

# **Collaboration between industry and academia making use of cutting-edge research in the field of supercritical science**

## **(Part I)**

### **— University licensing of research results to industry, Launching entrepreneurial ventures**

#### [ Theme of this case ]

This case aims to examining the conditions of actual collaborative R&D project between industry and academia in Japan. And also, to understand the importance of entrepreneurial start-up company by using the results of collaborative R&D conducted by industry and academia.

#### Cast of characters

Professor Miya, Applied Chemistry, Department of Engineering, Tobu University

Graduate student Shima, Applied Chemistry, Department of Engineering, Tobu University

Mr. Akita, a researcher in the R&D Department, Major Chemical Manufacturer A

Director Iwate, Corporate Officer, R&D Senior Manager, Mid-sized Vacuum Equipment Manufacturer B

This lesson is based on a true story, but details like the names of the companies, type of business, and names of the people involved have been changed.

In the spring of 2001, Professor Miya was appointed research professor of Tobu University, Japan’s leading research university in supercritical science. He launched a research laboratory aiming to create a new functional material by developing a supercritical reaction mechanism. In the fields of supercritical science, a large number of academic papers had already been published and it was a mature field. But Professor Miya, who had taken his doctor’s degree in chemical engineering, thought that this field had large potential with the developments of nanotechnology.

At the annual Applied Chemistry Conference in the spring of 2002, Professor Miya and his second-year graduate student Shima presented “Discovery of new functional material a1 that utilizes a supercritical reaction.” As a result, two companies proposed joint research projects about the new functional material. One was from Mr. Akita, a researcher of Company A, which is one of the largest integrated chemical manufacturers in Japan. He was interested in a1 and its solvent E, and wanted to examine the possibility of having a1 completely disperse in solvent E (provisionally, “e1”). The other one was Senior Managing Director Iwate, the head of R&D at Company B. He was interested in supercritical manufacturing equipment with high expectations that it could be applied to a wide range of industrial applications, because he worked at a mid-sized company that manufactured vacuum equipment.

Professor Miya was pleased to receive both of the offers. However, he found it difficult to decide which of the companies he should carry out joint research with. This was partly due to the fact that, as a recently appointed professor, Miya had a very small group of four students and a small research facility, with no research staff. It was impossible to carry out joint research with both of the companies. The proposal from Company A was not a challenging theme for Miya actually. And it was relatively easier to estimate the possibility of commercialization when a1 completely dispersed in solvent E. This solvent E was widely used in the manufacturing processes of Company A’s products. And because Company A was a huge company that provided materials to a wide range of industries, such as the motor vehicle, steel, rubber, electrical and electronics, and food processing industries, Miya anticipated there would be a wide range of a1 applications with the top-rank R&D ability and facilities of Company A. Hence, Miya thought that this joint research could be a trigger for further collaboration opportunities. On the other hand, there were also attractive aspects about conducting joint research with Company B. Miya had previously thought that as long as his team worked enough hours and used enough research staff members, only the academic research team could successfully develop the new functional material a1 without an industrial partner. But the most important thing was to have a1 mass manufacturing equipment to make it possible to supply a1 cheaply and steadily. To accomplish this, the know-how of an advanced equipment manufacturer was a key issue, and Miya felt that Company B was a good candidate in that respect. Since Director Iwate was a top-level R&D manager, Miya thought that future interactions would be smooth. He also thought that the capabilities of a middle-sized company would further enhance joint research. In the end, however, he decided to conduct the joint research with Company A. Because he attached importance to focusing on developing a1 for a wide range of industries, expecting that would bring merits for future research.

The joint research project that was launched in the fall of 2002 benefited not only Professor Miya, but also the overall activities of his research team. Researcher Akita, who was dispatched from Company A, came to Tobu University for about one week each month. Because Miya's laboratory was not so spacious, although Akita was an experienced researcher at a big company, he had to experiment using the same equipment and at the same tables as students. Because Akita usually stayed in the lab from early in the morning until late at night, he knew the students well, and was particularly friendly with Shima of D1. They often had meals and drinks together after they finished their work late at night. At such times, they analyzed data and discussed the progress of the research. Akita's boss (the leader of the R&D group of Company A) also attended the monthly meetings to catch up with the progress of the research. And at the get-togethers afterward at night, they developed a good relationship with each other, so that they would freely discuss the potential of their research.

The joint development project had an initial contractual period of a year and a half, going up to March 2004, and a budget of 350 million yen. It progressed smoothly, and the members learned quite a lot about a material that would completely disperse in solvent E. Akita was excited about the research, and a good relationship developed between him, Professor Miya, and the other personnel participating from Company A, including Akita's boss. Another factor contributing to the success of the project was the participation of Shima, a doctor course student. The main topic of his doctorate thesis was controlling processes related to a supercritical reaction. Shima's wide-ranging knowledge about cutting-edge academic research, as well his good knowledge on the failed experiments, enabled him to make important contributions to planning the experiments. Because Shima wanted to have an academic career path after taking his Ph.D., it was essential for him to be a first author of a major academic paper. So, he wanted to submit to a top-level journal a paper entitled "Control reaction of material group e1 exhibiting complete affinity to ethanol-based solvents" that he had spent one and a half years working on.

