A Perspective on Information Resources

PROGRAM SCOPE, AIMS AND PRACTICES

Annual Report 1974-75
Volume One

PROGRAM ON INFORMATION TECHNOLOGIES AND PUBLIC POLICY

Harvard University
Cambridge, Massachusetts

PROGRAM SCOPE, AIMS AND PRACTICES
ANNUAL REPORT 1974-75
VOLUME 1

Available on request is Volume 2 of the annual report for 1974-75, *The Program Year in Review*, describing the specifics of Program research, teaching and communication activities.

PROGRAM ON
INFORMATION TECHNOLOGIES
AND PUBLIC POLICY
OCTOBER 1975

HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS

Act as men of thought. Think as men of action.—Henri Bergson

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PROGRAM DIRECTOR

Anthony G. Oettinger is Gordon McKay Professor of Applied Mathematics, Professor of Information Resources Policy, and a member of the Faculty of Public Administration at Harvard University. He is currently director of the Harvard Program on Information Technologies and Public Policy and has served as chairman of the Committee on the Computing Center and as a Research Associate to the Program on Technology and Society.

He is Chairman of the Cable Television Commission of the Commonwealth of Massachusetts. He was an advisor to the subcommittee of the Committee for Economic Development that prepared the report *Broadcasting and Cable Television: Policies for Diversity and Change*, issued by CED in April, 1975. Since 1956, he has served as a consultant to Arthur D. Little, Inc., on the application of information technologies to many industries; he served as a principal consultant to the ADL team that prepared *The Consequences of Electronic Funds Transfer — A Technology Assessment of Movement Toward a Less Cash/Less Check Society*, a report for the National Science Foundation issued in January 1975.

He has been president of the Association for Computing Machinery (1966-68) and a consultant to the Office of Science and Technology, Executive Office of the President of the United States (1961-73). He is a Fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Science and the Institute of Electrical and Electronics Engineers.

As chairman of the Computer Science and Engineering Board of the National Academy of Sciences (1967-73), he led the preparation of NAS reports on *A Technical Analysis of the Common Carrier/User Interconnections Area* (Lewis S. Billig, Project Director), *Databanks in a Free Society: Computers, Record Keeping and Privacy* (Alan F. Westin, Project Director) and on *Libraries and Information Technology—A National System Challenge* (Ronald L. Wigington, Project Director).

He is the author of *Automatic Language Translation: Lexical and Technical Aspects*, of *Run, Computer, Run: The Mythology of Educational Innovation* and of numerous papers on the information technologies and their uses, including, most recently, *Elements of Information Resources Policy: Library and Other Information Services*, a report of the Program to the National Commission on Libraries and Information Science.

EXECUTIVE DIRECTOR

John C. LeGates is Executive Director of the Program and Research Fellow in Information Resources Policy. His experience prior to joining the Program has been in the development of educational and medical applications of computing.

At EDUCOM, he was the executive director of the Educational Information Network (EIN) and the author of several articles on computer networking. Earlier, as Vice President of Cambridge Information Systems, Inc., he was director of the technical staff, and responsible for the company's nationwide marketing efforts. He also directed the development of the Massachusetts General Hospital Integrated Information System.

At Computer Advisory Services to Education, Inc., he was vice president and director. At Bolt, Beranek and Newman, Inc., he was responsible for exploring the potential of the TELCOMP language in education.

His studies were in mathematics (Harvard) and philosophy (Yale).

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INTRODUCTION

The public has a vital interest in the rapid and fundamental changes occurring in:

- how information systems perform;
- what controls information flow;
- and on what terms what information is made available to users to meet their needs for the knowledge and understanding required to participate fully in our society.

Of central importance is the question of who holds how much power over whom.

It is the aim of the Harvard Program on Information Technologies and Public Policy to develop an understanding of information systems and information technologies and to use that understanding to illuminate public discussions of information policy.

