Launch of AIST journal *Synthesiology*

― Discussion with Japanese researchers at the University of Illinois at Urbana-Champaign ―

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This paper presents the discussion with Japanese researchers of computer science at the University of Illinois concerning the launch of journal *Synthesiology* and the underlying philosophy of AIST. Based on questions and comments that were raised in the discussion, we indicate current problems and issues that must be considered in the future for the journal.

1 Background

This article is a commentary based on the discussion between the authors and the Japanese researchers at the University of Illinois at Urbana-Champaign (UIUC), concerning the journal *Synthesiology* launched in January 2008 by the National Institute of Advanced Industrial Science and Technology (AIST).

First, we briefly describe the background of how this article came to be. Ohsaki, one of the authors, was conducting the research on system verification and tree automata at UIUC for one year starting June 2007 in the AIST overseas research program. His research activities at UIUC include giving lectures to graduate students to explain his research, and managing seminars for Japanese researchers in the computer science field (CS Seminar).

The CS Seminar started in August 2007 as a place for exchange among UIUC Japanese researchers. The objective of the seminar was to introduce stances of individual researchers of different disciplines. The seminar participants could make comments or ask questions based on their own experience and knowledge. The seminar also provided a forum for free discussion after presentation by the topic provider.

The backgrounds of participants became apparent as more seminars were held. Even in same computer science field, research styles and involvement with society through research differed greatly. Positions as university faculty, graduate student, or researcher seemed to influence the ways of thinking of individuals.

Using the opportunity provided by the CS Seminar, on March 2008, Ohsaki served as a topic provider to introduce the new journal and the underlying principle of AIST, followed by discussion by seminar participants. We had absolutely no clue to whether AIST's new challenge would be treated as mere self-gratification or whether people outside may have clearer view of the course of AIST than the people inside the organization.

The *Synthesiology* Editorial Committee had initially suggested us a roundtable talk. However, we did not employ the committee's proposal because we did not want to interfere with the free discussion atmosphere and we wanted to make our statement.

Therefore, the text is mainly speculation by the authors while citing comments of researchers who participated in free discussion at the seminar.

2 Academic research and fieldwork

Full Research, which is goal of AIST, is composed of three types of researches: *Type 1 Basic Research*, *Type 2 Basic Research*, and *Product Realization Research*. We explain the terminologies and basic concepts according to the article on *Full Research*[1].

Type 1 Basic Research is defined as "research to create new knowledge that is not in conflict with the discipline of knowledge based on the specific knowledge of the closed discipline." This research attempts to gain new knowledge that is independent and does not mutually interfere with existing knowledge, to organize new knowledge, and to contribute to the overall knowledge system. In general, it is known as "academic research."

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Type 2 Basic Research is defined as "research to create something that is socially perceivable by fusing knowledge not limited to certain discipline and by creating new knowledge as needed." The research process is unique since there is no limit set on discipline. It is known to produce less visible results in form of papers even if it is equally hard work as conventional research, because research process itself is not considered to be research result according to conventional academic standard. It is also characterized by various research risks such as requiring long time before tangible results can be obtained, and is often wrought with extensive problems that must be solved before further research can be continued.

However, activities that pursue result wanted by the society using specialized skills and knowledge create opportunity where basic research and society can recognize each other. At the Research Center for Verification and Semantics where Ohsaki is currently affiliated with, research in which society is observed and framework for explaining it is created is called "fieldwork"[2]. This style of research can be an instance of *Type 2 Basic Research* according to the definition as described above.

On the other hand, it is difficult to immediately understand the concept of the two basic researches that is not yet widely accepted, only by written description. Therefore, schematic diagram shown in Figure 1 was used to explain *Type 1* and *Type 2 Basic Research*es in the CS Seminar.

Two basic researches were represented by two ovals on left and right. Mutual interaction of the two basic researches was explained as large arrows going from one to the other. The flows from *Type 1* to *Type 2 Basic Research* were explained by large arrows that connected the ovals. Also, to explain the characteristics of two basic researches, we explained that *Type 1 Basic Research* was composed of self-contained circular motion, while *Type 2 Basic Research* was composed of motion that flowed across all disciplines.
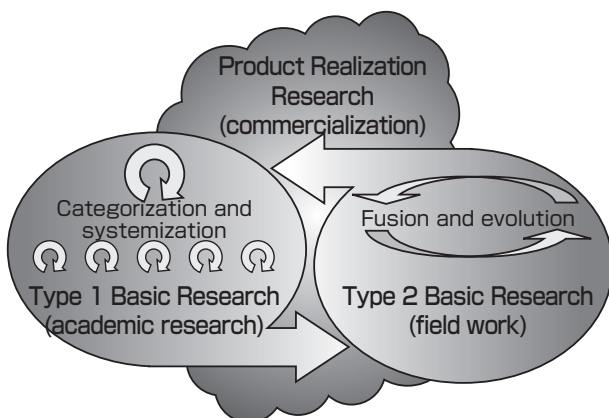

Fig.1 Two types of basic research.

