A Study on Cases of Practical Applications of University-Industry Research Collaborations

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Abstract. The university-industry research collaborations (UIRCs) have been recognized as an important factor of the production of innovation. In practice, however, the cases of the practical applications of UIRCs are not so many and there are a lot of problems in the UIRCs. In this paper, first the UIRCs conducted in Niigata University that is located in one of the regional areas are analyzed based on joint research projects in order to clarify these problems of university-industry collaborations in regional areas of Japan. Next, the cases of practical applications are extracted and their characteristics of the patterns that lead to the specific subject are made clear. Finally, the cases of the practical applications are classified and are discussed from the point of view of technologies and markets.

Keywords: university-industry research collaboration, practical application, innovation.

1. Introduction

UIRCs have been recognized as an important factor for the creation of innovation. Further, the UIRCs have been encouraged in recent years in Japan from the view point of new industry and job creation [1]. Due to these encouragements of UIRCs, the number of joint research projects has increased about 3.6 times from 4,029 in 2000 fiscal year (fy) to 14,677 in 2010 fy in National Universities in Japan. Many results from UIRCs have been reported recently focusing on the size of collaboration partner companies, on the sources, characteristics, and financing, on the geographical distance between university and industry, and on the number of projects by technology [2-8].

In practice, however, the cases of the practical applications of UIRCs are not so many and there are a lot of problems. The main reason is as follows: The small-medium companies rather than large companies are accumulated in Japan. It is difficult to develop the UIRCs to practical applications for small-medium companies by themselves because the small-medium companies are lacking in funds, technologies, and organizations.

In the previous paper [9], the UIRCs were analyzed based on the case study of joint research projects in order to clarify the structure of the UIRCs in regional areas of Japan. In this paper, first the UIRCs conducted in Niigata University that is located in one of the regional areas are analyzed based on joint research projects focusing on recent trends. Next, the cases of practical applications are extracted and their characteristics of the patterns that lead to the specific subjects are made clear. Finally, the cases of the practical applications are classified and are discussed from the point of view of technologies and markets.

2. Analysis of Joint Research Projects

The joint research is essential for the UIRCs because the contract content including the ownership of the intellectual property is clearly defined and private companies are the main partners. Therefore, the analysis of joint research projects becomes the first stage in order to understand the present situation of the UIRCs. In this section, the trends of joint research projects in National Universities in Japan by time series are shown and the characteristics of companies that engage in joint research projects in Niigata University are analyzed focusing on recent trends.

Figure 1 shows the number of joint research projects in National Universities in Japan by time series. The number of joint research projects has been increasing steadily since the start of its establishment in 1983 fy. The rate of the increase decreases in recent years although it is outstanding since 1998 fy. This means that the UIRCs in Japan have been converged.
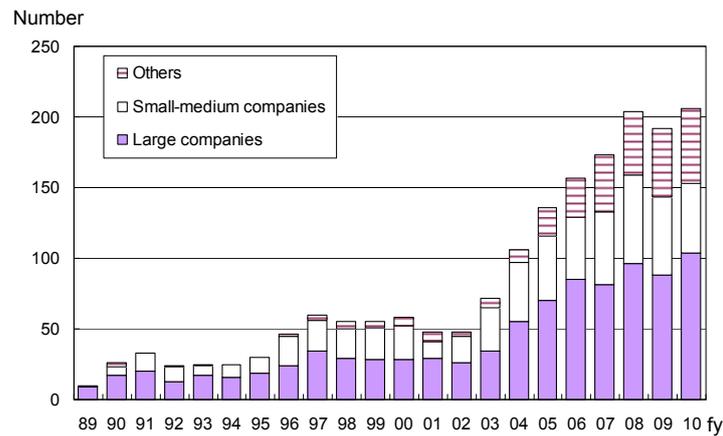

Fig. 1: Number of joint research projects in National Universities in Japan by time series.

On the other hand, 1,789 joint research projects have been conducted in Niigata University in the period from 1989 fy to 2010 fy. The average budget per project is about 1,226 thousand yen (about 15.1 thousand US dollar) and is not so high compared with others for the country.