This is the first volume of a two-volume annual report, the third the Program has issued. In this volume we summarize the scope of the Program (Section 2). This volume also reports on the purpose of the Program (Section 3), and offers fairly detailed commentary on how we go about our work (Section 4; Appendix).

The second volume of the annual report describes the specific research activities undertaken by the Program in pursuing the broad objectives described

The Information Industries
Approximate Gross Revenues. **FIGURE 1.**

Estimates gathered from U.S. government, trade associations and other sources; all figures in current dollars; double counting not eliminated.

	(in billions of dollars)			
	1970	1971	1972	1973
Broadcast television	2.8	2.8	3.2	3.5
Cable television	0.3	0.3	0.4	0.5
Broadcast radio	1.1	1.3	1.4	1.5
Telephone	18.2	20.0	22.4	25.5
Telegraph	0.4	0.4	0.4	0.5
Specialized common carriers	0.0	0.0	0.0	0.0
Satellite carriers	0.1	0.1	0.1	0.1
Mobile radio systems	2.0	2.2	2.4	2.6
Motion pictures	3.8	3.8	NA	NA
Organized sports, theaters, etc.	4.4	NA	NA	NA
Computer software suppliers > Computer service suppliers	1.9+	2.4+	3.0+	3.7+
U. S. Postal Service	6.3	6.7	7.9	8.3
Private information delivery services	0.7+	0.8+	1.0+	1.2+
Newspapers; wire services	7.0	7.4	7.8	8.3
Periodicals (including newsletters)	3.2	3.4	3.5	3.7
Business consulting services	0.9	1.1	NA	NA
Advertising	7.9	7.6	NA	NA
Marketing	32.4	37.7	41.3	43.4
Brokerage industries	40.6	47.4	54.4	NA
Book publishing and printing	3.4	3.7	3.9	4.1
Libraries	2.1	NA	3.6	NA
Schooling	70.0	76.3	83.2	89.5
Research and development	26.5	27.3	29.2	30.6
Federal information institutions				
Census Bureau	0.1	0.1	0.1	0.1
National intelligence community	4.0+	NA	NA	NA
National Technical Information Service	0.0	0.0	0.0	0.0
Social Security Administration	1.0	1.2	1.3	1.4
County agents	0.3	0.4	0.4	0.5
Banking and credit	61.1	68.9	76.9	NA
Insurance	92.6	103.5	121.4	NA
Legal services	8.5	9.6	NA	NA
U. S. Gross National Product	977.1	1,055.5	1,155.2	1,294.9

in this booklet; it also tells about our efforts to pass along our findings to the general public and the interested parties in the policy issues we have studied, and it includes a list of available Program publications.

2

THE SCOPE OF THE PROGRAM

The Information Industries

Information pervades all organized activity. Information is as vital a resource as energy or matter. It does not warm us or shield us from the elements, but it is all around us, filling our heads, our files, and the memories of our computers. Its characteristics are unique, its possibilities are endless; it is ill-understood, but it must be understood.

Some of the members—public and private—of the present constellation of information industries are illustrated in Figure 1. A common trait of the listed activities is that, in each case, information is the primary or sole output. Excluded from the table, but important as information users, are all the industries where information processing, however important, is incidental to producing such primary outputs as cars or haircuts.

The Social Security Administration, the county agent system and the banking, insurance, securities and legal service industries are listed to mark the borderline suggested by such a "primary business test." Whether the output of these industries is information or something else is arguable. However, each industry's "production line" is essentially nothing other than an information processing line.

These information industries occupy an unusual public-private milieu with regulation on varying scales and of varying intensities. They employ millions of people, deal in billions of dollars and use varying technologies to achieve diverse missions. Each has developed independently with little reference to any but direct competition.

