The Promise of National Information Systems

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IT IS NOW generally accepted that we are embarked on the development of a number of national systems for scientific and technical information which will ultimately produce "a coherent array" of information subsystems with the capacity to intercommunicate. If there is any skepticism about or argument against this thesis, it is usually centered in the "when" and the "what," rather than the "why" and "how." The existence of a number of incipient and growing information subsystems provides ample evidence that there is at present a benevolent environment which may be compared to a solution favorable to the growth of crystals—in this case, information systems crystals.

What are some of the reasons for this belief?

Most obvious, of course, is the arrival of the most sophisticated of mechanical data processors, the computer. This interesting piece of equipment has shown an amazing talent to extend man's memory and his ability to manipulate rapidly masses of stored data, and to react to his signals from near or far. Formal and informal information networks are certainly possible without computers and they do exist, *de facto*, employing telephones, long lines transmission, television, radio, and other electronic devices, but computers add a powerful new dimension to communications networking.

Illustrative of progress is the experience of a project supported by the Advanced Research Projects Agency at the Massachusetts Institute of Technology known as Project MAC (Machine-Aided Cognition), which has shown that a scientist or engineer or student can enter a direct conversation with a time-shared computer to obtain information. Moreover, multiple access to the computers, both remotely and simultaneously, by a number of individuals has been amply demonstrated. It is the view of at least one observer, H. G. Dammers of Shell

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Research, Limited, that if "the time has now come to treat information retrieval by computer as an economical and practical proposition, it is not because all the theoretical problems have been solved. It is because of the very rapid increase in the availability of computer capacity—at least 50 per cent per annum during the past two decades —and associated with this a drastic decline in the cost of computing power."[1] Dammers argues that "the main merit of computer systems, however, is undoubtedly their great adaptability, circumventing the threat of obsolescence which hangs over the great majority of conventional information systems."[2]

It is no longer difficult to document the growth of computer-based information networks in education, industry, commerce, law, weather, medicine, health, defense, intelligence, libraries, space, oceanography, crime detection and control, and in many research and development programs in and out of government. Yet it is widely believed that we are only on the threshold of the development of computer applications.

The parallel development of micro-photography is also making it possible to process masses of data, removing the formidable obstacle previously presented by the need for material to be readable by eye if it was to be useful. With the arrival of the technical capability to move automatically from eye-readable print to magnetic or paper tape to computer language to microform and back to eye-readable print, and procedural variations from one mode to another, yet another new dimension was added to the practicality of networking. The development of new photographic films and techniques makes further reduction of print possible. A commercial process with a 150 to 1 reduction ratio from print to microfiche is now being marketed.

There is little need to expand on the theme of what has been termed the "information explosion," but without the phenomenon of more and more people producing and reading more and more literature, even the magnificent technological progress in communications would not underwrite the development of information networks. The current increase in traffic and the high probability that the increase will materially expand in the future should be cited as the most important reason for the potential growth of networks. Particularly in science and technology, there is little likelihood that the exponential rise will flatten out in the foreseeable future. This expectation is bolstered by the growing concern demonstrated by all nations to increase their investments in research and development, hence in science communications. Since the United States, with only about 6 percent of the world's population, is supporting about 40 percent of the world's research and development, it is patently obvious that as other nations put more of their gross national product into research and development, the world literature output will keep pace with the increase in the number of scientists, engineers, managers, and others involved.

Fortunately, another development has emerged to make it possible for us to structure new programs to solve many of our information problems. The emergence of the systems or operations analysis approach permits the blending of opportunity, resources, and needs into potential information networks. The growth of a unique national bank of talent, trained to the highly exacting demands of systems and operations analysis, advanced systems planning, programming, budgeting, problem-solving, and dynamic management of complex operations, is a vital ingredient necessary to progress in this field.

Another reason for expecting information networks to grow more rapidly results from the continued proliferation of specialization in science and technology, a phenomenon that demands better information systems lest it degenerate into a modern Tower of Babel of the sciences, at the very time that societal problems and complexity demand an integration of all knowledge and better intercommunication for the common good. The availability of linked networks with common language and fairly uniform communications techniques gives us a fighting chance to overcome some of the disequilibrium resulting from the spectacular specialization evident in science and technology in the last two decades. While the return of the universal scientist may be impossible, the construction of well-designed information networks will at least, through expert translation and repackaging of scientific and technical data, reduce the growing alienation.

