論説 Commentary

Academia's role in preparing for the future of Japan's chemical industry

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Introduction: Study Group on Visions of the Chemical Industry

The Ministry of Economy, Trade and Industry set up the Study Group on Visions of the Chemical Industry in November 2009 for the purposes of identifying challenging issues concerning the Japanese chemical industry and examining measures to cope with such issues. To this end, the study group concentrated on discussions for the six months to April 2010. Its committee has consisted of not only presidents or chairpersons of 10 major chemical companies, but also the chairperson of the Japanese Federation of Energy and Chemistry Workers Unions (JEC), two security analysts, and, from the academia side, one business scholar with a deep insight into the chemical industry, one economist also with substantial knowledge of the chemical industry, Professor Noritaka Mizuno (Department of Applied Chemistry, School of Engineering, The University of Tokyo), and this author as the study group's leader. We have learned that this was the first time so many top executives of leading chemical companies gathered together. In addition, the subject was directly related to corporate management policies. So it was no wonder that the discussions proceeded in a tense atmosphere. This article will start with a look at excerpted contents (namely the part especially related to the academia side) from the study group's report, which was compiled in April 2010. Then, this author will suggest what roles academia should play in pursuit of further development in the Japanese chemical industry.

Excerption (1) from the study group on visions' report: Current status of the chemical industry and changes in its environment

According to the recent multi-annual data where the top 5 diversified chemical companies' petrochemical divisions and their non-petrochemical divisions have been compared, the two groups show almost the same performances in terms of sales, but operating profit of the latter group is at least twice as large as that of the former group and the gap is expanding year after year. The Japanese chemical industry excels especially in functional chemical products, which have formed a basis of the global dominance of the Japanese automobile and telecommunication equipment industries. And yet, it is imperative to continue to develop new products one after another ahead of foreign rivals because there is a limit to the lead period during which individual products can maintain their global dominance. Moreover, effective and efficient R&D is essential as the lead period tends to get shorter at an accelerated pace. In recent years, however, foreign rivals have established research bases with expensive advanced facilities in the field of semiconductor devices and related materials, and the shift to the open innovation-type research system has been rapidly proceeding on a global scale. It gives us the impression that Japan seems to have missed these trends. Additionally, in terms of human resources capable of being engaged in R&D activities, there is a tendency that fewer Japanese students want to major in science and engineering courses when they go to university. With regard to doctoral degree holders, some critics have pointed out that desirable doctoral degree holders as human resources in the eye of industrial world are different from ideal doctoral course students in the eye of academia or university education and that the gap is widening.

Excerption (2) from the study group on visions' report: Challenging issues and future efforts in the chemical industry

With the above issues in mind, the study group classified the chemical industry's challenging issues into the following four categories in an orderly manner: (1) international development, (2) shift to higher value-added segments, (3) sustainability, and (4) enhancement of technological capabilities. Then, the group members discussed directions and specific measures to cope with these issues in each category. The findings were compiled in a report. Among the reported findings, this article will focus on those in the category of "enhancement of technological capabilities."

In order to enhance technological capabilities, "R&D" and "cultivation of human resources" are the so-called two wheels of the same cart. With regard to the first wheel or R&D, it has been confirmed that **R&D projects addressing social issues should be speeded up** and that green innovation, including its commercialization, should be proactively promoted. Furthermore, it has been articulated that the government should provide support in order to speed up R&D projects which are designed to solve these social issues. As one measure to achieve these goals, assessment and R&D bases, which will be intensively equipped with expensive prototyping facilities and assessment facilities, are expected to be developed in a proactive manner. These bases, when established, will attract excellent material manufacturers and academic researchers and will further call in users. In this way, these bases are highly expected to promote fusion studies and vertical collaborations with new users.

With regard to the second wheel or cultivation of human resources, the study group's report contains the following highly specific descriptions: "The industrial world will convey vigorously to universities its common needs including desirable types of human resources. Then, based on the articulated needs, new programs will be created to cultivate human resources. Under such programs, **the industrial world will select advanced courses and the like, which have doctoral courses and other curricula to meet the industrial world's needs. Brilliant students in the selected advanced courses will receive scholarships from the industrial world and thereby will be financially supported. These doctoral course students, who meet the industrial world's needs, will also be actively recruited.**"

The above has been excerpted from the report compiled by the study group on visions. Based on these descriptions, the roles which academia is expected to play for the future of the chemical industry can be summarized as follows: (1) To provide research outcomes which can lead product development, and (2) To produce excellent human resources capable of being engaged in distinguished research activities. Therefore, in the following sections, this author intends to analyze the current status and raise issues in each of the two roles from the viewpoint of academia.

Academia's role (1): To provide research outcomes

We can say that the level of Japanese research in the field of chemistry is extremely high by international standards. In fact, there are various documents which objectively present supporting evidence for this statement. Nevertheless, the industrial world and the government do not always highly appreciate the outcome of academic research. Or

rather, it would be more appropriate to describe their evaluation as "extremely low." For example, recentry, harsh criticisms such as "Scholars do their research only for their own interests, and their achievements hardly contribute to society" or "Their thoughts concentrate on their own field of science. I suspect that they lack enthusiasm to contribute to Japanese industry" have been heard increasingly more often at government councils and other panels.