As a group, they have grown in step with the vast increase in the sheer amount of information processing that has occurred in the last 30 years. As Figure 2 shows, while population grew at an average rate of 1.5 percent a year between 1940 and 1970, the number of checks written went up 6.7 percent a year; the number of motor vehicle registrations went up at the rate of 4 percent; the number of individual federal tax returns grew at 5.8 percent a year; passports issued, at 16 percent; individual social security payments, at 17.1 percent. Improvements in electronics have greatly increased our capacity to handle information and greatly reduced the costs of handling information, but the growth of the information industries and of labor engaged in information occupations (Figure 3) reflect changes in society far beyond mere technological innovation.

Until recently, virtually all attempts to study the information industries have concentrated on particular cases and not on the basic functions of information industries, on diversity rather than affinity. The notion of the importance of thinking about basic functions and not only about particular cases is not yet widely accepted in the realm of information services, but it has been usefully applied elsewhere. As competition grew from aluminum, plywood, plastics, glass fiber, and other materials, steelmakers came slowly to understand that they were supplying only one of many structural materials, and that many of steel's functions could be fulfilled by alternate materials. Similarly, most railroad men have learned, sometimes forcibly, that trains are but one of several competing modes of transportation. Oil, coal, electricity, radioactivity, the wind and the sun are alternate, competing sources of energy.

Alterations in the relations between oil and coal in the energy industries, or among trains, boats and pipelines in the transportation industries clearly have large implications for public policy. Changes in the relations between information industries (Figure 4) may have a similar impact on the public.

Today, major political, economic and technological factors are altering or eliminating the historic barriers between information industries (Figure 5) and making new alternatives available to information users. Most notable are the vast increases since World War II both in transactions entailing information processing and in the capability and reliability of electronics, increases that go hand in hand with large decreases in the costs of electronic technologies. What therefore happens to one information industry strongly affects not only all the others, but also the public generally. These relationships have not been widely recognized and little is known about their effects on either the industries or the public.

The Information Technologies

The story of the growth since World War II of alternate technological and institutional means for creating, storing, processing, distributing and using information is mainly, though by no means exclusively, the story of electronics.

Figure 2 speaks volumes about how public and private transactions affecting millions of people and entailing massive information processing have increased in the past three decades, whether driven by, or driving, simultaneous advances in information technologies. Changing patterns of world trade in the products of electronic technologies are illustrated in Figure 6.

Advances in electronics continue swiftly in both the private and the public sectors. For example, in the public sector, defense research and development is still an important factor in electronics today, as it was in the development of electronic computers. According to testimony by the Pentagon's Director of Defense Research and Engineering, "military-oriented electronics technology continues to be one of our fastest moving and most productive areas of applied research and development," accounting for $216 million or nearly 15 percent of the $1,474 million budgeted for the "total technology-base effort" in fiscal year 1974.[1]

[1] John S. Foster, in "Hearings on Cost Escalation in Defense Procurement Contracts and Military Posture and HR 6722", Committee on Armed Services, House of Representatives, 93rd Congress, First Session, 1973, p. 701. Another estimate has it that "the Pentagon's direct and indirect outlays for electronics and materials R&D will top $3.2 billion in fiscal 1974. . . . The total, approximately 40% of the Department of Defense's $8.1 billion in planned R&D expenditures for the year, is not only the largest R&D outlay by far of any Federal Agency, its electronics content exceeds that of all other agencies combined. . . . In fact, Federal support of electronics technology is as pervasive as electronics itself." *Electronics*, Oct. 25, 1973, p. 200.

The technological bases of computers and telecommunications are increasingly similar and both of these tools are increasingly pervasive as means for controlling and linking hitherto separate old and new technologies. The notes on merging technologies illustrate how this is a major factor in making the functions that information industries perform and the technologies they use both less distinguishable and more interchangeable.