In the last few years, scientists and information experts have publicly expressed their concern about the viability and future of the learned or scientific journal. Some of the same concern is now being shown for abstracting and indexing journals. This concern is largely a result of the continual expansion of these important announcement publications, which came into existence largely because an even earlier proliferation of literature made reading all the articles in learned journals a physical impossibility for busy scientists and engineers. While flat prediction of the future discontinuation of journals is based less on fact than on strong conviction, today there are constant complaints (and admissions) that journals are often more archival than current. This is borne out to some extent by a growing body of experiments in the selective dissemination of information, in the growing exchange of preprints, and in the continuing attempt by the learned journals to reduce the time from receipt of articles to their fully refereed publication. While there is little expectation that much can be done to improve dramatically the traditional canons of publication, it is quite possible that new information networks can do something to overcome the problems of growing literature coverage, exploding production costs, and the attendant slowdown resulting from the administrative burden of handling large publication programs with part-time, though public-spirited, contributors.

The suggestion has been made that "computers will handtailor journals for the needs of individual users." [3] In a way, selective dissemination of information is a precursor of such a system, and the interest of more than one professional society, deeply involved in communications, in marketing this kind of service is an interesting straw in the wind.

Another reason supporting the expectation of the development of national information systems is the growing international interest in the development of world-wide systems for handling scientific and technical information. Logically, there is little chance for the success of an international information system without the development of sound national subsystems. A number of organizations are seeking to exploit the opportunities offered by improved scientific communications to improve international relations and underwrite international progress in science and technology. Among these organizations are the International Council of Scientific Unions (ICSU), the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the Organization of Economic and Cultural Development (OECD), and others. Significant steps are being taken in a number of professional and other fields, such as chemistry, nuclear energy, health, documentation, physics, highway research, and space, to name but a few.

In a world that Marshall McLuhan believes will before long become a "global village," the importance of improved communications as a binding force can hardly be over-estimated, especially as populations increase, science and technology expand, education increases, and national efforts to develop and improve information systems draw more support and resources.

The need to help underdeveloped nations develop, construct, and operate information-processing systems that will help them make their way and live in harmony with the more advanced nations of the world is a responsibility the developed countries cannot ignore. Unilaterally and through international organizations, one may expect the United States to take a leading role in assisting the developing countries to achieve modernity through better information systems.

While a number of *de facto* information networks in a variety of fields already exist, there are also a number of networks in the making. One prototype project has been proposed by the Interuniversity Communications Council (EDUCOM) to link a group of more than sixty universities in the United States and Canada for the exchange of information about science, technology and the education process. According to a news release, "the network will be used for dialogue between scientists and other users for mutual solution of their problems." The proposed program, which is known as EDUNET,

> envisages an eight-month start-up period of a prototype system in which specifications and charges will be established. This will cost $500,000. Then follows a year in which the network is set in motion on a narrow-band basis of digital and voice information at a cost of $3 million. Finally, there will be another one-year period for testing and moving the network into high gear for image transmission, including television. This will cost $5 million. The first step will consist of establishing system research laboratories in the U.S. West Coast, Midwest, and East Coast—each with a time-shared computer. These will handle information among the universities in their respective areas and, in addition, there will be five switching points that will take care of universities too remote to use the three computers directly. With expansion, EDUNET will be available to any EDUCOM university or government agency.[4]

One of the most compelling reasons to support the prediction that national information systems are drawing near is the amazing proliferation of information networks in industry. Virtually all large corporations and many medium-sized ones (especially those that are geographically dispersed and that offer a wide range of products and services) are moving rapidly to develop better internal and external communications systems.

According to Merrill M. Flood, "At least one of our largest manufacturing corporations operates an internal network that makes it possible for each of its offices equipped with a teletypewriter to use several company computers at various points in the country. The interaction between the person at the teletypewriter and the remote computer is essentially instantaneous in both directions with the user receiving exactly the same service were he at the computer." [5] Flood concludes, "Those with a teletypewriter on the telephone system have all the equipment necessary to make full and effective use of several major computing installations in the United States." [5]

Another revealing trend is the arrival of the information utility network. Not only are organizations like Western Union and American Telephone and Telegraph Company moving in this direction, but large computer manufacturers like IBM are also in the field. The trend has become sufficiently pronounced to cause the Federal Communications Commission to undertake a series of new studies, dealing with regulations and rates for service.

