Factors in Building an Operational Information Program*

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Efficient use of the economic means available to an information system can be enhanced by taking every reasonable advantage of compatibility with other information systems; by judicious allocation of functions to centralized and decentralized operations; by improving products in an evolutionary fashion; and by multiple adaptation of processing effort to provide a greater variety of appropriate products and services.

The problem of economic support of information systems immediately raises the issues of projecting the amount of support needed for a service, acquiring the necessary means to fulfill intended functions, and making the most efficient use of the funds that are provided. I wish to direct attention to the third issue of optimal use of the means already available to an information system.

Living within one's means can be enhanced by taking every reasonable advantage of the benefits that accrue from compatibility with other information systems; by judicious allocation of functions and services to centralized and decentralized operations; by improving products in an evolutionary, rather than revolutionary, fashion, so that the innovations can be made with minimum reprocessing of materials already in the system; and by multiple adaptation of processing effort so as to provide a greater variety of products and services to meet the increasing and ever diversifying demands of the users.

There are certainly additional methods for getting the most out of your information dollars; perhaps I emphasize these four for personal reasons. I will draw for illustration upon the characteristics of the information system developed for the National Aeronautics and Space Administration. Fortunately, or foresightedly we like to think, the basic principles upon which this system was designed provide for the means of enhancement that have been noted: compatibility, allocation, evolutionary innovation, and multiple utilization.

COMPATIBILITY

Much of the source material needed by an information service supporting the activities of any given organization, whether research, developmental, operational, or managerial, is produced outside that organization. A particular information service must therefore acquire a great deal of outside material, process it, distribute it, and have it available on demand to the users in the organization. By the same token, the inhouse-generated material of the given organization is needed by other information services with like requirements to acquire, process, and distribute. This exchange flow of source materials becomes greater and greater with the wider application of the team approach to research and development and with the rise of more and more mission-oriented functions. NASA, for example, with its team approach to many of its mission-oriented projects, must be able to serve the information needs of chemists, physicists, engineers, metallurgists, geologists, astronomers, nuclear technologists, and biologists. Fulfilling the information needs of such an array of interests requires us to draw upon the information produced by the corresponding professional societies, related activities in other government agencies, and industrial concerns in the aerospace community, to name but a few and yet emphasize the range of outside resources. Other agencies appear to have a like need to draw upon NASA as a source of information.

With such a give-and-take imperative, an information service can make more efficient use of its supporting appropriations by entering into cooperative arrangements and developing operational interlocks with other systems. Economic justification, it should be noted at the outset, is not a plea for compatibility as an end in itself or as a mere exercise in sociability. Considerations of efficiency demand that compatible procedures be developed and adopted when they do indeed fit the requirements of an information service, serve directly useful purposes, and contribute to the more effective use of each service's resources. When reasonably applied, however, compatible procedures can be beneficial at all stages of an information service's work—for input, for processing, and for distributing.

A number of interested agencies have cooperated in developing standards for descriptive cataloging, with all its attendant procedures and format of citing and listing documents for purposes of bibliographic control. These procedures are described in the now familiar pamphlet *Standard for Descriptive Cataloging of Government Scientific and Technical Reports* (*1*) prepared by the Committee on Scientific and Technical Information of the Federal

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Council for Science and Technology. With these compatible procedures it is now possible to introduce items from one government organization directly into other government information systems without having to duplicate the cataloging processes or expend major effort modifying someone else's method of bibliographic control. The recent work on the development of standard subject categories and related indexing procedures is another example of compatibility which should contribute to direct input without elaboration of cost.

Bibliographic and indexing data are typically prepared on worksheets or stored on magnetic tape. Given the proper compatibility, worksheets for relevant items of information or the magnetic tapes can be exchanged among information services. Thus, the bibliographic and indexing data prepared by the agency processing the information item are available for immediate use by the receiving agency. Such arrangements are in effect, for example, among the Defense Documentation Center of the Department of Defense, the Clearinghouse for Federal Scientific and Technical Information of the Department of Commerce, and the National Aeronautics and Space Administration.

