

One-year anniversary of *Synthesiology*

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One year has passed since the launch of *Synthesiology*. In its first year, four issues containing 24 research papers were published. We have attempted to present original research papers with a new style of expression that differ from those of conventional journals. We have received positive reactions from a wide cross section of readers engaged in a variety of fields, as well as from the authors and reviewers. On the one-year anniversary of the journal, the editors got together for a roundtable discussion to reflect on the first year and to speculate on the future of *Synthesiology*.

Synthesiology Editorial Board



Participants of the round-table talk

Dr. Hiroyuki Yoshikawa	AIST President
Dr. Akira Ono	Editor in Chief
Dr. Naoto Kobayashi	Senior Executive Editor
Dr. Akira Yabe	Senior Executive Editor
Dr. Motoyuki Akamatsu	Executive Editor
Dr. Koh Naito	Executive Editor

(Ono)

It has been one year since the launch of *Synthesiology*, and I would like to hear your impressions on the activities so far.

Importance of evolving through “metamorphosis”

(Kobayashi)

I am very glad that we were able to publish a new type of academic journal. I have puzzled for a long time over the question “What is synthesis?” . When I interviewed Prof. Richard K. Lester of MIT in March 2008 (see the interview article in Vol. 1 No. 2), we discussed three types of synthesis methods for inclusion in *Synthesiology* and realized at that time it was necessary to further refine the emphasis on synthesis. It is important not simply to gather and combine elemental technologies, but to discern the changes caused by the combination and to document how *Type 1 Basic Research* is transformed into *Type 2 Basic Research*. During this transformation, the research content must also undergo “metamorphosis.” This “metamorphosis” is critical for the transformation of *Type 2 Basic Research* into *Product Realization Research*.

Another point I feel happy about is to have published both English and the Japanese editions. Initially, we discussed whether the journal should be published in English or in Japanese, but we created both because we thought it would be insufficient to have one but not the other. Although, it

requires a lot of effort, I would like to continue the bilingual editions in the future.

Synthesiology was born from the enthusiasm of AIST

(Naito)

I was involved in discussions of *Type 2 Basic Research* and *Full Research* from even before the answer to the question “What is *Type 2 Basic Research*?” was widely known within AIST. Therefore my honest feelings are: “Finally, we got the journal started!”

About two years ago, interest in publishing a new journal rose rapidly in AIST, and staff members were united. It was finally launched in January 2008. I am deeply moved by the fact that it was actually launched.



Dr. Naoto Kobayashi

Re-appreciation of the “importance of writing”

(Akamatsu)

We created a journal from zero, and I think it was good opportunity to carefully consider, “What is a paper?” and “What is discipline?” In a conventional journal, there is a set writing style, but we suffered because we did not have one. On the other hand, because we did not have a style, we were able to rethink what “writing,” style was most appropriate and were thus able to more deeply appreciate the “importance of writing.”

We often engage in verbal discussions about *Type 2 Basic Research*, but it is important “to write them down properly” in prose. “To write down properly” here means to express the important points without insufficiency or excess, and only by writing, can one see what is insufficient and what is excessive. As I review papers, I am beginning to gradually see what are the insufficiencies and excesses.

“Visualizing” research to overcome the valley of death at AIST

(Yabe)

I have always told the people outside AIST, including those from companies and the mass media, “We can overcome the valley of death through *Type 2 Basic Research*,” and I think now we are able to allow people to “visualize” this process through the journal. For the first time, I was able to demonstrate *Type 2 Basic Research* and *Full Research* to people outside AIST.

There is substantial impact whenever I visit companies with the results. I tell industry-academia-government collaboration coordinators in various organizations who are working to revitalize small and medium businesses, “To overcome the valley of death, development in this area of technology is necessary.” They respond surprised, “I thought the valley of death could be overcome if we put in enough money in.” Last year, I was able to present the process convincingly. It was quite significant.

Reviewing is reading the logic

(Ono)

I totally share the opinions of the four of you, and I am reminded that we’ve been working toward certain goals. Personally, I have been thinking: “What is science?” “What is research?” “What is a researcher?” Since we became AIST, I have been thinking “What is *Full Research*?” I feel that *Synthesiology* provides significant answers to those questions, and I think it has been very successful.

