Scientific Literature in Policy Decision Making*

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At the policy level, the Federal Government concern with problems of science and technology requires consideration of economics, politics, organizational structure, and the availability as well as the existence of information. The scientist working in this environment must arrange for information input over a broadened range of subjects. His personal interest in a few special areas must be diffused to cope with policy level and staff problems of an interdisciplinary nature. Three types of information resources are frequently useful—expert consultants who can provide individual interpretation; panels and committees to afford an integrated balance of independent viewpoints on a particular problem; and encapsulated information, such as annual reviews and state-of-the-art summaries. Technical articles in professional society news organs and even in news magazines may be considered as belonging to this last category. The common feature of these information sources is that they all provide an indirect channel for the content of the original scientific literature. Each interposes a screening and selection process between the literature and its use in policy decisions.

This article contains no case histories of how some important article from a learned journal was thrust, by the hands of the author, under the eyes of the President of the United States, and how the fate of nations was thereby changed.

Instead, I will make some observations on the way in which a staff and interagency policy office, like the Office of Science & Technology, obtains technical information for use in the process of defining issues and making decisions. Then, in line with the over-all theme of this symposium, I will look more closely at policy-level concern with the current status and the future of scientific literature in particular and scientific and technical information as a whole. To relate this concern to specific organizations, I will mention a few of the groups in the Federal Government which focus attention on this latter subject. Finally, I will offer some comments on expected future developments, not as a prophet, but as one who worries daily about the present health of our information organism and its prognosis.

To set the tone of my remarks, let me give you a preview summary; we have a flourishing body of scientific literature in this country, containing a vast amount of valuable knowledge. The sources of this knowledge and the channels into which it flows are mutually well adapted to one another. The organizations which are responsible for the main channels—the learned journals—are vigorously and intelligently administered and generously supported. The system does a good job of assembling knowledge into packages which are about 90% mismatched to the needs of users.[1,2] We do not have efficient ways to obtain and use the knowledge in the system. Major surgery, new planning, rethinking, and rebuilding will be needed if we are ever to meet a vital individual and national responsibility—the development of an information system which is *user* oriented instead of *source* oriented.

Having stated this heresy, I return to the first topic—how scientific literature enters into policy decision making at various levels. It is obvious that policy decisions cannot be made solely on the basis of specialized concern for the problem at hand. By definition, policy takes into account interactions of one technical problem with another, one organization with another, one need with another. Scientific policy is influenced by budgets, politics, existing organizational capabilities and objectives, and by technical information which is readily available. Other, perhaps better, information which is not at hand has no impact.

Does this sound as though science policy making is less than a perfect process? It should. Let me quote Alexander King, Director of Scientific Affairs for OECD, speaking at the December AAAS meeting in Dallas:

> You cannot have a clear, dictated science policy unless it is dictated by God. . . What with the naiveté of the natural scientist, the arrogance of the economist, the ignorance of the politician, and the superiority and complacency of the general bureaucrat, there isn't a hope in hell of getting an integration (of science policy with economic, social, defense, and other policies), and this is the situation we're in.[3]

Nevertheless, this is the situation in which policy decisions

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have to be made. And there are conscientious people who are trying to avoid ignorance, naiveté, and complacency.

One of the responsibilities of the scientist who takes part in policy decisions is to make sure that his information channels cover a broader range of subjects than his own personal professional interests. He cannot select among the problems which arise and require decisions, so he must take steps to widen the scope of the information he receives. Many of our country's major technical problems are so interdisciplinary in nature—for example, environmental quality, water resources, and urban planning—that relevant decisions cannot be made by any one scientific expert, no matter how wise.

But policy decision makers can obtain, directly and indirectly, the scientific information and opinions which bear on the necessary decisions. Individual consultants from academic institutions, industrial organizations, and federal agencies are regular sources of both factual knowledge and expert interpretation. Panels and committees flourish; two of the best known are the President's Science Advisory Committee[4] (which consists of technical advisors from outside of government) and the Federal Council for Science and Technology[5] (which is a coordinating body of government administrators). Such groups help to integrate a variety of opinions and develop a balanced point of view. For more extensive tasks, especially fact-finding or correlative in nature, the mechanism of the contract study is frequently used. Later I will show titles of a few studies—a very biased sample since they are all taken from one specific area.

