Development of a Comprehensive Network for Scientific and Technical Information in Japan

YUTAKA KOBAYASHI

THE FIRST REGULAR SCIENTIFIC JOURNAL published in Japanese was inaugurated in the 1870's and secondary publications in the field of science began around the turn of the century. Both of these steps had been initiated by leading figures in Japanese science and had been backed by Japanese scientific and professional societies on the basis of European models. The creation of the Japan Information Center of Science and Technology (JICST) by the Japanese government in 1957 was a landmark in the history of science information work in Japan. With this step the government began to take the responsibility for establishing and promoting scientific and technical information services in the modern sense.

During and particularly after World War II, many governments in other countries started setting up or subsidizing national documentation or information centers and laying the foundation for the science information networks of today. The establishment of JICST was therefore not an exception, and Japan was fortunate in having taken this decisive step and establishing such a powerful service to assist it in its rapid economic reconstruction.

At the operational level, JICST was, from its beginning, destined to adopt mechanized means to process a large amount of scientific information. Although this seems quite natural today, it should be remembered that the situation of mechanized systems in 1956-57 was quite different, only a simple imported accounting machine was then available in Japan. Even in the United States the first operational computerized KWIC-index system, devised by the late H. P. Luhn, was being demonstrated at the International Conference of Scientific Information, Washington, D.C., in November 1958. At the same con-

Yutaka Kobayashi is with the Japan Information Center of Science and Technology, Tokyo, Japan.

ference this writer heard the conflicting views held between Americans and British as to the significance of computers. The latter discredited computers because of their commitment to the role of human intellect, but many Americans defended their belief by saying that one could not predict the future of these newborn instruments. Such a division of views was reconfirmed two years later by a Japanese expert mission which visited the U.S.A. and Europe.

Nevertheless, a decade of computer technology and systems engineering seems to give a partial answer to the side of the conflict adopted by Japan. JICST is now proceeding to organize a fully computerized method of editing its abstracting journals in Japanese, i.e., in Kanji and Kana. This is the first operational science information system in the world to use Kanji and Kana, and it is designed to be operated eventually by computer means on a time-sharing, on-line, multi-access basis. Under these conditions, the Japanese government has begun to plan a national science information network, with the computerized JICST at its center, to cope with expected changes of the 1970's.

JICST from 1957 to 1967. The Japan Information Center of Science and Technology was set up as a central science information service to collect scientific and technical information, to process and store it, and to make it available to the public. In April 1968, it was regularly acquiring 7,000 periodical titles and publishing 353,000 abstracts annually. Its publications included the monthly *Current Bibliography on Science and Technology,* with sections dealing with mechanical engineering; electrical and electronics engineering; chemistry and chemical technology; earth science, mining, metals; civil engineering; architecture; physics; atomic energy; and management science. There is also an indexing journal, *Foreign Patent News* (chemical), a news digest, *Technical Highlights,* and a monthly publication, *Information and Documentation.* During the year ending March 1968, there were 6,000 reading room visitors, 289,000 requests for photocopies, 5,400 translations supplied, and 1,900 literature searches made. The staff as of June 1968, totalled 312 employees. The permanent staff is assisted by a large panel of abstractors and translators, as well as typists and photo-laboratory workers.

Journals and other primary publications are delivered to information officers who select articles according to pre-established criteria and mail them to abstractors to have them abstracted in Japanese. Each abstract averages 200-250 letters. The abstracts are then clas-

sified and edited; typed on 4″ × 6″ cards; arranged and numbered; and then sent to commercial offset printers.

Progress of Mechanization. To date various mechanized systems have been planned in Japan and many of them are now in operation. Due to limitations in computer equipment, these systems have to use alpha numeric and/or Katakana character sets. Although they are working rather well, it is unnatural to utilize information in English or in Katakana instead of in Kanji and Hiragana as in regular Japanese texts, and it inevitably causes psychological resistance among users. In order to overcome this, considerable effort is being spent on computer research in this field.

The present JICST system can process regular Japanese texts in machine-readable form in order to prepare abstracting journals by photo-composition. For this purpose a character set of about 3,000 letters is required to print the following families of characters:

	Number of letters		*Number of letters*
Kanji	1861	Arabic numerals	10
Katakana	81	Roman numerals	20
Hiragana	77	Symbols	199
Roman alphabet	65	Spaces	6
Russian alphabet	66	Reserve	78
Greek alphabet	33		

Some of the above may be printed in either boldface or italic types.

Kanji teletypewriters are employed as input devices for this system. They are widely used for direct telecommunication in Japan in combination with Kanji teleprinters. The computer used is a large-scale general-purpose digital computer operating on a time-sharing, on-line basis. The success of this system is due to the ingenious development of this display mechanism by a Japanese electronics company.

