

Analysis of Collaborations Between Small-Medium Companies and Universities Based on Joint Research Projects

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University-industry collaborations have been recognized as an important factor for the creation of innovation. Although the university-industry collaborations have been mainly conducted by large companies in Japan so far, the small-medium companies rather than large companies are accumulated in regional areas. However, there are a lot of problems in the university-industry collaborations of the small-medium companies. In this paper, the collaborations between small-medium companies and universities are analyzed based on joint research projects. The results show that the joint research projects of small-medium companies for collaboration partners are not conducted enough. Moreover, the results also show that the average budget per project of small-medium companies is low according to the detailed data of Niigata University. The active area of company and university in research and development is discussed. The stage map that proceeds to commercialization for the collaborations between small-medium companies and universities is made and discussed. Based on these results, the problems of the university-industry collaborations of small-medium companies for collaboration partners are extracted.

Keywords: university-industry collaboration, innovation, joint research project, small-medium company

Introduction

University-industry collaborations (called UICs in short) have been recognized as an important factor for the creation of innovation. Moreover, the UICs have been encouraged in recent years in Japan from the view point of new industry and job creation (i.e., Rahm, Kirkland, & Bozeman, 2000). The UICs have become more active and changed to the period of the quality from the quantity. The types of the UICs differ widely from university to university because of the differences in geographical conditions, in preparations of the UICs systems of universities, and in industrial structures in the areas. Since the UICs in regional areas affect the local community in addition to the industry world, those have a significant role in the view point of a social contribution. Many results from the UICs have been reported recently focusing on the geographical distance between university and industry, on the company scale of collaboration partner, and on the number of projects by technology (i.e., Acs, Audretsch, & Feldman, 1994; Mansfield, 1995; Lee, 1996; Vedovello, 1997; Audretsch, 1999; Saitoh, Nakayama, Hosono, Fukugawa, & Kobayashi, 2001; Santoro & Chakrabarti, 2002; Cohen, Nelson, & Walsh, 2002; Motohashi, 2003).

On the other hand, although the UICs have been mainly conducted by large companies so far in Japan, the small-medium companies rather than large companies are accumulated in regional areas (i.e., Audretsch, 1999; Santoro & Chakrabarti, 2002). However, there are a lot of problems in the UICs of such small-medium

companies. It is difficult to activate the UICs of small-medium companies by themselves because the small-medium companies are lacking in funds, technologies, and organizations. Therefore, the intensity and extent of the UICs are important for the support of small-medium companies and the activities of economy. Moreover, it is important for universities in regional areas to set up the strategy of activities of a social contribution making use of the regional characteristics because there is talk of the competition of the universities and regions. In order to set up such strategy, it is essential to analyze the present condition and to extract the problems of the UICs.

In this paper, the collaborations between small-medium companies and universities are analyzed based on public and detailed data of joint research projects in order to clarify the structure of the UICs in regional areas of Japan. The detailed data are obtained by Niigata University. The active area of company and university in research and development is discussed. Moreover, the stage map that proceeds to commercialization for the collaborations between small-medium companies and universities is made and discussed. Based on the analyzed results, the problems of the UICs of small-medium companies for collaboration partners are extracted. Niigata area is one of the areas in which small-medium companies are almost accumulated in Japan. These results are applicable to many other areas because there are many areas in which small-medium companies are almost accumulated.

Joint Research Projects Between Small-Medium Companies and Universities

The UICs are used as a very wide meaning. This paper is focused on joint research projects for the analysis. The reason is that the joint research projects are essential for the UICs because the contract content including the ownership of the intellectual property is clearly defined and private companies are the main partners. The execution situation issued by Ministry of Education, Culture, Sports, Science and Technology in Japan every year is used in order to know the record of the projects (i.e., http://www.mext.go.jp/a_menu/shinkou/sangaku/sangakub.htm). The public data of the joint research projects are limited to national universities for this analysis due to the difference of the systems by private and national universities.

Analysis Based on Public Data

Figure 1 shows the trend in the number of joint research projects in national universities in Japan dividing collaboration partners into large, small-medium companies and others by time series in the period from 2001 fy (fiscal year) to 2008 fy. The number of joint research projects has been increasing steadily and is in a total of 14,303 in 2008 fy. This means that the UICs have been encouraged steadily. Figure 2 shows each rate of the divided joint research projects in national universities by time series. Both the number and rate of large companies for collaboration partners have increased. The number of large companies in 2008 fy is about 3.5 times than that in 2001 fy. On the other hand, although the number of joint research projects of small-medium companies has increased slightly, the rate of these projects has decreased since 2002 fy. The number of joint research projects of small-medium companies in 2008 fy is slightly 2.0 times than that in 2001 fy. The rate is only 23.9% in 2008 fy. Therefore, the joint research projects of small-medium companies for collaboration partners are not conducted enough comparing with those of large companies when the numbers of large and small-medium companies in Japan are considered, respectively.