Figure 2 shows the number of joint research projects in Niigata University dividing collaboration partners into large, small-medium companies, and others by time series. First, examining the trends regardless of the company scales, the number of joint research projects is 206 in 2010 fy and this is 3.6 times than that in 2000 fy. This increase is the same as 3.6 times in the whole country. Next, examining the trends of company scales, both the numbers of the large and small-medium companies has shown increase and the increase of large companies is especially outstanding in recent years. The reason is as follows: The various policies to encourage the UIRCs have been established in Japan. The small-medium companies inside the prefecture have maintained the status quo in the mind toward the policies while large companies have responded to the policies sensitively. The rate of the large companies is about 52 percent and it is higher relatively than that in the whole country. Therefore, the large companies have been the main partners in the limited area of Niigata Prefecture although the small-medium companies are more than 90 percent of the companies inside the prefecture.
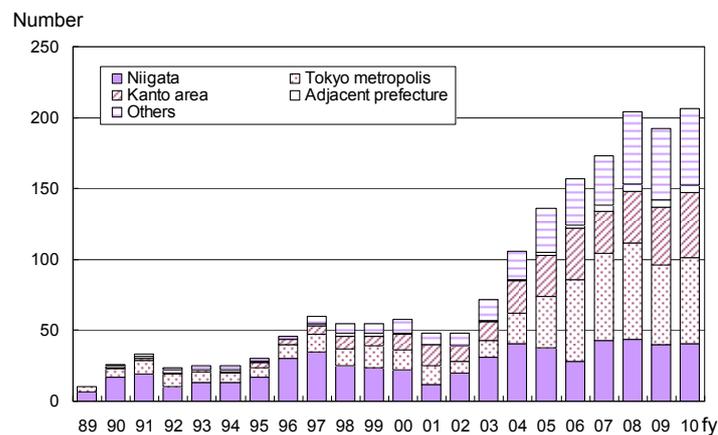
Fig. 2: Number of joint research projects divided by company scale in Niigata University by time series.

Figure 3 shows the number of joint research projects dividing collaboration partners according to their location in the country by time series. The collaboration partners in Kanto area including Tokyo Metropolis have increased in recent years. The whole increase of the joint research projects in Niigata University links to that of the collaboration partners in this area directly. The trend is especially outstanding in recent years although the collaboration partners inside the prefecture roughly have flattened. The reason seems that the knowledge information in Niigata University has extended into a metropolitan area and the large companies in a metropolitan area tend to search the knowledge of university researchers. The joint research projects

inside the prefecture concern the regional contributions. Further, there are almost no partners from the adjacent prefectures due to the locality of Niigata University. The other part is occupied by metropolises such as Osaka and Nagoya. Putting things together, the collaboration partners are concentrated inside the prefecture and in Kanto area including Tokyo.
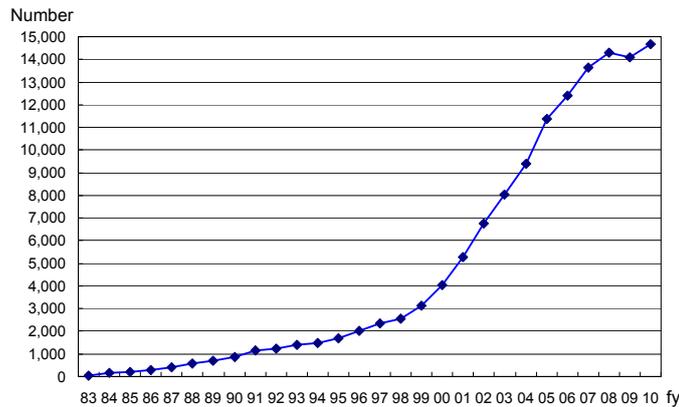

Fig. 3: Number of joint research projects divided by location of collaboration partners in Niigata University by time series.

3. Cases of Practical Application

In this section, the five cases of practical applications are extracted from the joint research projects conducted in Niigata University.

3.1. Development of Equipment for Photosynthesis Advance in Oil Combustion System

The cultivations of strawberries in Niigata area do not grow up due to the low temperature and low amount solar radiation in winter. Therefore, the full-grown period becomes long and sugar content becomes high comparing with the cultivations in warm area. The "Echigo-hime" is a new type of strawberry in which the breeding is conducted so that fits to the climate in Niigata area. A company has developed the equipment for photosynthesis advance in oil combustion system. For this reason, the test of the growth improvement of "Echigo-hime" which was cultivated using this equipment was conducted in Niigata University. As a result, the increases of cumulative amount and sugar content, and the largeness of fruits were confirmed by the effectiveness of charity of carbon dioxide [10].

3.2. Development of Rice Powder Bread for Allergy Free

An egg, milk, and wheat are mainly taken up for three kinds of allergies. The adult patients are occupied and obstinate in the case of the food allergy of wheat. A natural ferment has been started to produce since Food Research Center, Niigata Agricultural Research Institute, has processed a bread to a rice powder in 2001. However, it becomes possible to produce the bread made out of a rice powder when active gluten is added. The bread made out of a rice powder in which the patient of a wheat allergy can eat in peace has been tried to produce. They have added hydroxypropyl methylcellulose and have established to produce the bread made out of a rice powder without a wheat allergy due to the thought toward a good taste [11]. However, the mass production of the bread utilizing the existing equipment has been difficult since the specific equipment has been needed in the produce field of the bread. Due to the flood occurred in 2004, it became impossible to utilize the existing equipment and half a year has continued not to produce the bread. On this occasion, they have started to introduce the new equipment and to produce the bread made out of a rice powder.