The increasing pervasiveness of electronics owes much to massive increases in capability accompanied by equally massive decreases in costs, both in absolute terms and in comparison with older information technologies. For example, computing speed increased by a factor of one hundred million-to-one between the 40's and the 70's. By the end of the decade, a transistor could "be about as cheap as a word printed on the page of a hard-cover book."[2]

The cost per component (mostly transistors) of the first rudimentary integrated circuits made around 1960 was about one dollar. By 1973, this cost had dropped to about one cent and it is predicted to drop to about .003 cent by 1980, a ratio of thirty thousand-to-one in two decades.[3] In the same time span, the number of components per integrated circuit is expected to grow by a factor between one hundred thousand and one million-to-one. Similar factors in other dimensions are illustrated in Figures 7 and 8. In electronics, large increases in capability and large decreases in cost go hand-in-hand, along with significant increases in reliability.

At present, many of the information industries do not produce or control the production of their technology. A notable exception is the telephone industry.

[2]William C. Hittenger, "Metal-Oxide Semiconductor Technology", *Scientific American*, August, 1973, p. 48ff.

Average Annual Growth of Various Transactions.

Increases in the volume of annual transactions. Adapted from Alan F. Westin and Michael A. Baker, *Databanks in a Free Society* (a report of the Computer Science and Engineering Board, National Academy of Sciences), Quadrangle Books, New York, 1972, pp. 224-227. The GNP growth rate is based on GNP expressed in constant dollars.

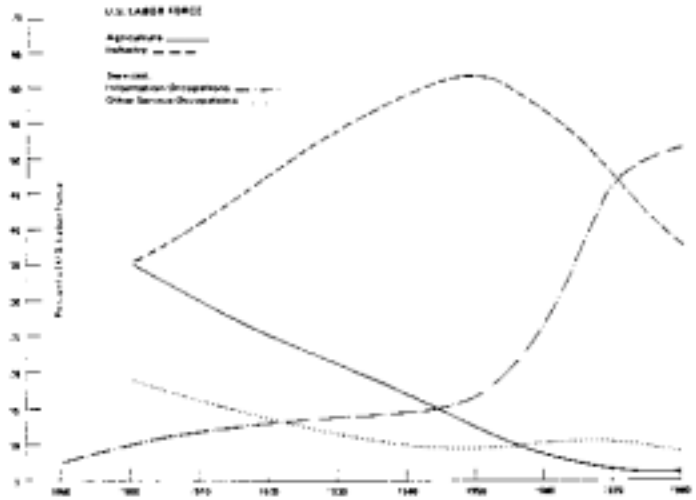
FIGURE 2.

AVERAGE ANNUAL GROWTH 1940-1970	TYPE OF TRANSACTION
6.7%	Checks written
6.2	Telephones in use
17.1	Individual Social Security payments
5.8	Individual federal tax returns
3.5	Public welfare recipients
14.3	Airline passengers
3.8	Persons entering hospitals for treatment
9.5	Persons covered by private hospitalization insurance
4.0	Motor vehicle registrations
16.0	Passports issued
5.2	Students enrolled in colleges and universities
3.7	Applications received for federal employment
8.3	New York Stock Exchange transactions
3.6	Pieces of mail handled, U. S. Postal Service
6.5	Abstracts produced by Chemical Abstracts Service
1.5	U. S. population
3.9	U. S. gross national product

Percent of U.S. Labor Force in Information Occupations.

Growth in information-processing service occupations is the major factor in the increase of all service occupations relative to industrial and agricultural occupations. This finding by Edwin B. Parker and Marc Porat is based on their analysis of U. S. Bureau of Labor Statistics data (*Social Implications of Computer/Telecommunications Systems*, Report No. 16, Program in Information Technology and Telecommunications, Center for Interdisciplinary Research, Stanford University, February 1975).

FIGURE 3.



American Telephone and Telegraph owns Bell Laboratories and Western Electric for research, development and manufacturing. General Telephone and Electronics owns GTE Laboratories, Automatic Electric, Lenkurt and Sylvania.