In addition to this indirect access to the scientific literature, a policy maker may be able to afford the luxury of a little first-hand reading. Some of it may be original literature in his own professional specialty. More of it will probably be specially prepared reports, summaries, digests, critical reviews, annual progress in this or that field. The purpose of his reading is less to maintain current expert knowledge in a single specialty than to develop a moderate understanding of a number of unfamiliar areas, which may take on importance in policy questions.

These indirect sources of information, both personal and impersonal, have one feature in common—they function as user-oriented devices for condensing and interpreting the original scientific literature prior to its application in policy decisions. They permit a fallible human being, with limitations on his knowledge, to cover a wide range of problem areas with only a modest increase in fallibility. If his screening devices are good, his fallibility may even decrease a little.

So far, we've been considering decision-making use of the original scientific literature published in professional journals and books. Now I want to mention a few areas for which there is policy-level concern relating to scientific information as a whole. After all, the total information resource goes far beyond original scientific research papers.

Other papers in this program tell you about some of the work done in compiling critically selected numerical data by massaging the primary literature and repackaging it for users. The products and the efforts which this work typifies are deserving of the highest praise. This form of tertiary literature is of great value for workers in both basic research and applied fields.

Then there is the extensive and poorly understood report literature. Much of it is assembled with the user in mind. Some of it gets polished up and appears in scientific journals. During the process, it is subjected to refereeing, which provides certification of its reliability. At the same time it loses both its user orientation and a wealth of detail, because of the rigorous space requirements of journal publication. When it does appear, it is six months to a year older than the parent report. I suggest that we all need to give thought to better handling of the report literature. For a challenging study on the subject, I commend to you a report published in 1968, "The Role of the Technical Report in Scientific and Technological Communication." It was written by a small task group headed by Sidney Passman of the U. S. Arms Control and Disarmament Agency.[6]

Next I call your attention to the growing national network of special-area information systems. Some of these systems are familiar to all of us, since we use them frequently—the weather information system, the airline-reservation information system, the credit information system, and the flight-control information system. Please note that while these systems have a variety of sponsors, they all serve a nationwide body of users.

Equally important are information systems which cover specific scientific disciplines—the Chemical Information System of the American Chemical Society, the Physics Information System of the American Institute of Physics, and similar, though less fully developed, systems for Psychology and Mathematics. These systems are operated by professional societies with financial assistance, during their growth phases, from the National Science Foundation.

Other special-area systems include the National Standard Reference Data System, operated by the National Bureau of Standards, the National Agricultural Information System of the National Agricultural Library, and the Biomedical Communication Network of the National Library of Medicine. The Atomic Energy Commission has an informal national information system on nuclear energy, which has direct ties to INIS, the International Nuclear Information System. The National Aeronautics and Space Administration operates an information system on space and aeronautics. The Office of Education is developing an Education Information System. Typical component activities of these federally sponsored systems are the publication of technical reports, abstracting and indexing of the journal and report literature, operation of information centers, data centers and information analysis centers, and programs for the application of internally developed results to the solution of general outside problems—the technology utilization effort.

I suggest that these systems foreshadow the total user-oriented national information system of the future. It will be made up of a large number of interconnected, but mostly autonomous special-area information systems run by professional societies, responsible agencies in the Federal Government, private organizations, and perhaps universities, each doing a job for which it is specially qualified.

It will utilize computers, telephones, journals, books, custom-packaged data compilations, cathode-ray-tube terminals, home television sets, microfilms and microfiche, technical reports, handbooks, and other devices yet to be developed. It will supply the information needed, in the required depth, without excess. It recognizes the relationship:

$$\text{Documentation} \neq \text{Information}$$

It will not assume that a list of ten or a hundred articles and books, through which the inquirer must search, is an answer to a request for information. It will offer information to the user in the form and through the medium most convenient to him. It will permit prompt access to information from any of the component subsystems, so that an inquiry made to any element of the system can receive the attention of all.