The new system will serve to cut down the amount of time needed to prepare the issues of the monthly bibliography from three months to one and a half months, and it will be able to produce annual and subject indexes shortly after the series is completed. This compilation until now has taken eight months.

The new computerized system will be put in operation to replace traditional procedures of journal composition and to make new, flexible services possible. In addition to preparation of the abstracting journals and their indexes, various types of other services are contemplated. For instance, selective dissemination of information (SDI), on-line inquiry-answer service; and transfer of data files by the sending of processed magnetic tapes are all possible.

The Kanji system is complicated for quick searching and there are often problems of incompatibility. A first step to resolve this has been to reorganize magnetic tape in Kanji mode into more compatible binary code decimal mode through transcribing Kanji into Katakana or Roman alphabet (Romaji). Another method of storing semantic and graphic information through microfilm is also under examination with a view to combining this with the computer search system.

Japan Council for Science and Technology. The Council for Science and Technology, headed by the Prime Minister, was organized in April 1959, in order to consider the national policy for science and technology and to submit recommendations to the government. Among its first tasks was that of preparing a "Coordinated Basic Policy for the Promotion of Science and Technology in the Coming Ten Years (1960-1970)." A subcommittee concerned with scientific and technical information was formed. In 1965-66 the recommendations of the original report were revised to cope with the new advances in science and technology.

In August 1966, a revised version of the report was released as the basis for future planning. Chapter 3 deals extensively with the information problem. Some of its recommendations follow: information producing organizations in Japan such as professional societies and national and regional research institutes will be required to maintain a high quality in their original published works, and will be encouraged to issue English language journals in order to promote the international exchange of new information.

The secondary information services provided by public bodies will take on special responsibilities. JICST, among other services, will consider introducing MEDLARS tapes in order to expand its activities. JICST will also extend the coverage of its services to include the bio-agricultural field. In this way it will have over-all subject coverage from astrophysics to zoology. Other means to secure comprehensiveness will also be carried out, such as providing a wide variety of services, including a rich collection, prompt and individual announcements to users, dependable abstracts, comprehensive printed indexes, user searches by computer, remote access to data banks, and automated microfiche reproduction to hard copy, and other services. These added abilities will also require related software packages, contract research and development services, consulting services, and advanced training courses for staff and users.

The above requirements for "comprehensiveness" will take some time to achieve, since there are many unknown factors both at the policy and operational levels. This problem will only be fully solved when other constituents of a national information system, discussed below, take shape and JICST's computer experiences are realized.

Special Information Centers. There are only a few national specialized information centers in Japan, such as those in the field of atomic energy and in the building industry. Discussions about the development of further such specialized centers so far has not produced practical results.

A similar situation exists in connection with data centers. It seems more reasonable to distinguish data obtained by experiments from other information secured by more casual observation. In the former case the data as measured and evaluated or standardized should be distinguished from unevaluated data. Data gathering in this sense is usually left to individuals or a smaller group of scientists and any systematic approach to this is relatively infrequent as compared with the general range of applied scientific research activity. But in the field of data compilation improved information handling techniques should be applied intensively.

During 1967 a working group was established by the Council of Science and Technology to devise a plan for a national information clearinghouse, in line with the Council's recommendation to this effect. It was concluded that such a national clearinghouse should function, complementarily to JICST, as:

1) a guide to pertinent information sources in science and technology, regardless of subject fields;
2) a depository and secondary distribution center for government-generated and supported research reports;
3) a center for collecting and processing research projects not yet recorded elsewhere; and
4) a principal center for contact with countries overseas.

Its organizational status should, ideally, be an independent government-supported one, with a staff of, for example, 100.

This recommendation, after having been submitted to the Science and Technology Agency, was brought forward for implementation in 1969 and its budget is now under negotiation with the Finance Ministry.

International Cooperation. In contrast to the informal agreements

that were characteristic between various information services in different countries in past years, the future international trends indicate more need for formal detailed agreements, in order to provide compatibility, particularly where machine-based records are used. Such a change causes many problems for Japan, which has a relatively large scientific output recorded in a language and orthography remote from that used in Western Europe and North America. Japan must make every effort to achieve agreement in the many projects such as INIS, MEDLARS and others which are now being planned.

In anticipation of almost simultaneous total computerization of existing large-scale abstracting services such as *Chemical Abstracts, Physics Abstracts, Engineering Index* and so forth by the early 1970's, it is evident that some feasible minimum standards will be required in order to facilitate future cooperation and save much duplication of effort.

Fortunately, JICST, as the sole centralized abstracting service in Japan, will have its computerized system fully operational in 1970, and we trust that this will prove to be a real contribution to the exchange of information among the various scientific communities of the world.