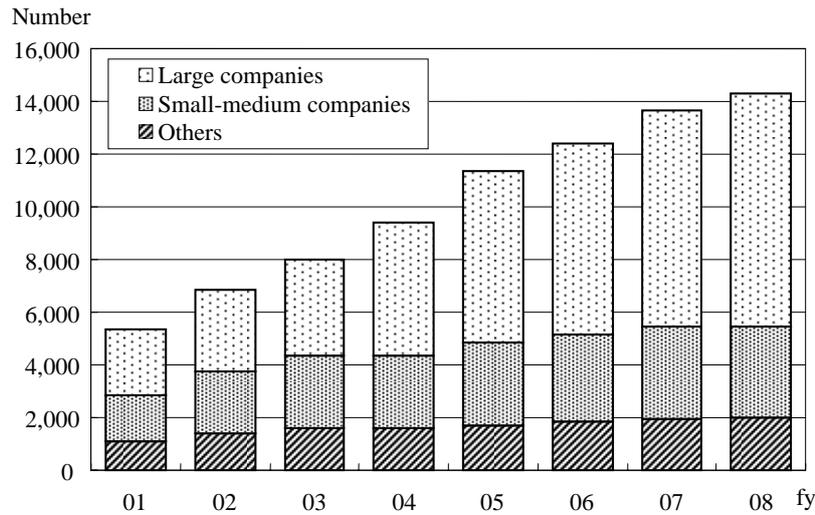


Figure 1. Number of joint research projects divided by company scale in national universities by time series.

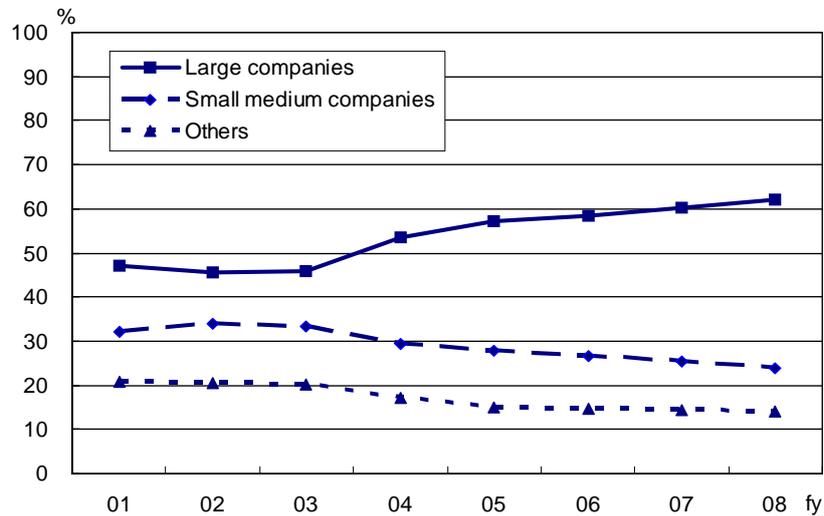


Figure 2. Rate of joint research projects divided by company scale in national universities by time series.

Analysis Based on Detailed Data

Figure 3 shows the trend in the number of joint research projects in Niigata University dividing collaboration partners into large, small-medium companies and others by time series. The number of joint research projects has been increasing steadily and is in a total of 204 in 2008 fy. The trend in Figure 3 examining the trend regardless of the company scale is similar to that in Figure 1. Figure 4 shows each rate of the divided joint research projects in Niigata University by time series. Although the number of large companies for collaboration partners has increased, the rate roughly has flattened in recent years. The number of large companies in 2008 fy is about 3.3 times than that in 2001 fy and this trend is similar to that in the whole of national universities. Comparing the rates of large companies in 2008 fy in the two cases, the rate is less than 50% in Niigata University although the rate is more than 60% in the whole of national universities. On the other hand, the number of joint research projects of small-medium companies for collaboration partners in 2008 fy is about 5.3 times than that in 2001 fy in Niigata University. This result is larger than that in the whole

of national universities. The reason is that small-medium companies have been accumulated in Niigata Prefecture and the support system to these companies has been strengthened. However, the rate of small-medium companies roughly has flattened and has been about 30% as well as that in the whole of national universities.

