable goals and time schedules seem necessary to build the credibility of the collaboration.
- ⁽²⁾Initial ideas don't generate much value in themselves. There needs to be professional guidance for creative problem solving and discussion of the idea.
- ③ Companies often have tended to claim openness, while knowingly concealing certain information, such as patents or possible sources of competitive advantage.
- (4) Clear prizes for innovation challenges are necessary. For example, a career-related reward is much more fulfilling and motivating. Other rewards include internships, monetary prizes, and presenting the winner's name on a website.
- ⁽⁵⁾Face-to-face is good for the initial phase where different concepts and processes are tested, but in the long run, online channels are more useful for the entire innovation process.
- ⁽⁶⁾Building trust and collaborating on an idea takes times. Financial institutions play a role in building trust.

(7) Conclusion and hypothesis

Although the findings suggest that the proposed method of innovation education is inapplicable to the "one size fits all" type of students, the method does overcome some of the limitations of current evaluation methods. This study shows that universities can play an active role in promoting innovation in an OI activity, as well as shows how study courses and projects can foster greater innovation by students. The study revealed several problems for further research.

The main conclusion of this study formulated as a hypothesis, is that: when clear guidelines for innovation management and indication of innovation performance, in OI are prepared, university students can become more collaborative and motivated to work with potential business partners outside the university, the effect of active learning can be further enhance.

(8) Limitations and future research

This study of innovation education in an OI required students to pose a theoretical framework of innovation education in OI and test it empirically. Future investigations should note the limitations of this study. First, the data source was limited to the author's university students. Second, the research conducted using qualitative content analysis.

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