However, the subject of the paper was about the overall control of reactions in ethanol-based solvents, and it was closely related to the joint research with Company A. When Shima asked Akita for advice about the paper, Akita said that publishing such a paper at that stage would not please the company. Actually, there had been no clear provisions made in the contract in relation to presenting the research results in academic conferences and journals, applying for patents, or such like. But Shima was worried about damaging the good relationship that had developed with Company A, so he restricted the paper's subject to "Generation of

material group e1, which has complete affinity,” and submitted it to a second-level journal.

At the regular monthly meeting in November 2003, the members discussed what would happen after the term of the contract expired next March. Company A was satisfied with the results of the first joint research effort (hereinafter, “first research period”). It proposed a two-year joint research project to be launched in March 2004 with a budget of 5 billion yen, and this would be called “New functional material a1, which completely disperses in solvent E” (hereinafter, “second research period”). Professor Miya had already been a star scientist doing joint research projects with several industries, such as motor vehicle manufacturers and medical device manufacturers. However, even though he had already acquired a distinguished professor status at Tobu University, he never had experienced such a big project. Accompanying the increase in the proposed research budget was a similar increase in his responsibilities, and he was somewhat worried. On the other hand, he had already developed a good relationship with Company A, and also thought that the theme of the second research period was promising. And the most important thing for him was the success of supercritical research which used in wide range of products; therefore, he expressed his basic intention to agree at the meeting.

At the next regular monthly meeting in December 2003, the concrete conditions of the second research period were proposed by Company A. The biggest differences with the first research period were: 1) the unit of Company A in charge of the project would be changed from the R&D Department to the Business Development Department for Organic Synthesis Group, 2) the experiment would be worked on by a three-member team at the Kawasaki Plant of the Business Development Group (not at Tobu University), and 3) Akita who belonged to the R&D Department would continue to participate in the project as a member of the Business Development Department. Accompanying these changes, the supercritical reaction apparatus jointly used with students at Tobu University during the first research period would also be set up at the Kawasaki Plant. On the basis of his previous experience in joint research projects, Professor Miya emphasized the advantages of conducting the research at the university. In particular, in the development stage, the environment can influence the reproducibility of an experiment, even when the same apparatus is used. The apparatus in the Tobu University lab was special equipment that had been customized by various modifications and improvements carried out primarily by Shima during the research project; that is to say, it was not apparatus that could simply be purchased on the market. However, Company A also had circumstances to deal with, and in the end, it was determined that one of the new researchers would be dispatched to the university for a certain period. During this time, he would study the experimental protocol

and the like, and acquire the necessary know-how.

Two of the new people from Company A that would carry out the research spent approximately six months acquiring basic skills in conducting general experiments. They then started conducting such experiments with the supercritical reaction apparatus that had been installed at the Kawasaki Plant. However, there were some technical problems with the apparatus. So Shima was appointed as an extraordinary researcher of Company A, and he provided support at the Kawasaki Plant for approximately four days each month. Meanwhile, Professor Miya had been receiving requests to give lectures at academic conferences internationally. He also held a symposium on a new era in supercritical science. At the same time, there were an increasing number of requests from industries that had sought technological consultations and requested samples. And Professor Miya, along with Shima, found it increasingly difficult to meet the requests. In fact, they had started joint research projects other than the one with Company A. But to meet the needs of each company, the commercially available apparatus had to be greatly modified for use in the experiments. This drastic modification was required in order to achieve optimal control of the reaction process. In order to meet the various needs, a small group was formed centered on Shima in Professor Miya's laboratory to concentrate on the supercritical reaction control apparatus itself as the research theme. However, modifying the apparatus for the purpose of supplying samples to each of the requesting companies was more like technology development than academic research. It was not something that could become the subject matter of a master's thesis or a doctorate thesis, and this troubled Professor Miya. On the other hand, the know-how gained through carrying out the modifications necessary to meet the corresponding demands of each company was extremely valuable. It was possibly the greatest knowledge acquired by Shima, who had been the main person handling the modifications. On the basis of this experience, Shima had begun considering launching a new venture himself, called Company C. He thought the new company would focus on supplying new functional material samples, evaluating the physical properties of materials on a commission basis, confirming the viability of evaluation processes, and manufacturing apparatuses. Professor Miya also thought that plan was good, and the Tobu University Industry-University Collaborative Office was actively supporting the launching of entrepreneurial ventures. However, while the business plan was being worked out, it was not possible to sell for a profit samples that had been produced using university facilities. And also, Company A asked Shima to thoroughly organize the inventions he had developed while working as an extraordinary researcher. In reality, it was very difficult to do this. So because he wanted to maintain his relationship with Company A, in the end, Shima gave up on launching a new venture named Company C.