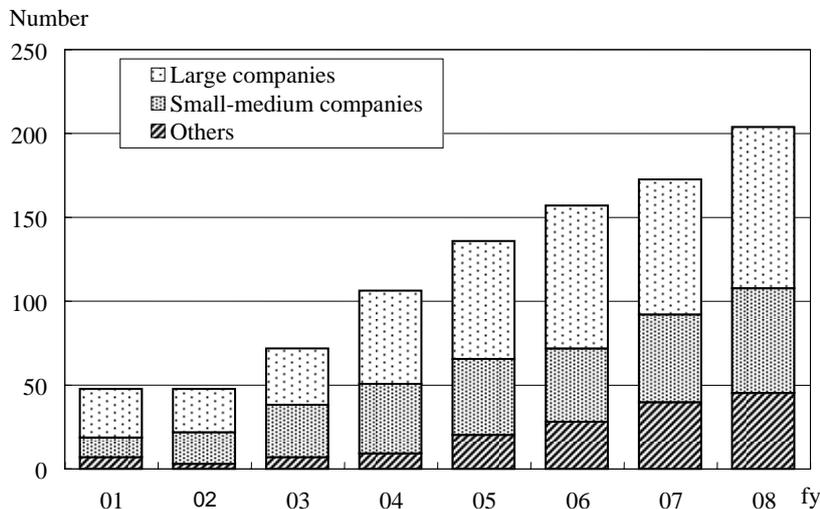


Figure 3. Number of joint research projects divided by company scale in Niigata University by time series.

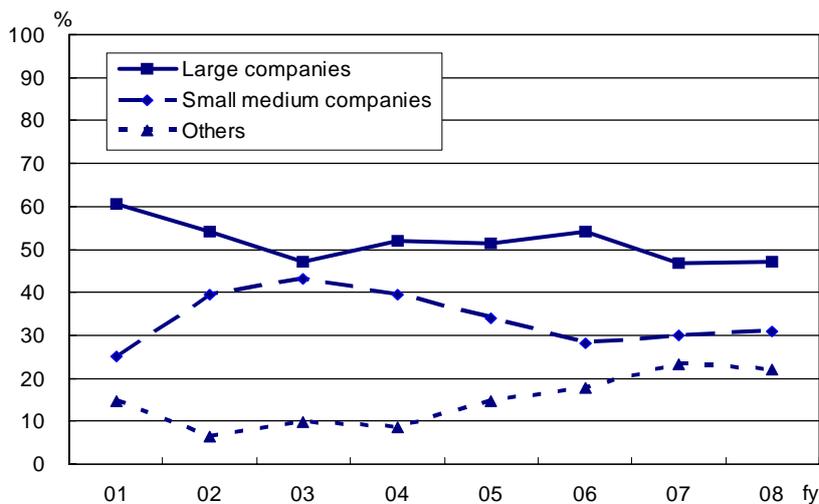


Figure 4. Rate of joint research projects divided by company scale in Niigata University by time series.

On the other hand, the average budget per one joint research project roughly has flattened from 2001 fy to 2008 fy in both the whole of national universities and Niigata University. However, the average budget per project in Niigata University is about 1,314 thousand yen (about 16.0 thousand US dollar) and is rather lower than 2,386 thousand yen in the whole of national universities. In the case of Niigata University, the average budget per one project of small-medium companies is about 933 thousand yen and that of large companies is about 1,449 thousand yen. That is, the average budget per project of small-medium companies is rather lower than that of large companies. We consider that small medium companies are lacking in funds, technologies, and organizations and the characteristics of regional areas are reflected.

Classification of Joint Research Project

The specific subjects of joint research projects are conducted at a lot of stages such as the research, development, evaluation, and commercialization. Therefore, the purpose of each research project is different. In the case of Niigata University, the specific subject of the joint research projects is roughly divided into the following three cases for an advance stage: (1) needs oriented joint research project; (2) knowledge development joint research project; and (3) evaluation type joint research project.

In the first case, the needs are brought into the university from the industrial world and the specific subject is almost clear. Moreover, the small-medium companies inside the prefecture are the main partners. The reason is that the university is utilized instead of lacking in funds, technologies, and resources. In this case, the part of development is great at this type of joint research project and the speed of result is required. The company usually requires extensive knowledge than the current result. On the other hand, since large company has organization and human resource for development, the development is proceed by oneself than the collaboration with the university at this stage.