I also encountered something unexpected, I surprised myself at being able to “read and understand” research papers of

different fields. Of course, I do read books and articles on research conducted in other fields, but I have never read the original research papers written by researchers of other fields. Even at academic meetings in my own field, I didn’t understand anything presented in a different divisions, and even in the same division, I could scarcely understand what was being presented if I walked into a different session. This time, I was surprised “I could understand” the research papers of other fields, and was even more surprised “I could make comments as a reviewer.” This surprise also lead to joy. I discovered this accidentally through working on *Synthesiology*, but I feel it was inevitable.

(Kobayashi)

It was also a great surprise for me that I could read and review papers from different fields. It was possible only because we discussed, shared, and accumulated what we have been trying to achieve. On the other hand, I can see the authors are struggling with great effort as they try to follow the submission guidelines. Rather than putting *Type 2 Basic Research* as the final goal, I would like authors to reflect carefully on the originality of the synthesis process and what is different from *Type 1 Basic Research*, or upon “What is synthesis in *Type 2 Basic Research*?”

(Akamatsu)

The ability to review papers is the ability to understand the underlying logic. Assuming that the details of the experimental method had been reviewed somewhere else in the context of a paper on *Type 1 Basic Research*, then, I just have to read and understand the logical threads and their combinations to reach the conclusion. Logic is the root of science. The age when modern science started and when René Descartes was alive almost coincided. Descartes pondered on how to understand the truth. I think this lies at the foundation of scientific methodology. In current *Type 1 Basic Research*, the logic to prove correctness is established, but in *Synthesiology*, the form of logic to be used must be considered carefully and the writer must think of how to build up the logic. Science-oriented people are good at logical thinking, and that enables reviewing.

Writing the logic of synthesis rather than the logic of a proof



Dr. Motoyuki Akamatsu

is the means to motivate the reader. By presenting the logical correctness of the synthesis procedure, readers may be moved to try it for themselves.

Synthesis can be written up as a scientific paper

(Yoshikawa)

Logic that moves people is a fascinating subject. Reflecting upon historical precedent, synthesis is more old than new. It was in the 1960s that I transferred from a research institute to a university, where I was initially engaged in the teaching of design. At the time, I was surprised at the poor situation in the teaching of design. Although the university claimed, “Design was the most important component in the curriculum, and it formed the core of the engineering department,” the gist of the course involved simply bringing in things designed by companies and copying them. The act of manufacturing is concentrated in the development of the product, but the professors could not teach anything about that. That was my starting point. Although the words “analysis” and “synthesis” existed then, I started developing my design course by thinking about how I could teach the process of synthesis. Because I took upon the study of design as a theme I became isolated in academic society and couldn’t get my papers accepted for five years. I maintained my interest in synthesis, and worked hard on devising a way to write a paper on the study of design.

When I first presented my studies on design at an international conference in 1985, I found that it was well accepted, unlike the situation in Japan. An academic society of dedicated to the study of design was subsequently started, and it became clear that synthesis was not compatible with the conventional style of writing papers.

Of course, companies are engaged in synthesis, but the process and results are not published as documents. I said, “The results of the intellectual activities carried out in companies may remain in the form of products, but the processes leading to their development are ‘scattered like clouds and have disappeared like mist,’ and will not be handed down to the next generation. This is a great loss to humankind.” When I came to AIST, I found that there were people working on this issue! That was a great surprise and made a deep impression on me. I can write papers on synthesis here. On the other hand, I realized that I couldn’t do it alone, and it must be a collaborative effort. In the first year I came to, AIST, I became convinced that synthesis could be developed into a scientific papers through decisive action.

One year later, I invented the word “*Full Research*.” The composition of the research units was indeed *Full Research*. Looking back, it was one of the actions that paved the way to *Synthesiology*.

“Place” to logically express the passion of researchers

(Ono)

What are your impressions of reading the *Synthesiology* papers?

(Yabe)

In *Synthesiology*, we ask the authors, “Please emphasize why your research went well. That is the point that appeals to people, and leads to a common methodology.” The authors understood this point and wrote appropriately. For example, they decided to write about meetings with people because discussions with certain people can lead to an innovation. Inclusion of such details helps to systematize the ways to overcome the valley of death. It is wonderful that the authors can write enthusiastically with our encouragement.