The details and trends of common control patterns vary among major information technology suppliers such as Eastman Kodak, Hughes, IBM, RCA, Xerox, etc. But, with some exceptions (see Figure 9), these suppliers now are generally still distinguishable (both by function and institutionally) from the industries whose output is information itself. The structure and performance of these supplying industries is also a matter of importance to the Program since the relationship between technology suppliers and information systems is a factor in understanding how patterns of competition, function allocation and public intervention in the information industries affect the public.

A COHERENT VIEW OF INFORMATION RESOURCES

Historically, patterns of information use, of market structure, of public intervention, of analysis and of evaluation have developed independently in the information industries. Presumably, these patterns were adapted to the particular users, markets and technologies of each.

However, the record of the past decade suggests that the information industries are becoming increasingly intertwined (Figure 5).

This growing interchangeability and indistinguishability is a natural development because all information systems perform one or more of the following basic functions:

- *creating* information
- *storing* information
- *processing* information
- *distributing* information
- *using* information.

These information functions, of course, pervade all organized activity. In the information industries, however, they are *primary* functions. Elsewhere, they are *incidental* to some other primary role. Even the massive information processing performed by railroads or supermarkets qualifies them as important information users, but not necessarily as information industries.

As the primary functions of the information industries overlap, so do the technologies available to perform these functions. There are many more alternate technological means for creating, storing, processing, distributing and using information than there were at the close of World War II, or even just five years ago. Consequently, many varied combinations of hitherto separate information industries are jockeying for control of old and new turf, thus raising specific business questions—such as those found in Figure 10.

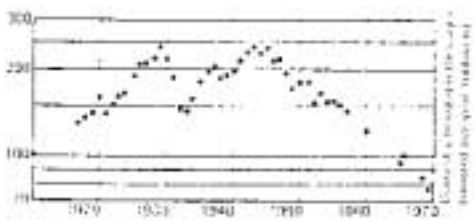
The need for a coherent view of information systems, for a look at the processes that mold the structure and performance of information industries as a group, can be best indicated by illustrating the stormy waves that shifting information functions among industries might drive across hitherto distinct industries and the general public.

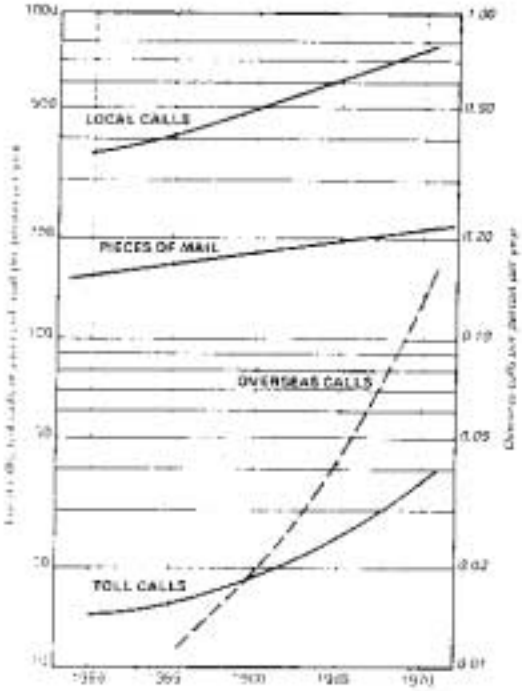
For example, were increases in the electronic transfer of funds substantially to affect the volume of transactions carried in the mail (Figure 11), this could substantially alter the patterns of paying for both the mail (Figure 12) and the telephone (Figure 13), as well as the relationships among financial institutions and their clients. The general public could be affected directly through the price of stamps and phone calls, and indirectly through changes in the costs of mail and

FIGURE 4.

Mail and Telephone Use Increases; Telegraphy Declines.

Information functions shift from one information industry to another. These charts, adapted from "Communication" by John R. Pierce (*Scientific American*, September 1972, p. 37), indicate a decline in telegraphy in recent years and a rapid growth in mail and telephone communication. Note that the charts are not comparable, and that two scales are superimposed in the chart on mail and phone usage.





phone services as seen by newspapers, television networks and book publishers among many others.