3.3. Development of Tongue Brush for Mouth Care

The president in a company has taken the scent of a cigarette to heart and has tried to use a commercial tongue brush. On this occasion, he has started to develop a tongue brush for the mouth care of people of advanced years. The width and thickness of the tongue brush are 31 mm and 13 mm, respectively, and the brush is made out of a special nylon. The both sides of the brush are useful. The one side is flat for a tongue surface and the other side is a depressed form that can remove dirt. However, a bacterium in the mouth often causes the pneumonia of people of advanced years. Therefore, he started to develop a tongue blush so that

the hit is soft and dirt is removed. For this reason, the technical consultation has been conducted in Niigata University in order to confirm the validity of the effectiveness of the tongue brash for the occupant in the facility for people of advanced years. The research collaboration in Niigata University has started and the validity of the effectiveness of the tongue brash has been confirmed [12].

3.4. Development of Measurement Equipment of Battery in Automobile

The loss inside the battery in automobile has increased when it has been used for a long time. In this case, it is difficult to take out the current and the automobile always stops. Therefore, the resistance inside the battery in automobile is needed to measure. However, the magnitude and direction of the current inside the battery in automobile change, at engine starting and usual drive moments, respectively. Therefore, the measurement equipment of battery in automobile has been developed. This equipment has the characteristic that can measure the resistance inside the battery in a run without the voltage outside. For this reason, the analysis of measured data and the method of data processing have been developed in Niigata University. As a result, the effectiveness of this equipment has been confirmed in automobile in a run [13].

3.5. Development of Quick Hydrogen Gas Sensor

The gas sensor has been needed in a company. A coordinator has found the knowledge which are behaviors of the hydrogen in metal in Niigata University. The related three organizations has made a license contract and the product has been developed. The product is a quick hydrogen gas sensor and it can detect hydrogen gas in a moment utilizing an electromotive force. This sensor has high performance comparing with the conventional products in a detection speed, tip capability, selection, life, and production cost. This case has been valued highly for the promotion of the UIRCs concerning the technology transfer in a university in a regional area [14]. Hereafter, a contribution of the sensor to a market is promising since it is assumed that the demand of a hydrogen fuel cell increases.

4. Classification of Cases of Practical Application

In the previous paper [10], the specific subject of the joint research projects was roughly divided into the three cases, (i) needs oriented joint research project, (ii) knowledge development joint research project, and (iii) interchange type of joint research project. The cases 3.1-3.5 mentioned above are classified based on this method. In this case, the cases 3.1-3.5 are replaced by (1)-(5), respectively. As a result, (2) applies to (iii) and (5) applies to (ii). (1), (3), and (4) applies to (i). This means that many UIRCs applies to (i).

The practical applications extracted from the joint research projects are regarded as "New business" and are classified from the point of view of technologies and markets. The technologies are classified into the following three parts. (I) The existent technology becomes deep and otherwise it is applied and is expanded. This is regarded as "Oneself". (II) The outside existent technology is applied and is expanded although the company does not have the direct technology. This is regarded as "Outside". (III) The technology is newly developed in the company. This is regarded as "New". On the other hand, the markets are classified into the following three parts. (I) The new product is provided to the present business field. This is regarded as "Existent". (II) The new business is developed on the surrounding the relating technology. This is regarded as "Periphery". (III) The new technology is developed in the different field. This is regarded as "New". The cases (1)-(5) are expressed as matrix relations of the technologies and markets as shown in Table 1. Only case (3) applies to "New" in both technologies and markets. The cases (1) and (2) apply to "Oneself" in technologies and apply to "Periphery" in markets. The cases (4) and (5) apply to "Outside" in technologies and apply to "Periphery" in markets, too. This means that almost UIRCs apply to "Oneself" or "Outside" in technologies and apply to "Periphery" in markets.

Table 1 can be compared with the product-market matrix that has been proposed by Anssof when the technology is regarded as "Product" which is embodied in research and development [15]. This product-market matrix has been proposed in order to confirm the product group and business direction for the analysis of the market.

The inventions have been created in joint research projects (2), (3), (4), and (5) and have been registered as joint patents between the university and industry in (2) and (4), respectively.

Table 1: Classification of cases of practical applications by technologies and markets.

		Technology		
		Existent		New
		Oneself	Outside	
Market	Existent			
	Periphery	(1) (2)	(4) (5)	
	New			(3)

5. Conclusions

The main conclusions obtained in this study are summarized as follows:

- The UIRCs conducted in Niigata University that was located in one of the regional areas were analyzed based on joint research projects focusing on the recent trends.
- The cases of practical applications were extracted and their characteristics of the patterns that lead to the specific subject were made clear.
- The cases of the practical applications were classified from the point of view of technologies and markets.

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