In the second case, the university provides the knowledge to the industrial world and it matches to the needs for the knowledge development joint research project. In this case, the large companies are the main partners. The reason is that the large company has organization and human resource, and research and development lead to practical use by oneself. However, the collaboration with university is efficient and effective when the creation of high knowledge and current research result are required or the research of high risk is conducted. Moreover, the variety is secured by the investment of a small amount and technological power is expected to strengthen. On the other hand, the part of research is great and is familiar at this stage for university researcher.

In the third case, the performance and evaluation are usually conducted after trial manufacture for the evaluation type joint research project. The merit for collaboration partner is great since the university owns valuable measurement equipments, the evaluation results are reliable, and improvement and new development are expected. In the case of Niigata University, the main collaboration partners are the small-medium companies inside the prefecture. The university researchers are good at and are familiar to this type of joint research projects. Since the results are published on the society etc. by university researchers, the company can utilize it to the advertisement.

Active Area of Company and University in Research and Development

It is important to understand that the joint research projects are conducted at which stage from the research to the commercialization as mentioned above (i.e., Degawa, 2005). Figure 5 shows the comparison of the areas that company and university activate in research and development. This is shown based on the results of Niigata University and experiences of author. Therefore, there is an exception to Figure 5. The active area is widely from technological research to commercialization in the large company. However, the active area is limited at the centre of commercialization in the small-medium company. On the other hand, the education and research are conducted based on the foundation research, and active area is from foundation research and technological research in the university. Therefore, the joint research projects are conducted in the conspired area between the company and university. The area is narrow in the small-medium company although the conspired area is wide in the large company.

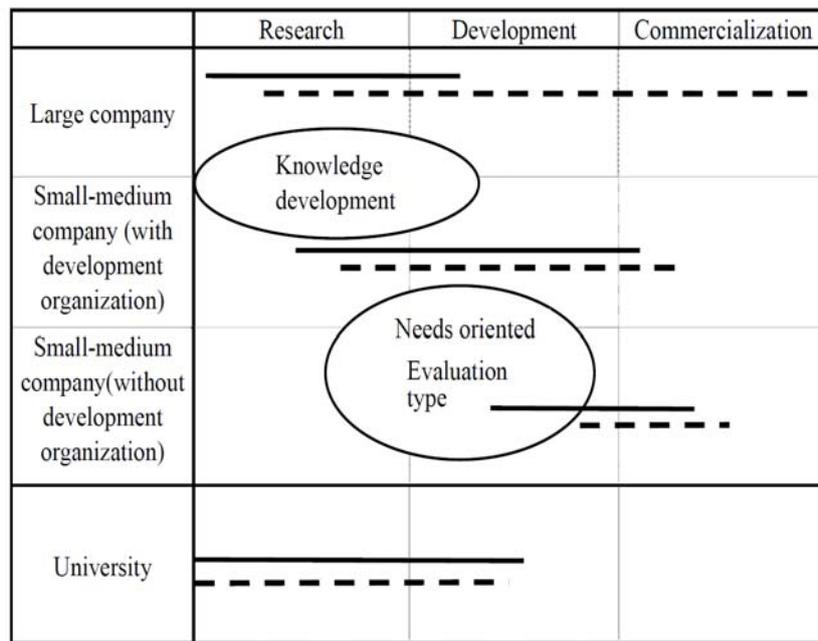


Figure 5. Comparison of active areas of company and university. Note. Solid lines for active areas of UICs, and dashed lines for main active areas in company and university.

Stages of Collaborations Between Small-Medium Companies and Universities

There are a lot of problems in the UICs of the small-medium companies and the number of successful cases where proceed to commercialization is limited. It is important to understand that the joint research projects are conducted at which stage from the basis to the commercialization in order to develop the joint research projects to the commercialization. Therefore, the problem in the UICs of the small-medium companies is made clear and the factors of successful cases where proceed to commercialization are discussed.

The stage map from the basis to the commercialization for the collaborations between small-medium companies and universities was made based on these results in addition to the case studies and experiences of the author. Figure 6 shows the made stage map. The management is important. The following management is required in order to develop the joint research project to the commercialization: The target is made clear and is shared at development stage as shown in Figure 6. In addition, each role is recognized and the management from bird's-eye view is properly conducted. The concrete items of the management are the target in the whole project, the setting of time, the milestone of each subject, the secure and distribution of fund, the grasp and adjustment of progress, and the treatment of outbreak thing etc. The result of research is applicable to practical use and is excavated at research stage. The university researchers can tackle without discomfort at this stage. We believe that the UICs are conducted smoothly at this stage. On the other hand, the style at development stage is different from radical style in universities. In addition, the results are required in the restriction of short time relatively. Therefore, university researchers are not familiar with this stage and the conflict is apt to occur between the companies and universities. For this reason, it is important to overcome this development stage through the collaborations between small-medium companies and universities in order to develop the joint research projects to the commercialization.