Both *Type 1* and *Type 2 Basic Research*es can move on to *Product Realization Research*. Unlike the conceptual diagram in "Research Methodology to Realize Innovation"[3], we added a cloud representing *Product Realization Research* between the two basic researches. The Figure shows that *Product Realization Research* results from constant exchange between the two basic researches.

Some young researchers in the CS Seminar commented, "It seems difficult to conceive the image of shuttling between the two basic researches" (Daimon, one of the CS seminar participants), but there were no particular objections or questions to this explanation.

3 *"Type 2 Basic Research* = Practical Application Research" ?

In order to progress from results obtained in basic research to commercialization phase, it is necessary that all people who so wish can readily use the research result. This is flow from basic research phase to practical application research phase, and then to commercialization. On the other hand, as mentioned in the previous section as issue for *Type 2 Basic Research*, there is no guarantee that the basic research result will develop into successful business. Figure 2 shows the flow from basic research to commercialization and the problems often encountered.

For presentation up to this point, the following questions were raised by the CS Seminar participants. Honorifics of the participants are abbreviated.

[Minami] Then, is *Type 2 Basic Research* same thing as practical application research?

Practical application research shown in Figure 2 is one of the research phases that lead to future commercialization. It is an attempt to obtain research result in form recognizable to the society. Therefore, according to definition in the previous section, "*Type 2 Basic Research* ⊇ practical application research (if practical application research, then *Type 2 Basic Research*)" is justified. On the other hand, if "*Type 2 Basic Research* ⊆ practical application research (if *Type 2 Basic Research*, then practical application research)" is true, according to the diagram "Basic Research → Practical Application Research → Commercialization," the objective of *Type 2 Basic Research* is commercialization. However, in *Type 2 Basic Research*, researcher may wish to extract elemental technologies and investigate specific material, observe them with scientific eyes, and systematize this technique. The objective of *Type 2 Basic Research* may not necessarily be commercialization. Therefore, it is more natural to think "*Type 2 Basic Research* ⊋ practical application research."

Synthesiology claims itself to be journal for presenting

the result of *Type 2 Basic Research*[1]. Certainly, research processes, which are rarely considered as topics of paper in conventional practice, are important in *Type 2 Basic Research*. *Synthesiology* looks at the research processes and views them as paper topics.

Combined with discussion "*Type 2 Basic Research* ⊇ practical application research," we think it is correct to say *Synthesiology* is a journal for presenting the result of *Type 2 Basic Research*, particularly of practical application research (as described in Figure 2) and its research process.

Next, following comments were made about Figure 2.

[Sato] In some case of companies and projects, the exit of research is very clear, so the arrows may point the opposite direction. For example, when the image of the product is presented as development target (by request of business division), research is most often started by considering which basic research results are needed to fulfill the request and what kind of people will be assigned to the project.

For some companies that work steadily on product development or for those that try to get specific result in short-term research project, perhaps things will be accomplished by top-down management. However in *Type 1 Basic Research*, research is motivated by desire to "discover the unknown." Therefore, it is rare that newly found knowledge leads directly to commercialization. Particularly in research of basic science, it often requires long time before the result is put to use in the society or it may even get lost. Figure 2 describes the situations encountered by the researcher before the result of basic research reaches the commercialization phase.

In product development where the image at the exit is very clear, if one aspires to develop an extremely ambitious product, the result of basic research result needed to realize the product cannot be found easily. Therefore, to obtain totally new basic research result and to take the basic research result obtained to commercialization, the research is conducted along the flow shown in Figure 2. In this case, one can easily imagine researchers falling into the situations described in Figure 2.
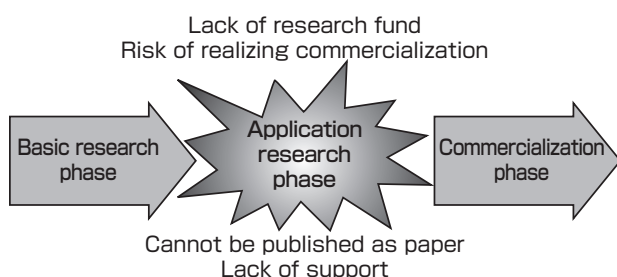

Fig.2 Research in practical application phase.

4 Behind-the-scene stories and technical reports

In the introduction of the launch of new journal, there is following passage: "…These technology integration research activities have been kept as personal know-how, however. They have not formalized in universal knowledge." Comments were raised that this claim may cause misunderstandings.