Future Administrative Arrangements. The Science and Technology Agency has now found it necessary to consider a long range program which includes activities not considered in the 1966 Recommendations. Such planning is a first step in the direction which any future national science information system of 1970's must take.

The major points in the plan follow:

1) Promotion and fostering of information science. As information science is an entirely new concept in Japan requiring integrated efforts by many disciplines, research efforts should be clearly and effectively divided among academic, governmental and industrial communities. Priorities should be attached to each research project in order to effectively utilize the limited research capacity.

2) Research and development in information processing techniques. This should involve development of necessary hardware, particularly input/output machine devices and software for handling scientific information and the Japanese language. The development of subject analysis, i.e., construction of keyword lists, thesauri, and classification schemes, is lagging behind more advanced countries, and emphasis should be given here.

3) Education and training of specialists and education of scientists in information science is urgently needed and should be carried out by the universities in order to:

a) secure coordination among scientists of different backgrounds in setting up new information services as in (1);

b) secure sufficient manpower for research and development in various organizations; and

c) secure manpower for staffing information transfer services as in (4).

4) Strengthening of information transfer services should be carried out by professional societies (primary transfer), information or documentation centers of various levels, and there should be set up a system bringing them together. For economy and efficiency, standardization in terminology, presentation, formatting and secondary processing should also be promoted in line with international achievements by ISO and other bodies.

5) In the total framework of a national science information system, the responsibilities and duties of the government agencies should be made clear. Those organizations recommended for establishment by the Council for Science and Technology should be brought into being as soon as possible by the government itself.

A draft of a time schedule designed for implementation from 1968 to 1972 appears below in outline form:

1) Formulation of basic policy

a) A Council for Scientific and Technical Information shall be organized as soon as possible.

2) National information transfer systems shall be established step by step

a) Primary information flow, the responsibility of the professional societies and national research laboratories, shall be improved by encouraging standardization, setting up a centralized depository system for pre-publication or hard-to-publish materials, and promoting inexpensive publication by microfiche, etc.

b) Secondary information transfer activities carried out by learned societies and national institutes shall be intensified by creating specialized information analysis centers in cooperation with JICST. JICST should refine its computer systems in a year or two, and then expand its service by the establishment of a clearinghouse, a patent information center, a training center, and

a depository of non-published materials, to name a few of the most urgently needed services.

c) A National Research Center for information science should be established at a relatively early stage, and information research facilities in universities should be strengthened.

d) International cooperation through standardization, exchange of information, participation in international systems such as INIS, MEDLARS, etc., should be continued.

e) Bilateral cooperation, e.g., the U.S.-Japan Science Cooperation Program, should be encouraged. This can best be carried on by exchanging experts, sending research fellows, or receiving trainees from overseas.

f) Language barriers should be minimized by the publication of English-language journals, reorganizing curricula for interpreters and translators, encouraging compilation of dependable technical dictionaries, and promoting machine translation techniques.

Conclusion and Prospect. Keeping pace with the development of electronic computers, the Japan Information Center of Science and Technology has passed its first ten years of existence and entered the second decade with a third-generation computer system. Throughout the first period the government's principal concern was to establish normal growth for the services of JICST. During this period, the intensive work that was done in order to set up the national centralized information center, in one way or another, may have held back overall advancement of scientific information work, a part of which should be borne by the active scientists themselves, and another part by bibliographers and librarians, and the third part by editors and publishers. Communication with clients of JICST's services was in some measure insufficient during this period.

However, at the end of the first ten-year period, and starting in 1967, there were significant changes of emphasis. This can be evidenced by the success of the computer system, substantial support and interest in Japan on the occasion of the 33rd FID Conference and International Congress held in Tokyo, and the move to formulate an over-all national plan by the government. Sooner or later out of all this will develop a well-balanced, multi-dimensional scheme of science information work in Japan which, eventually, will be its contribution to world science and technology.

General References

Fukudome, Takao. "The Japan Information Center of Science and Technology (JICST): Its Organization and Function," *American Documentation,* 18:146-152, July 1967.

Japan Documentation Society. *Science Information in Japan.* The Society, Hyakunintyo 4/400, Sinzyuku-ku, Tokyo, 1962; and Japan Documentation Society. *Science Information in Japan.* Second and revised edition, Kikai Sinko Kaikon, Siba Park, Tokyo, 1967.

Kikuchi, Tohru. "Scientific and Technical Information in Japan," *American Documentation,* 18:250-252, October 1967.

The National Diet Library. *Organization, Functions and Activities.* Tokyo, 1966.

Okamoto, T., *et al.* "Automatic Transaction of Russian Chemical Titles into Japanese." Paper given at the 33rd Conference of FID, Tokyo, 1967.