(Ono)

As Dr. Akamatsu says, logic is important and one should write as logically as possible. However, as Dr. Yabe says, there are challenging aspects, and some aspects slightly differ from logic. I call it “passion.” I think conventional scientific research only partially represents the intellectual activities of researchers. We engage in our research with “will,” “intent,” “passion,” and “hope,” but we remove all of these aspects from our research papers. I wanted to create a forum in which researchers are able to express and communicate the “whole picture” of their intellectual activities.

(Akamatsu)

I don’t think passion is necessarily removed from logic. Rather, the fun in the papers of *Synthesiology* is the fun of reading a story of how the logic is set up toward a certain goal, and I think that is the “importance of writing.”

(Yoshikawa)

Even the analytical papers are not entirely composed of logic. Sir Isaac Newton described the three laws - uniform motion, acceleration, and action-reaction - in the first three pages of *Principia*, but it doesn’t contain the description of how Newton arrived at the three laws. This is synthesis itself. One sets up a hypothesis, calls the hypothesis an axiom,



Dr. Hiroyuki Yoshikawa

and a good match with the observed facts can be achieved a derived from that axiom. This is, therefore, a verification, and is a scientific thesis. The creation of the initial axiom or hypothesis is an abduction or a synthesis, but the structure of the scientific thesis does not allow it to be mentioned.

However, in the actual practice of manufacturing, a certain hypothesis may appear, but the verification is done not by logic, but by synthesis in society. The order is changed. In the editorial policy of the journal, it says, “Describe your research goal.” This is very important for human behavior. However, conventional scientific papers have removed that. I feel strongly that science expresses only part of the process in the human thought.

No room for failure in the age of sustainability

(Akamatsu)

Technological development in terms of engineering advances because of failures. One makes something, it fails, therefore one realizes that a particular method doesn’t work, and one is forced to think how it can be made to work. However, enormous amount of time and social resources are necessary. Now, the demand is on how to minimize the failures.

(Yoshikawa)

In the era of sustainability, the room for failure is getting extremely small. Human activities and the consequences of their results, or the revenge against mankind, have been accelerated. Mistakes cannot be tolerated. Although re-evaluation must be done, there isn’t much time. We are in an era where the human ideal and the changing situation are in competition. Therefore, along with solving the extremely big problem of “*Synthesiology*” in an academic sense, it also must meet the demand of modern society.

(Akamatsu)

Perhaps it may be an exaggeration, but a person who can write such a paper is truly a wise person. I am certain that the wise people needed by society can be found in *Synthesiology*.

How can we help solve the social issues through *synthesiology*?

(Kobayashi)

There are data that indicate that recently Japan’s R&D efficiency (the ratio of the amount invested in R&D to the total additional value five years later in the relevant segment of industry) is lower than that of Europe and the USA. Japanese manufacturing has been considered great, but is now struggling. We hope we can contribute to Japanese manufacturing, but this is a social issue.

(Yoshikawa)

Type 2 Basic Research must be done, but even after *Full*

Research and *Product Realization Research*, the product may not get used. The process of “socialization” or “incorporation of knowledge into the society” is necessary, and this is beyond the framework of *Full Research*. The philosophy of *Synthesiology* helped demonstrate this issue.

What are the problems that impedes investment efficiency? Even if we work hard on scientific research, why isn’t it reflected in the economy? According to some studies, Japan has poor investment efficiency, but we can say it’s because the behavior of companies in “socialization” is poor. Product realization up to the finished product is done well. The rest is socialization. I call this “societal technology”, and I think there the main problem is that the “societal technology” of Japanese industry is immature.

Clarification of the logic of synthesis and methodology to overcome the valley of death

(Naito)

These words –“mass preparation,” “accessible design,” “low-cost production,” “risk assessment strategy,” “design and retail support,” and “improving reliability.” – are from the title of the papers of the first edition, and they are keywords that are not seen in ordinary papers. In 10 or 20 years, when the papers of this journal become a subject of study, I think one can see how the strategy of research will have shifted by analyzing these keywords. In the future, with the increasing importance of issues such as the environment and sustainability, the use of such keywords may increase, and the discussions on the underlying issues will become more clarified and focused.

