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# Quantitative Analysis of the Organization of Scientific Knowledge° - A Case of Ecology and Civil Engineering as Mode2

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Recent years, in the fields of social science and history of science, it is said that we need an open system model with regard to the system of knowledge production to understand the close relationship between science/technology and economy/society. Michael Gibbons et al. (1994) proposed the mode theme based on such arguments. Gibbons looked into the diversity of researchers' background on the change of research systems in advanced nations. They concluded that this change is caused by conversion from mode1 to mode2. Mode1 is the style of the knowledge production performed in each field. Mode2 is the style of trans-disciplinary knowledge production performed in a social context. However, research on mode theme have been mostly qualitative so far, and there has been little study that uses objective data. How mode 2 functions in reality has not been tested yet.

In this study, the organization of scientific knowledge is defined as the process of systematization of dispersed and fragmented scientific knowledge and/or methods of scientific knowledge production by using a new concept that is not restricted by the norms of the existing discipline. It is a case study of the ecology and civil engineering field that was

born as an interdisciplinary domain of ecology, biology, and civil engineering.

The purpose of this study is to acquire further knowledge about the mode 2 by describing and analyzing the organization of scientific knowledge in ecology and civil engineering as the knowledge production in the mode2. Finding practical implications for activating the mode2 by interviewing participants in the mode2 is another goal.

Scientometrics and interviews were used as tools of analysis in this research. Scientometrics analysis used the bibliography information (author's name, publication year, affiliation, quotation reference) of the papers obtained by the keyword search on the reference databases, JOIS and NACSIS-IR. JOIS was offered by Japan Science and Technology Corporation (JST). NACSIS-IR was offered by National Information Study Research Institute (NII). Interviews were conducted on Kayaba Yuichi, the chief researcher of the Aqua Restoration Research Center of Ministry of Construction (ARRC) (June 27, 2000), Takemon Yasuhiro, Assistant professor of Department of Earth and Life Sciences, Osaka Prefecture University (November 30, 2000), Miura Yoshiyuki, the head of the OYO Corp. production engineering division ecology and civil engineering research institute and Saito Hiroshi of the OYO Corp. (December 6, 2000).

Based on the Scientometrics analysis, following were found:

- 1) Advocating the Neo-Natural River Reconstruction by the Ministry of Construction activated the research in ecology and civil engineering.
- 1) There are 3 groups that are Ministry of Construction related organization group, ecology engineering group, and ecology and biology group in the ecology and civil engineering field. Ecology engineering group was organized with Sudo Ryuichi (Tohoku University) and Inamori Yuhei (National Institute for Environmental Studies) as leaders. Ecology and biology group was organized with 25 people that are persons of Advisory Committee for the Facility Adjustment of ARRC(1999) and the ecology and civil engineering research study group officer(1997) as leaders.

Through the interview analysis, the followings were found:

- 1) Three groups were formed according to the differences in subjects or evaluation standards in each discipline.
- 2) In ecology and civil engineering, research was developed towards habitat, which is a trans-disciplinary concept. In the process, researchers in the civil engineering field were required to think on the scale of a living thing, and researchers in the ecology and biology fields were required to think of the natural environment with artificial influence.

- 3) The existing disciplines changed their evaluation standards of papers and the methodology of a subject setup so that they can realize the trans-disciplinary concept.

In conclusion, this study found that there were two factors that prevent researchers from participating in the socially significant mode 2. First, academically significant research and socially significant research are not necessarily the same. Second, socially significant research is usually an interdisciplinary research, and the methodology of interdisciplinary research hasn't been established yet.

The former problem is being solved by academics getting closer to the society. The concept of individuality, which characterizes the mode 2, disagrees with the concepts of universality and reproducibility, which characterize science. However, the gap between the academic research and socially significant research is being narrowed as the academics are starting to accept the concept of individuality.

With regard to the latter problem, it can be said that it is effective to systematize dispersed and fragmentary knowledge or a method theme of knowledge production in order to realize a trans-disciplinary concept. Public works projects that are relevant to the ecology and civil engineering by the government made it possible for the ecology and civil engineering to be developed.

Hence, as the practical implication of this study, we can say that enforcing mode 2 related public works is one of the effective methods to activate the socially significant mode 2 since it makes people with diverse background participate in the mode 2.

As the subject to future research, the effectiveness of realizing a trans-disciplinary concept by systematizing dispersed and fragmentary knowledge or a method theme of knowledge production should be tested in other interdisciplinary research.