Established relationships among the players in any one game, illustrated for telecommunications in Figure 14, could be upset by the entry of players from other affected games with different rules. Thus, present differences in structure, in jurisdiction, in legal and other traditions among the information industries are as important to understanding how their interacting affects the public as are the growing similarities of basic functions.

Some of the information industries, for example newspapers and the telephone companies, are primarily in the private sector. Others are essentially in the public sector, like the U.S. Postal Service and the Federal information institutions. Still others are mixed, like libraries and schooling. Some, including the telephone and telegraph companies and the Postal Service, transfer information without exercising substantial control over what content flows among users. Others, including television, newspapers, book publishers and public schools create, process and disseminate information content.

Different traditions of government and other public intervention apply. The competitive book publishing and newspaper industries have been affected indirectly through devices such as taxation or postal rates (which side-step judgments as between "worthy" and "unworthy" publications that might interfere with the protection extended to content by the First Amendment) and directly as through censorship. The telephone and telegraph companies are monopolies sub-

Notes on Merging Technologies. **FIGURE 5.**

Once upon a time, telephone technology seemed to be what the telephone industry used to supply telephone service. But the scientific and technological foundations of telephone systems and of computer systems are now merging as both increasingly rely on the same large-scale integrated digital technology for their information transmission, storage, processing and control functions. The boundary between telecommunication and data-processing functions has been the subject of a major inquiry by the FCC, but the issue is still wide open.

Motion pictures once meant only film technology, but motion pictures are now routinely recorded, stored and played back on either film or videotape, often under the control of computers. Digital recording of pictures exists, but is not yet routine. Once upon a time motion pictures had to be physically "bicycled" to theatres. Now they may also be electrically broadcast over the air or sent over telephone company or cable television lines to theatres, hotels or homes.

Cable television relies on coaxial cables to retransmit broadcast television material, including motion pictures, but also relies on microwave wireless technology to capture this material. Coaxial cables are also a major element of the telephone network where they are used, among many other functions, to transmit television pictures and computer data. Most computers also incorporate some coaxial cable. And, coaxial cable is by no means the only technology suitable for non-broadcast distribution of either television signals or computer data.

Printing, once associated exclusively with moveable, reusable slugs of metal type, increasingly relies on computer-aided composition directly onto film. Some visions of future home delivery of "newspapers" foresee an all-electric operation from the moment a news item leaves a reporter's hand at a keyboard, is transmitted over someone's wire or wireless service for display to an editor working at a TV-like screen, is assembled with other materials in a computer's storage medium and then is retransmitted over someone's wire, microwave link, light pipe, laser beam or whatever to the home television set of a reader who then has the option of capturing the text permanently through some form of dry-copying or printing technology.

The Mailgram service links electrical transmission by the private sector with on-foot transmission by the public sector into a single system. Customers of the telegraph company with teleprinters on their premises transmit messages to post offices equipped with teleprinters where postal employees remove messages, place them in envelopes and put them in the first class mail stream.

jected to economic regulation, but essentially free from intervention as to content, over which, in any case, they have little control. Intervention in television content is manifest through such devices as the Fairness Doctrine, through governmental pressure, and through the actions of consumer groups before regulatory agencies or the courts. The public schools are instruments of state and municipal governments.

The information industries are inexorably international. All transactions between nations rely heavily on information transfer. The International Telecommunications Union and the International Postal Union are among the oldest arenas of international cooperation, but in keeping with the times, their proceedings have become increasingly politicized.

The pattern of information resource development in the United States differs sharply from that for most of the rest of the world. Nowhere else is the private sector so predominant. Most developed countries have their postal, telephone, and telegraph industries united in a single government ministry. The underdeveloped countries are all pursuing the establishment of national and international telecommunications and broadcasting, placing very large hopes on information as a vehicle of national consciousness and development.