As you are all saying, I think a journal structure where the reviewers and the authors collaborate with each other is important.

(Akamatsu)

Certainly. Reading the papers cultivates a keen sense of what one should do in the future. The word “connoisseur” appeared when I interviewed Mr. Umeyama of Toyota Motor. I think there are many points one must be learned before becoming a “connoisseur,” such as the different points of view of a the element being synthesized and the elements that



Dr. Koh Naito

can be combined.

(Kobayashi)

On the other hand, I feel that some people may misunderstand that one must have gone all the way to product realization in order to write the paper in *Synthesiology*. I think we should provide a place where people can write papers on their work at different stages of synthesis.

(Yabe)

Yet, I think the company people respond better to success stories. I think they become very encouraged when they read about some methodology on how to overcome the valley of death, or stories of “we succeeded because...” I feel that the journal can deliver a positive message to such people, and it will be accepted readily into society from this perspective.

(Yoshikawa)

I think the main readers of the journal are those who wish to read success stories, but I think it is extremely valuable for people who study “What is synthesis?” if there are papers written with no prominent results. When the discipline of synthesis is established, it will be a subject onto itself, so we should always keep this in mind and be keenly aware of what Dr. Yabe has mentioned.

(Ono)

The points of this journal are scenario writing and synthesis. Most of the authors can recall the scenario made and can even revise it. But I have found that sometimes they have trouble with writing about synthesis. Personally speaking, I can scarcely recall why I made certain decisions or took a certain process of synthesis.

(Yoshikawa)

I’ve been studying that process. I’ve studied the thought process of design, but I have failed entirely. I have totally forgotten what I’ve been thinking. The abduction does not remain in memory. The greatness of the editors of *Synthesiology* is that they started by asking the authors to write objectively what happened to them, regardless of the logical synthesis. I think that this is the correct way, and one can only write what he/she remembers. The process of ideation is very difficult.

(Ono)

Ideation occurs not only by one person thinking, but from ideas arising during discussions with others or when visiting someone else’s laboratory. Good research groups, I think, provide such places. I believe there are many creations of synthesis, or highly productive research groups at AIST.

(Yabe)

I think how to analyze and incorporate the writing in *Synthesiology* is an issue challenging us. I think the process

of analyzing and proposing the common methodologies for overcoming the “valley of death” will become very important, including topics such as why I did this for what purpose, for example to improve economy, to maintain environmental acceptance, or to reduce societal risks.

(Akamatsu)

In conventional *Type 1 Basic Research*, simply writing a paper is contribution to science, whereas the paper of *Synthesiology* must show the necessary capabilities in actually utilizing technology in society. By writing such papers within the company, one can appeal that he/she is a connoisseur or a human resource capable of integration, and should be able to move up to a better position. It should be used in such way.

Getting a patent only proves the capability of creating elemental technology. One should not just file patents or write papers on elemental technology, but should write papers that show he/she has the capability to integrate. The person should then be treated with respect in society for this capability as a result of writing such papers. We must create a science and technology society that allows that. I think creating such a social system is lacking in the science and technology policies.

(Yoshikawa)

In the old days, there was a sort of harmonic hypothesis in that if one wrote a research paper on *Type 1 Basic Research*, it could lead to a patent in some cases, and the society will absorb and use the new ideas which were presented randomly. That was innovation as stated by Joseph Schumpeter, but modern innovation won’t be realized unless we act swiftly. If we do not reduce carbon dioxide levels, global warming will progress and the humankind may become extinct. We must have a keen objective of how we can create the new technology to overcome the situation.

Therefore, company people should read this journal keeping in mind innovations are urgent issues on which they must work. The journal can serve as a guideline that shows how something like basic research, which seems to be floating in the air, can travel all the way to socialization. Researchers must realize that the motivation for writing papers in



Dr. Akira Yabe

Synthesiology is that we must change our mind by noting that science should be used eventually for solving problems. I think it is necessary to take this position.

(Ono)

Thank you very much. I hope there will be submissions to *Synthesiology* from companies and universities, and from abroad. I believe there is much to be gained by writing *Synthesiology* papers.

(December 19, 2008)



Dr. Akira Ono