Efficiency of processing can be enhanced, not only by exchange of materials, but also by arrangements for the cooperative use of equipment. Take, for example, a recent improvement in NASA's announcing, abstracting, and indexing service. The published medium of this service is the journal, *Scientific and Technical Aerospace Reports* (usually referred to as *STAR*). Each semimonthly issue of the journal includes a subject index, a personal author index, and a corporate index (among others); and the indexes are cumulated quarterly and annually. Copy for these indexes was previously prepared by computer printout. Though rapidly and effectively produced, the format of the resulting printed indexes was necessarily determined by the characteristics of the computer printer. Now, however, through cooperative arrangements with the National Library of Medicine, our indexing has been reprogrammed to use the NLM Graphic Arts Composing Equipment. GRACE is a high-speed "photoprinting" machine actuated by computer tape; it therefore combines the advantages of photocomposition, extremely rapid preparation of copy, and direct input from computer tape. By the GRACE of NLM, the indexes are now produced in a three-column format which is both a more readable and a much more compact device for searching purposes. This has been achieved, not at additional cost, but by stretching the already available information dollar.

The recent interest in standardization of cover formats to ease the problem of identifying report numbers and in standardized dissemination procedures to avoid overlap are instances of possible compatibility which can contribute to the efficiency of distributing information products. Another instance, and a highly successful one, already in effect results from the standardization of microfiche, again achieved through the efforts of the Committee on Scientific and Technical Information. The standards specify such characteristics of microfiche as reduction ratio, image frame size, limits of separation between frames, background density, resolution, and title area format. What is of significance here is that, through exchange of microfiche, the receiving agency need no longer duplicate the effort of filming but has immediately available a master which can be readily duplicated for distribution as needed. The Atomic Energy Commission, the Clearinghouse for Federal Scientific and Technical Information, and the National Aeronautics and Space Administration now can enjoy the advantages of such exchanges.

ALLOCATION

Compatibility stems from an interest in living efficiently with one's neighbors. What of the internal interest in living effectively with one's components: Which functions should be performed centrally, and which are better allocated to local components? Ideally, the user should have what he needs right at his place of work. Yet, to establish completely redundant information systems at each working location would be very expensive, if not prohibitively so. And were there ever enough money, there would not be enough trained personnel to hire for the purpose. On the other hand, a completely centralized system, though relatively less expensive, runs the risks of missing the healthy interaction between producer and user, of severely restricting the availability of service, and of aggravating delays. In fact, the evidence of recent surveys disquietingly suggests that the existence of such large depersonalized systems may be quite unknown to the potential users and so constitute a waste. The problem, then, becomes one of balances.

The answer seems to depend so much upon the size and the type of organization to be served that generalizations would be of very limited value. The number of users in one organization may be so small and the mission so circumspect that decentralization is a needless elaboration. Or an organization may be so large and its activities so diversified that various degrees of decentralization are advantageous—say, from central to special or regional to local centers. So, then, let the point be made by describing the demarcation that has been drawn in an organization of NASA's size and relatively well-defined mission.

In the NASA information program the allocation is based on consideration of economics and service contact. The first has to do with determining the functions which can be performed most efficiently and economically for the entire system at a central facility; the second is concerned with the locations at which the products and services must be available to the users. Services are developed and information tools needed by the entire system are prepared centrally, then distributed (or the means of producing them distributed) to information personnel at NASA's several research and development centers, who in turn make the products and services available to the individual user. The central facility thus becomes something of a factory warehouse which distributes in job lots to the local stores, which line their shelves with what is needed and can be adapted to the needs of the individual customer.

The NASA abstract journal, *STAR*, with its abstracts and indexes, is prepared centrally but widely distributed to serve as a current awareness and retrospective search tool at any desk or workbench where information is needed. Technical series publications are processed by a central

staff and then distributed to the center libraries so as to be available as they are announced in *STAR*. Microfiche of the items in *STAR* are distributed from the central facility to the local centers, where they may be searched or reproduced for the use of the local scientist and engineer. Magnetic tapes, carrying the citations of all the materials in the NASA collection, are routinely updated and sent to the centers for purposes of local literature searches under conditions enabling the local user to discuss his query directly with the information personnel and to receive the results with a minimum of delay. Even NASA's Selective Dissemination of Information program, which began in its developmental stages as a centrally based operation, is to be operated by the individual centers.