The over-all array of systems is already beginning to take shape. People have been planning along these lines for several years. In fact, the development of national systems for scientific and technical information is explicitly called for in the charter of the Committee on Scientific and Technical Information (COSATI), as follows:

> The Committee on Scientific and Technical Information (COSATI) is a committee of the Federal Council for Science and Technology. The primary objective of COSATI is the development among the Executive agencies, of a coordinated, but decentralized scientific and technical information system for scientists, engineers, and other technical professions. As a secondary objective COSATI will be concerned with coordination and cooperation with improved federal and national systems for handling scientific and technical information.

I point out to you that the path we are taking toward this national array does not begin with the creation of an administrative superstructure and the later development of operating subunits. On the contrary. The individual subsystem components have come first. Quite a few are alive and well, doing business and serving customers. They have come into being because there was a need for them. They are being run and supported by organizations—professional societies or federal agencies—which require such systems for their own members. Once in being, they find that they are able to serve a larger body of users, and so they extend their services—nationally and, in some cases at least, internationally. I have mentioned the International Nuclear Information System, and there are other similar developments. The American Chemical Society and the Chemical Abstracts Service, have taken notable steps to build an international system for receiving and distributing their information. The Committee on Data for Science and Technology (CODATA) is an officially recognized unit of the International Council of Scientific Unions. CODATA is taking positive action to provide international coordination of data compilation efforts.

As the number of special-area systems grows, it is becoming obvious that some degree of centralized attention is needed to provide coordination, to reduce unintentional overlap of services, to encourage compatibility and communication, and to undertake solution of common problems. COSATI has this responsibility. COSATI is a committee of the Federal Council for Science and Technology. It brings together some 26 federal agencies as members or observers. COSATI also provides liaison with nongovernmental bodies such as the American Chemical Society, the American Institute of Physics, The University Communications Council (EDUCOM), and the National Academies of Science and Engineering, all of which have major interests in scientific information and communications.

The COSATI organization is shown in Figure 1.

COSATI serves as a coordinating body for the activities of federal agencies in scientific and technical information, and as a forum for discussion. It oversees in a general way operations which had a budget for Fiscal Year 1968 of over a half billion dollars, distributed as follows:

Federal Funds for Scientific and Technical Information—FY 1968

Category	Totals
Publications and distribution	\$172,764,000
Support of publications	4,625,000
Bibliographic and reference	155,573,000
Specialized information centers	50,201,000
Translations	5,409,000
Symposia & technical meetings	48,148,000
Audio-visual media/oral communications	17,180,000
R&D in information, documentation, etc.	77,494,000
	\$531,394,000

COSATI provides interagency consensus for specific plans devised by its panels and task groups. These latter are the working units, each having responsibility for some aspect or problem area of information system developments.

Panels and task groups prepare reports which are usually published throughout the Clearinghouse for Federal Scientific and Technical Information, and they submit action papers which are reviewed by COSATI and presented to the Federal Council for Science and Technology. Acceptance at this level gives them the status of federal policy. Typical reports published through COSATI are listed in the annual report of COSATI.[7]

These reports are applicable to our discussion today for three reasons—first, they are products of an organized effort to survey and improve the scientific information resources of this country. Second, they are examples of how policy decisions evolve and are made explicit, examples chosen from the area of scientific and technical information. Third, they offer us, as information practitioners, blueprints for growth in specific areas of scientific and technical information handling and use.

The panels and task groups are indicated in Figure 1, and are described in the annual report of COSATI, referenced above.

The task group most closely related to our topic today is the one concerned with national systems. It focuses attention on many of the specific-area information systems I talked about earlier. It has been responsible for a number of studies on various aspects of information planning. Some of the study reports are listed below:

System Development Corporation. "Recommendations for National Document Handling Systems in Science and Technology," Santa Monica, Calif., November 1965, 3 vols, PB 168 267, AD 624 560.

American Institutes for Research. "Exploration of Oral/Information Technical Communications Behavior," Washington, D. C., 15 March 1967, AD 650 219.