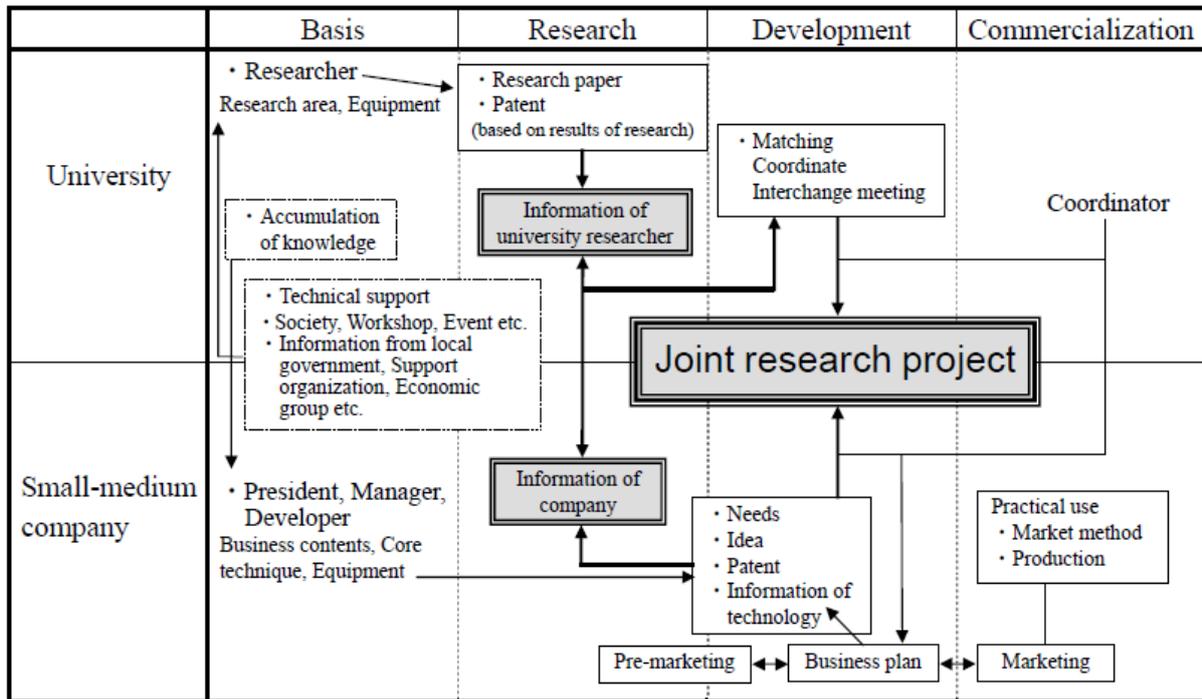


Figure 6. Stage map for collaboration between small-medium company and university.

We consider that the role and target are enough recognized, and the self-sufficient function is needed in the case of the collaborations between companies and universities, namely, the collaborations between different sectors. The researchers and developers in companies and universities can confirm the flow and position of the whole joint research project, and the direction of this project from bird's-eye view. This aspect is shown in Figure 6. The presidents, managers, and developers of small-medium companies, university researchers, and coordinators between companies and universities etc. can grasp the basis, research, development, and commercialization. This map is expected to use for stage map confirming the present position and the direction to proceed next. Hereafter, we will modify and improve this stage map supporting the UICs and investigating successful cases through the collaborations between small-medium companies and universities. Therefore, we believe that the collaborations between small-medium companies and universities are systematized and the economics are promoted when the successful cases are increased and accumulated.

Conclusions

In this paper, the collaborations between small-medium companies and universities were analyzed based on joint research projects in order to clarify the structure of university-industry collaborations. The results showed that the joint research projects of small-medium companies for collaboration partners comparing with those of large companies were not conducted enough considering the numbers of large and small-medium companies in Japan, respectively. Moreover, the results also showed that the average budget per project of small-medium companies was rather lower than that of large companies. The active area of company and university in research and development was discussed. The results showed that the active area was narrow in the small-medium company although the conspired area was wide in the large company. The stage map that proceeds to commercialization for the collaborations between small-medium companies and universities was

made and discussed. The map is expected to use for stage map confirming the present position and the direction to proceed next. Based on these results, the problems of the university-industry collaborations of small-medium companies for collaboration partners were extracted.

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