[Sato] The new journal says that it will publish research process of *Type 2 Basic Research*, but it is already established practice in companies to write up process leading to commercialization and behind-the-scene stories of the project. Such articles are published as technical reports or company reports. The reports of other companies of same industry can be viewed in the company library. They are also available to general public.

For example, Hitachi Groups publishes the Hitachi Hyoron (http://www.hitachihyoron.com/) regularly to introduce new products and systems and to report the direction of business and technology. The title for February 2008 issue was "Special: Latest Technological Development in Electric and Energy Field"[4]. Unlike papers written by researchers of universities and research institutes, they contain descriptions of technologies and applications related to the new product, and stories during the development process, along with introduction of new products and system such as "Work on globalization of nuclear energy business" and "Features and application of Hitachi H-25 Gas Turbine."

Also, *Mitsubishi Electric Technical Report*[5], *NEC Technical Report*[6], and *Toshiba Review*[7] are distributed free on the Internet, and can be viewed by anyone. *NTT DoCoMo Technical Journal*[8] and *Toyota Technical Review*[9] are sold as magazines.

Company and technical reports introduce and explain the activities within the organization, and in most cases do not accept submission from outside. Also articles that depart from philosophy and goal of particular corporation are not likely to be published. Also, some research fields have culture of not wanting to include knowledge of "what ought to be" and synthetic judgment. In this situation, even if the researchers who are grounded in basic research make some synthetic judgment to make the result useful to the society, there are few receptacles that allow systematic discussion of such thinking.

5 Undisclosed research result

[Furukawa] In *Type 2 Basic Research*, I think there are many cases where case-studies become research result, but aren't there also many cases that cannot be disclosed due to non-disclosure agreements?

In companies, in principle, research results that link directly to profit are non-disclosed. For example, research on technology to increase yield of LSI is a major topic in the semiconductor industry. In general, yield is ratio of volume of raw material to volume of product. In the semiconductor industry, yield is the ratio of good products that show certain performance in all products produced such as IC chips and memories. Normally, yield is set at certain percentage to determine the product price. That means if the yield improves above certain percentage, the difference becomes company profit.

Therefore, the details of yield improvement technology for LSI are extremely sensitive information for semiconductor companies. Even if the researcher or technician at a company proposes idea to improve yield, it is general practice not to disclose that information outside the company including academic societies.

On the other hand, in principle, universities and public research institutes attempts to advance science and technology by using and diffusing accumulated knowledge. In reality, there are many cases where research results are intentionally not disclosed. If the research result is expected to cause economic loss, disclosure may be slowed or not done at all, to provide time to take measures against major loss. Also, in research whose objective is commercialization, results may not be disclosed due to strategic reasons. How were the results obtained? Are the results reproducible? Not disclosing the heart of research prevents the competitors who are also working on similar products from catching up.

There is choice of disclosing the research result as patent. It is choice when there is financial security to start the next phase of research after some progress in application research. However, since the screening period for patent may require two to three years, another choice is licensing where exclusive rights to use the research result is provided. In this case, the agreement is not to disclose the details at least during the agreement period. As result, since not much can be written up as paper, outsiders make evaluation like "the research was done but not much result was obtained."

Negotiations and agreements on how much can be published as academic paper are settled prior to starting research. Here, the research leader's ability to negotiate wisely with future development in mind greatly influences how much can be written in the paper. The "Japanese-style valley of death of research" where excellent research results fail to become innovations is said to be result of poor leadership. The result that can be disclosed differ greatly depending on the leader.

In *Type 2 Basic Research*, particularly those that aim at commercialization and product realization, we can see that the results may not be disclosed for various reasons. However, *Synthesiology* was not created as refuge for researchers who do not have a place to make their statements. The objectives of this journal are to record matters that researchers feel that other researchers should know, and to reconstruct and use accumulated knowledge.

6 Expectations and doubts for *Synthesiology*

There were many comments on expectations for future activities of *Synthesiology* as journal to publish results of application research and its research process. On the other hand, there were comments that contrary to the wish of the journal to publish good papers, good papers may seek publication in traditional academic journals.

[Sato] From the standpoint of someone (outside of AIST) wanting to submit papers, higher the quality of the paper, it is natural that they wish to submit papers to renowned, traditional academic journals. Papers for commercialization and product development are also accepted if they are innovative businesswise or superior as product, so may not be necessarily the priority to submit the papers.

This problem is common to all newly launched journals. *Synthesiology* tries to extract certain laws and general theory for "synthesis" from a posteriori knowledge. Therefore, by targeting researchers who wish to have their papers evaluated from the perspective from synthetic learning, compartmentalization with traditional academic journals is possible. Also, *Synthesiology* has role to transmit messages to researchers who wish to establish *Type 2 Basic Research* as a discipline.