Information networks share common characteristics with more familiar forms of communication, such as the American highway system with its ever-increasing size and ability to carry traffic, and the web of railways of an earlier day. The networking phenomenon has been evident in the growth of a complex of pipelines, power lines, airlines, and waterways. It seems part of the genius of Americans to spin networks as the busy spider spins webs, an arachnoid tendency shared by other countries of the world as they achieve modernity. An understanding of ontogenetics may be useful to explain the phenomenon, but this is left to the historians and the scholars to investigate. Information network growth is merely part of a more general communications systems development.

More than twenty years ago the science-fiction writer, Arthur C. Clarke, wrote a paper on the synchronous satellite and predicted that orbiting satellites might be the key to communications in the future.[6] While his prediction has not come to a full flower, there is ample evidence to show that greatly improved world communication is at hand. International telecasting by means of large networks of television stations is commonplace today, drawing less interest on the part of the populace than a new automobile in the neighbor's garage.

If there is any doubt about what this means to us, one might recall the late John Von Neumann's observation that all experience shows that even smaller technological changes than those now in the cards profoundly transform political and social relationships. Von Neumann, whose theoretical work in mathematics had so much to do with the development of the computer, observed that the world finds itself in a rapidly-maturing crisis which can be attributed to the fact that the environment in which technological progress must occur has become both undersized and underorganized.

If Von Neumann was correct—and it is hard to disprove his logic—and we are in a crisis of underorganization and that a transformation of political and social relationships is in the cards, it becomes easier and perhaps more productive to consider the structuring of scientific and technical information and other networks as productive and necessary acts of protective or social engineering.

Communications technology, it has been frequently said, provides man with an unprecedented opportunity to help solve some of the pressing problems resulting from an expanding population in a shrinking world. Anthropologists and historians of science remind us of the contributions and impact made by the Stone Age cave painters, the scribes of the Middle East, the copyists of the Middle Ages, and the printers of the world. In our own era, the man in the street is increasingly familiar with the advance of the electronic media and microphotography, and even copies documents himself by means of xerography at the corner drugstore or local library. These milestones reveal the simple fact that as man develops new communications tools to improve his control of his environment he is in turn influenced by the communications tools he fashions. Norbert Wiener understood this all too clearly when he enunciated his theories of cybernetics, defining the relationship between the control and communications arms, and and the need for some kind of balance.

An understanding of what is happening and what may happen in the future is a necessary prelude to the next stage—the development of better communication systems.

Just as we sense conflicts arising in the quest for ownership and control of domestic communications satellites, we should expect to see the same thing happening in the growth of information utility networks. While this is to be expected in a pluralistic society and undoubtedly the process contributes to the vigor and momentum of our science and technology, we should not expend all of our energy in fighting interminable, energy-draining campaigns and battles that might turn out to be Pyrrhic victories for all. The important objective is not primarily the construction of elaborate communications hardware, but formation of information systems that promote better communications among the peoples of the planet, that encourage the channeling of information and data for the common good, and that make the content of the world information bank more readily available to all.

Many forces are driving us towards national information systems, and there are many problems to be solved: resources to be obtained and applied, agreements to be made about the operation of subsystems, determination of the respective roles of all components of the information systems (including libraries), selection and preparation of those who will man the systems at all levels, integration of the systems elements, preparation of plans, ascertainment of user requirements, determination and establishment of ownership and control of components, ascertainment of relationships and switching of information throughout the systems, and many others.

What does all this mean to librarians? There is no doubt in my mind that librarians can and will have a substantial contribution to make in the development of modern information systems. Just how much will depend on a number of factors, some within and some outside of the control of the library community.

First, I believe that the initial requirement for librarians will be to utilize their excellent centers of learning to focus on the gathering of knowledge about the visible and foreseeable changes in information-handling. Such a charting of intelligence is mandatory.

Second, in order to undertake programs designed to adapt to modern information systems, it is necessary to evaluate critically the capabilities of libraries to undertake necessary changes. The balance sheet should not exclude staff readiness to change, availability of resources, presence of long-term leadership, evolution of goals and objectives, and required educational and training updating.

Third, the library community or specific groups in it should be consulted to determine how they want to participate, or feel qualified to participate in development of and participation in national information systems. Consideration should be given to the presence and probable growth of non-library information activities in the determination of the library role.

Fourth, decisions should be made about specific actions to be taken by various groups in the library world, and necessary agreements with these groups should be made.

Finally, a small, full-time group should be established to keep the program moving, listen to reactions, and provoke new actions and ideas.

The library community, with its dedicated people, its large plant, and its desire to participate in the development of modern information systems based on new technology and human needs, can play an ever more significant part in the common quest to expand and use human knowledge.

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