In the main, the tools are fashioned centrally; the application and use of them is decentralized. The local customer need hardly be aware of the central factory: it is the local information personnel with whom he deals, and it is they who should receive the credit for the services performed.

EVOLUTIONARY INNOVATION

Information services are perhaps as much growth phenomena as are the expanding fields of knowledge they serve. An information service is constantly forced to adapt and to innovate as new demands are made upon it, as new methods or procedures or equipment become feasible, and as changes occur in the subject matter field. To become static or rigid is to die. But the attempt to progress by radical replacement of products or substitution of entirely new procedures can be equally debilitating. Therefore, at the risk of being platitudinous, the point should be made, even if only as a caveat, that economic justification favors innovation by evolution, rather than by revolution.

This concern with how much of the already processed and available can still be functional or adapted to fulfill new uses and meet new demands is by no means unique to information management. Each year's new automobile model, while adding new features, still retains to functional advantage some of the previous and familiar and does not destroy the utility of last year's model. Black-and-white television programs are not denied to the user of a new color set; the production of stereophonic equipment has not made obsolete one's collection of monaural records, but actually enhances listening pleasure. Contrast this with the effects, known to every husband and career girl, of the periodic revolutions in woman's fashions.

By appropriate cross referencing or suitable programming, new thesauri can be introduced or indexing procedures modified without making previous retrieval data obsolete or necessitating reprocessing of entire collections. As more advanced computer equipment is put into operation, programs and tapes can still be supplied to those retaining the previous machines; NASA does this as it converts to new equipment because the improvements are in speed, versatility, and cost, not necessarily in content or use. The improvements gradually introduced into the content and format of *STAR* have not made previous issues obsolete; they are still usable, there has been no drastic break in continuity. When one's products and services are farsightedly planned and prove their worth, innovation can evolve into greater usefulness.

MULTIPLE UTILIZATION

In the bygone days of the buffalo nickel, an acquaintance of mine claimed that his mother persuaded the Indian to get off and ride the buffalo while she used the nickel to ride the streetcar. Now that that nickel has become more like a quarter or even a 50-cent piece, it is perhaps more imperative than ever that each information product or service available to us be persuaded to serve as many useful functions as possible.

The bibliographic citation and abstract, which took time and effort to prepare, need not retire from further participation once they have appeared in an announcement journal. They can reappear on cards or microfiche or computer printouts for use in assembling special collections at any location. They can also be reused in a selective dissemination program to alert individual users to information in their areas of interest. At NASA bibliographic citations and indexing terms are stored on magnetic tape for initial use in preparing the *STAR* indexes, but these same entries serve over and over again in preparing continuing bibliographies and demand literature searches. Microfiche of documents may be used for the initial distribution of information materials. They can be reproduced for further distribution as often as required; and, by means of reader-printers, documents can be reproduced from them, either in whole or in part, as suits the needs of the individual user at his place of work.

In applying the principle of multiple utilization, the significant consideration is not merely to find additional uses for the products and services you have, but at the very outset to so design the information system that the products and services are prepared in such a way as to be readily adaptable to the variety of uses you have and can foresee. Good service requires that we anticipate the needs of our users and also requires that we respond as quickly and as adequately as we can to needs we have not anticipated. Preparation of abstract copy by, say, a Justowriter may appear to be less costly at the time and to serve the immediate purpose of publication in a journal. But of what further use is this copy when a special collection is needed or a literature search is required?

To me, it is in this sense that computers, Photon machines, consoles, even the card-sorting icepick are valid and economically justifiable: They are flexible supplements capable of adaptation to diversified uses—not the final answers or substitutes or replacements. An information system receives input only once. But the output must take many forms. Some of these forms could not even be considered seriously unless the input were already paid for by other uses. This combination of products from a single, continuing input is what makes an information system economical.

LITERATURE CITED

(1) Document PB 181605, available from the Clearinghouse for Federal Scientific and Technical Information, Port Royal Road, Springfield, Va. 22151, $1.00.