Surely there are many excellent basic research results, but it seems that few of them contribute to society. It may be also true that excellent researchers are deflected to the field of basic research and that they tend to disrespect downstream research projects. In a sense, this might be inevitable, because the ultimate aim of academics is to create disciplines. To this end, it is necessary to generalize individual phenomena. Articles will be qualified to appear in high-quality academic journals when authors are able to generalize their arguments. If researchers can accumulate such experiences, they will be qualified to join the society of the best and brightest by international standards. When this happens, it will be the happiest moment for any scholar. In contrast, downstream research projects need to be specific. Inevitably, they concentrate on particular cases. As a result, they are considered to have low academic value, and it would become extremely difficult for their articles to appear in high-quality academic journals. To put it plainly, high-level researchers hesitate to participate in such downstream projects. They have a lot of good reasons to think in the following way: "I will concentrate on basic research. It is my responsibility to pass on the excellent outcome of my basic research to engineers and/or researchers in the field of application." And yet, they should recognize that basic research achievements extremely rarely lead to new products in a spontaneous manner, no matter how excellent their research outcome is. The outcome of basic research can be socially accepted only when it is received by the kind of excellent talent that has the good fortune to solve every new problem one after another in the application field.

Now let me introduce my experience. I have been involved in all processes ranging from basic research and application research through to product development in the field of photocatalyst. I have to admit that it was extremely difficult for me to publish an article when I was involved in application research, let alone in the phase of product development; although I could write articles which appeared in prestigious journals when I was involved in basic research. Nevertheless, when I was involved in downstream research projects close to products, I could feel a different kind of joy or pleasure strongly, which could not be derived from basic research. My experience has also told me that know-how for basic research can be extremely effective for downstream research projects as well in many other cases. Above all, I would like to underscore the following fact: Joint projects with researchers in different fields and/or continuous two-way information exchanges with corporate staff with deep knowledge of markets have been highly effective for the further development of initial outcomes, and such development has in turn triggered new ideas in basic research.

I would like to encourage exceptional basic researchers to participate in application research and product development processes with interest rather than sticking to their own professional field of basic research. To make this happen, the above-mentioned assessment and R&D bases to be established in the near future will become effective platforms. For that matter, I would add that such excellent basic researchers should demonstrate their abilities as project leaders who are in charge of the entire R&D program from the upstream to the downstream.

Academia's role (2): To produce human resources for research

Among human resources for research, this section will focus on senior-level talent with a doctoral degree. Concerning the doctoral education, requests from the industrial world to academia can be summarized as follows: "We would like you to cultivate not only your successors but also human resources who will be able to become leaders on the strength of broad knowledge." This means that, from the viewpoint of the industrial world, it is certainly necessary for senior-level research talent to have deep professional knowledge, but it is at least equally necessary and important for such talent to have the abilities to find and solve problems. In addition, communication skills, management skills and other basic skills as a full-fledged member of society are also emphasized. By the way, such human resources are just as desirable in academia.

However, the current education curricula for doctoral courses concentrate on research programs for writing doctoral theses, while other menus such as schooling are hardly provided. We on the academia side must face this reality and should regret that we have not yet fully lived up to the industrial world's expectations. To reveal another reality, the proportion of research expense to be financed by competitive funds has been increasing in recent years, and demand for research outcomes has become stronger year by year. Under such circumstances, doctoral course students have been also placed under heavy pressure. In order to cultivate promising human resources, strong determination will be required to consciously reform the current situation.

As described in the foregoing section, the study group on visions passed a resolution stating that the industrial world should create a scholarship system for doctoral course students in the near future. This resolution represents the industrial world's determination to get actively involved in the curriculum creation for doctoral courses. Academia should not regard this movement as interference in internal affairs, but should consider it as the advent of good advisors for the institutional reform toward the cultivation of human resources. Information and opinions should be actively exchanged between academia and the industrial world.

Conclusion

Vitality is about to evaporate from Japanese society entirely. However, the chemical industry still maintains vigor in a relative way. And yet, when I listened to arguments at various study groups, most of them expressed an extremely strong sense of future crisis among business executives and government officials. Academia cannot afford to become the only exception by shutting itself out. For the sake of the future, academia should now deepen cooperative relationships with the industrial world. Meanwhile, the industrial world and the government entities (especially the Ministry of Economy, Trade and Industry (METI) in this case) are asked to understand that having a long-term view is extremely important when it comes to education-related matters. Based on this understanding, they are expected to give due consideration to the continuity of measures and policies.

The first half of this article was written on the basis of the report compiled by the Study Group on Visions of the Chemical Industry, but the excerpted part in this article is only a small portion of the entire report. Therefore, this author is personally accountable for the selection and summary of the contents. Also please refer to METI's website at the following address, where you can find the full text of the study group's report in Japanese.

(*Kagaku Bijon Kenkyu-kai Houkokusho* (Report by the Study Group on Visions of the Chemical Industry): http://www.meti.go.jp/press/20100430004/20100430004-3.pdf)

The commentary shown here is written by one of the members of the Commentary Committee of the Society, and the author is basically responsible for the contents. The Society acknowledges that this is important and worth publishing. Opinions and comments of the readers are highly appreciated.
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