On the other hand, as indicated in Section 4, many companies that do research, development, and product realization publish article on application research results and R&D process in their company publications and disclose them to the public. *Synthesiology,* as a new project for AIST, also tries to publish articles on application research results and R&D process. Therefore, one will be unable to see difference with corporate technical reports if only this point is emphasized.

Papers that discuss research processes of basic research way before product realization is basically different from articles of corporate technical reports. Even if majority of the papers published in *Synthesiology* are submitted from within AIST, it will be strike a chord in people outside AIST if they describe what kind of thought process researchers have when they are sandwiched between academia and society, and how they sublimate their research.

Whatever it is, we must look at the future of the *Synthesiology* to draw conclusions about success or failure of the new journal.

On the other hand, it can be said that any research is worthy

of publication if the results and research processes contain universal statement.

[Inaba] I think the uniqueness and value of *Synthesiology* can be claimed as open opportunity to publish behind-the-scene stories of research, without limiting the topic to results and research processes of application research. In that sense, AIST, which is the largest Japanese research institute for basic research, must have lots of researchers that can provide stories.

Can the famous "First Draft of a Report on the EDVAC"[10] written by John von Neumann at the dawn of computers be called paper of *Type 2 Basic Research* or a paper that described "ought" knowledge. At the time, computer technology was concealed as classified information. Particularly, there were only few papers that described the details of ENIAC, the predecessor of EDVAC[11]. The "First Draft" was more like an academic paper that comprehensively explained the architecture of stored-program computer (the archetype of current computer) from mathematician's perspective, rather than a technological document describing the state-of-art technology of the time. In fact, it was conceptual, though universal, explanation of basic components of stored-program computer and flow of arithmetic processing. Influenced by this "First Draft" and several papers by von Neumann that followed, stored-program computers were developed around the world after 1948, and diffused globally as standard of computers[12].

The example of von Neumann paper is perhaps a special case. However, following lessons can be learned from this example. In academic insight gained by studying, analyzing, and synthesizing the result of *Type 2 Basic Research*, boundary between ought knowledge ("value") and factual knowledge ("fact") is unclear. Indeed, even if the paper is composed only from factual knowledge, subjective statement of the author seeps out between the lines.

What then is a paper for ought knowledge? Traditional "scientific" paper is a paper formed of factual knowledge and thus conclusion is drawn from accumulation of facts. The conclusion, on the other hand, can be convinced within particular discipline of knowledge.

However, ought knowledge include subjective statements. Aside from apparent mistake, paper with stance of "no ought from an is" demands final judgment by the readers for appropriateness or even truthfulness of the statement.

On the other hand, if the stance that ought knowledge and factual knowledge are indivisible[13], the paper of ought knowledge is an opportunity to state conclusion drawn by accumulation of facts within the framework including social norms or values. There is possibility that truthfulness or appropriateness may become difficult to judge.

Regardless of the stance one takes in paper that discusses ought knowledge and subjective statement, the situation shunned by most academic journals is accepted, and ought knowledge papers now has opportunity for publication. *Synthesiology* states that it will accept this difficult situation as a journal to achieve its initial objectives. I think this stance makes this journal unique.

The problem of review process was indicated concerning the point that there were papers from multiple research fields.

[Sato] Submitted papers include those of diverse products and fields. Therefore, how do you maintain evenness of review quality, and how do you maintain fairness of review processes and results?

Discussion between reviewers and authors are published at end of each paper, to keep the review process transparent. Whether the quality of review is maintained or not can be checked by reading the discussion. Errors that can be verified objectively can be corrected in the review process, while the following points can be communicated: (1) how reviewers see truthfulness or appropriateness of statements (conclusions) that include subjective elements, and (2) that the final judgment is left to the readers.

For a new journal to ask submission of papers under its unique objective may seem arrogant from outside. However, if there are more people outside AIST who agree with the objective and attempt to increase the significance of the journal, the journal as well as the underlying philosophy of AIST will be justified.

[Minami] For that purpose, is raising awareness of the journal a priority, or is it to have people understand the objective of new journal launch?

There is no conclusion in the discussion of "chicken or egg." Rather than discussing the journal, perhaps the priority should be how to establish the unique concept of AIST where research is categorized into *Type 1 Basic Research*, *Type 2 Basic Research*, and *Product Realization Research* rather than basic research, application, research, and design development.

7 Summary

In the discussion at the CS Seminar, we had an opportunity to review the ideological objective of the journals, as exemplified by the launch of *Synthesiology*. Also, several issues that must be considered in the present and reviewed in the future were raised. They are not easy at all to solve. However, how these issues are resolved will be the key to success of new journal *Synthesiology*.

Acknowledgements

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