System Development Corporation. "A System Study

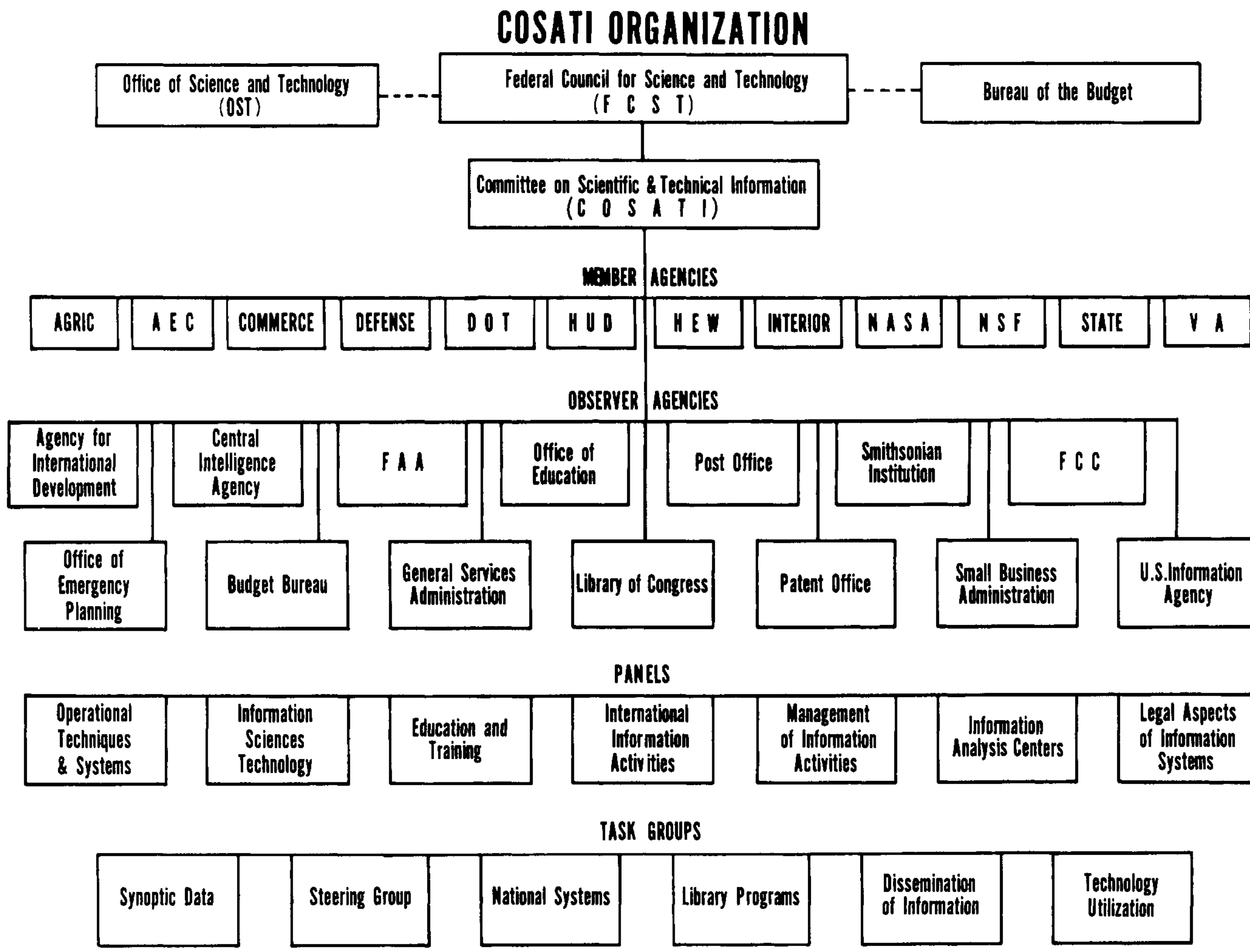

Figure 1.

of Abstracting and Indexing in the United States," Falls Church, Va., 16 December 1966, PB 174 249.

Science Communication, Inc. "A Study of Scientific and Technical Data Activities in the United States," Washington, D. C., April 1969, Vol. I, AD 670 606; Vol. II (A&B) AD 670 607; Vol. II (C&D) AD 670 608.

