The Japanese Science and Technology Indicator System

- Analysis of Science and Technology Activities -

(NISTEP Report No.19)

Second Theory-Oriented Research Group

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The Institute has published NISTEP Report No.19 "The Japanese Science and Technology Indicator System: Analysis of Science and Technology Activities". This report is a result of the continuous research, "Research on Development of Science and Technology Indicators", which was done during the three years from fiscal 1988 through fiscal 1990. The following is an outline of the report.

1. Purposes of Developing Science and Technology Indicators

1) Activities in science and technology are playing important roles for socio-economic growth and creation of richer lives of people. The roles are getting more important. Thus, when making policies, it is important to accurately grasp and evaluate the present state of science and technology activities based on quantitative data.

2)This report aims to develop a system of indicators that quantitatively grasp complex and diverse activities in science and technology in Japan, and make it available for wide use in policy-making and other activities.

3)In the US, National Science Foundation (NSF) biennially publishes indicators reports ("Science and Engineering Indicators"), and they are widely used in administrative departments. In Japan no such indicators exist so far.

2. Ideas in Developing our Science and Technology Indicators

1)"Science and Technology Indicators" indicate the state of activities in science and technology quantitatively.

2)Science and technology activities are extremely complex, so their state cannot be represented by a single indicator. A combination of many indicators is necessary.

3)In developing our science and technology indicators, we did the following to represent the complex science and technology activities as a whole appropriately:

- While referring to existing indicators, statistics, and research papers on indicators, and as a result of many times of discussion at research meetings (sponsored by Professor Nishikawa at Engineering Department of Kyoto University), we first systematically arranged science and technology indicators into a "cascade structure".
- Then we collected and analyzed data, and examined validity of indicators. In this process, we found that there were some indicators for which data was difficult to obtain and that some were inappropriate as indicators.
- As a result, we have organized about 70 indicators as follows:

(Organization of this report)

Introduction

Chapter 1 Science and Technology Activities in Japan (overall summary)

Chapter 2 Human Resources Development (primary and secondary education, higher education, careers of those completing higher education)

Chapter 3 Supports for R&D (government's S&T budget, societal support)

Chapter 4 R&D Activities in industry, Academia and Government (Current status of R&D, R&D in industry, R&D in universities, R&D in governmental research institutes)

Chapter 5 Regional R&D Activities (regional distribution of research institutes, regional distribution of researchers, R&D activities in private research institutes)

Chapter 6 Achievements of R&D Activities (scientific papers, patents, specifications and standards, achievements in S&T viewed from awarding systems)

Chapter 7 Internationalization of R&D (exchange of people, exchange of R&D)

Chapter 8 S&T and Society (S&T and industry, impact on life, contribution to conservation of global environment, S&T and culture)

Chapter 9 Public Opinion on Science and Technology (public opinion on S&T in general, public opinion on individual areas of S&T)

Conclusion Future and Outlook for Science and Technology Indicator Development

3.Characteristic Features of our Science and Technology Indicators

(1)Wide Range of Indicators

1)Although the core of science and technology activities is research and development activities, the actual research and development activities are done on wide support bases such as education. Results of research and development also have impact on society in terms of contribution to intellectual stock of human beings, economic development, people's life, and even on people's senses.

2)Our science and technology indicators mainly deal with research and development activities, but also deal with wide-ranging areas including their support bases and implications. For example, Chapter 8 "S&T and Society" and Chapter 9 "Public Opinion on Science and Technology".

(2)Indicators from new viewpoints

3)This report has introduced indicators from new viewpoints that are not seen elsewhere.

4)For example, it includes the following indicators:

[Academic papers]

- Shares of Japanese papers in the world in terms of number of production and count of being cited. They indicate that Japanese papers in recent years are improving both in quantity and quality.
- Flow of contributed papers, from the countries where papers are produced to the countries where academic journals are published. It indicates that the increase in number of Japanese papers is partly due to an increased number of contribution of papers to foreign journals.
- Flow of citation of papers, from the countries cited to the countries citing. It indicates that the increase in count of Japanese papers cited is due to a recent increase of foreign papers that cite Japanese papers.

[Patent]

- Noting that the US has a database of patents that were cited by patent examiners during the process of patent examination, shares of Japanese patents in the US are compared in terms of number of granted patents and count of cited patents.

- According to this, the US dominates both in the number of patents granted and the number of patents cited in the US, but its shares are gradually decreasing. Japan occupies a prominent position among countries other than the US, and its shares are significantly increasing.

(from Chapter 6, "Achievements of R&D Activities")

[Internationalization]

- We examined international co-authorship of academic papers, mainly to grasp internationalization in basic research areas quantitatively. We found that the percentage of internationally co-authored papers among Japanese papers is low when compared with advanced Western countries, but the percentage is steadily increasing.

- We examined change in the number of research facilities of foreign-affiliated firms in Japan. From this we found that establishment of such facilities was concentrated in the period from the mid-1960s to the early 70s (the first period) and after the early 80s (the second period), and that the number of R&D type of foreign-affiliated firms has been increasing in recent years.

(from Chapter 7, "Internationalization of R&D")

In addition, Chapter 4, "R&D Activities in industry, Academia and Government", describes importance of international comparison by FTE (Full-Time Equivalent: a conversion method to determine the number of researchers based on their actual working hours).