Now let me mention two specific examples of activities which are receiving current attention within COSATI and OST.

First, in November (1969) there will be held a small seminar on scientific publications intended to provide a future-oriented look at the whole scientific publication effort. As of September 1969, the program for the seminar had not been released, but here are some of the issues which are relevant to its concern:

There are substantial indications that the practice and even the philosophy of scientific publication is due for some changes. Page charges have been an important source of revenue for scientific journals for many years but recent cuts in the federal budget have caused some painful experience with page charges. What will be the effect of continued tight budgets on this source of funds and what alternatives do we have?

Abstract journals are supposed to be a compact guide to the scientific literature. The volume of original literature is now being matched by a swelling of abstract journal bulk to the point where few people can afford to read complete abstract journals, let alone buy them. Can systems for the selective dissemination of information make abstracts more useful?

Federal information and document centers have recently been required to impose service charges. Is this requirement going to expand or inhibit the flow of information?

I think this November seminar has some substantial issues to face.

Then there is the problem posed by the scholarly report from the Committee on Scientific and Technical Communications (SATCOM). This study and the report were organized under the auspices of the National Academy of Sciences and the National Academy of Engineering. Three years of thought and discussion have produced 55 recommendations. Some of the recommendations apply to professional societies and some to the Federal Government. The recommendations must be reviewed and decisions must be made as to what actions can and should be taken.

Now obviously, these two examples do not show either the start or the resolution of policy questions. Behind both lie many individual and small group actions which lead to the situations described. Additional actions must also be taken before policies are formulated. Still, these are two cases which show policy decision making in progress.

To recapitulate—the scientific literature enters policy decision making processes importantly but indirectly. Because of various pressures, decision makers find it helpful to have their information restructured for their use in applying it to policy questions.

Looking at these features of the use of the scientific literature, a direction for future growth appears. This direction should involve a major increase in the restructuring of primary information to make it more directly applicable to users' requirements. A variety of special service organizations may perform the restructuring. Information analysis centers are already doing such work in many well-defined subject areas. More generally, the future holds promise of a national network of information systems, with individual component systems focusing on special subjects, missions, or problem areas in which the user will receive prime consideration. New operations for manipulating information will be essential parts of these systems, and a range of new information packages will be produced. Here is a challenge and an opportunity for service and for benefits to scientists and engineers on a nationwide scale.

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Patent Literature: Current Problems and Future Trends*

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The historical growth of U. S. patent issuances is reviewed showing the portion represented by chemical patents, factors affecting future growth of both U. S. and foreign patent documents, forecasts of total and chemical issues of U. S. patents through 1975, and some of the measures taken within the Patent Office to cope with file growth.

When Secretary of State Thomas Jefferson delivered to Samuel Hopkins of Vermont a document bearing, in addition to his own name, the signatures of President Washington and Attorney General Edmund Randolph, he began a procession of steps that has in the years since that 31st day of July 1790 brought to countless inventors and at the same time to the annals of technical literature an ever growing number of U. S. patents. This week, the postal service will perform this same act delivering 1300 patents which make up the latest weekly issue.

At the same time, the printed specifications of these patents will move across the length and breadth of this country and overseas to many foreign lands to add to the pile of documents. With 90 copies of each new specification distributed on patent issue day, more than 6 million individual documents will move this year into such repositories. And the flow which begins anew with each weekly issue continues for many years as users of patent literature find need to obtain copies from back issues. The sustained demand for such copies which is usually expressed in individual orders for one or two different patent numbers runs at a daily average of nearly 22,000 copies. This adds 5.5 million more copies to shelves and files each year.

Because patents are given consecutive numbers under the practice begun in 1836, the total number of patents issued since then would normally be indicated by the latest issued number. Actually, however, the total is less. This results from the fact that over the years about 3000 prospective patents had to be withdrawn from issue at a time in the issuance process when it was too late to enter substitutes for them. On the other hand, some few patents have half-numbers. Hence, while patent number 3,466,000 will be issued tomorrow (September 9, 1969), it will actually be the 3,463,000th document to enter the public annals.

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