Because of the differing patterns of structure, jurisdiction and tradition among information industries and across national borders, a shift in the performance of some basic information function from one information industry to another entails specific political and legal questions and not only classical economic questions about returns to scale, price-setting mechanisms and so on. These questions are illustrated in Figure 15.

The specific business, political and legal questions illustrate broader underlying questions. Information, materials and energy are the fundamental resources essential to the physical and spiritual well-being of every living creature. Profound technological changes characterize all three realms. The already enormous and still forthcoming increases in the capacity and decreases in the cost of electronic information-processing devices may efface contemporary time and distance on a global scale and profoundly alter information flow over historical time. The very context

FIGURE 6.

Changing Patterns of World Trade in Electronics Products

	IMPORTS	EXPORTS	BALANCE
		(in millions of dollars)	
CONSUMER ELECTRONICS			
1967	562	98	−464
1970	1,274	144	−1,130
1971	1,487	169	−1,318
1972	1,993	231	−1,762
1973	2,259	318	−1,941
1974	2,100	300	−1,800
1975 (est.)	2,400	320	−2,080
TELEPHONE AND TELEGRAPH EQUIPMENT			
1967	31	46	+15
1970	55	76	+21
1971	79	61	−18
1972	86	77	−9
1973	125	113	−12
1974	157	150	−7
1975 (est.)	170	180	+10
COMPUTERS AND CALCULATING EQUIPMENT			
1967	59	475	−416
1970	180	1,237	−1,057
1971	232	1,262	+1,030
1972	348	1,342	+994
1973	344	1,717	+1,373
1974	382	2,315	+1,933
1975 (est.)	440	2,780	+2,330

The trends in U.S. imports and exports in three categories of electronics goods, as tabulated by Paul Polishuk, Office of Telecommunications, U.S. Department of Commerce, from data in the Department's *U.S. Industrial Outlook, 1975*.

of all other questions may thereby be altered, as illustrated by some of the underlying questions being asked (Figure 16).

3

ADDRESSING PUBLIC POLICY — THE PROGRAM'S PURPOSE

On the premise that clarity will serve everyone better than the present muddle, the Program aims to develop an understanding of information systems and information technologies and to use that understanding to illuminate public discussion of information policy and the information industries.

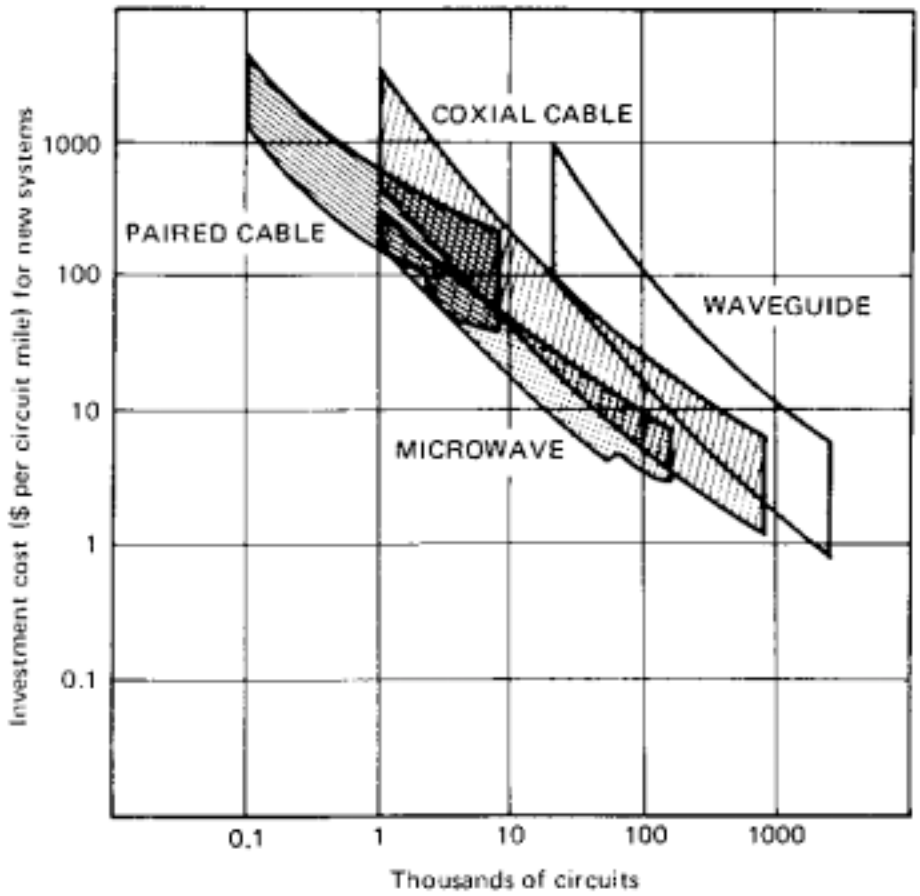
This means:

- finding the facts about what happens now and how it came to be that way, by addressing the specific business, political and legal questions raised in the preceding section as well as the implied underlying questions;
- identifying and addressing basic policy questions, like those in Figure 17, about who is likely to get what, when, how, and working out significant options and their likely consequences by considering a wide range of policy instruments, as illustrated in Figure 18;
- presenting these facts, options and consequences to government, industry and the general public in intelligible and timely fashion.

The Program seeks to frame and present options and consequences that are significant for the neglected middle term, two to ten years ahead. Questions relevant to that period can be recognized as such, but have usually not been asked; policy options are concrete

Costs of Alternate Methods of Information Transmission.

FIGURE 7.



Cost trends for terrestial transmission of information are down while carrying capacity is up. Paired cable is the original telephone technology still in use; the others are later developments. The increases in the handling capacity of the four transmission systems represent developments over time as well as technical improvements. The investment costs are expressed as a range. This chart is adapted from staff papers prepared for the President's Task Force on Communications Policy, 1969.

enough to be meaningfully discussed, but they have not yet been foreclosed; the consequences of choice are not so remote from the present as to defy any but the most speculative projections.

In the short term, we bow to the consultants, and draw on their work and expertise. In the long term, we bow to the academic and professional disciplines, and draw on their work and expertise.

In addressing the middle term, the Program seeks to be responsive enough to the perceptions of policy players to be relevant to matters seen as important, and intellectually independent enough to examine both the perceived importance and the appropriateness of different ways of addressing these matters.

The procedures the Program follows toward these objectives are described in the next section.

4

ADDRESSING PUBLIC POLICY — THE PROGRAM'S PRACTICES

APPROACH TO RESEARCH

Methods

The Program's work draws extensively both on conventional academic research techniques and on the working relationships established with affiliates and other private and public individuals and organizations. The Program has successfully developed and used processes for exchanging data, ideas, commentary and review with the latter. This capability is vital to research in an area where the literature is sparse or unreliable.

Some background material is amenable to discovery by research in printed sources within the University and out-

FIGURE 8.

Information Access Time, Storage Capacity and Costs.

ACCESS TIMES		
Typical today:		
Millions of bits		**10-100 milliseconds (10^{-2} sec.)**
Expected in future:		
to 1 billion (10^9) bits		**1-100 microseconds (10^{-6} sec.)**
to at least 1000 billion bits		**100 milliseconds (10^{-2} sec.)**
to perhaps 100,000 billion bits		**1-10 seconds**
TYPICAL ON-LINE CAPACITIES		
8 Tape units	Routine	**1-5 billion (10^9) bits**
8 Disk units	Routine	**1-5 billion bits**
IBM Photo-digital store	Borderline	**500 billion bits**
Precision Instrument Co. Unicon 690	Borderline	**1000 billion bits**
"New" disks	Foreseeable	**4-20 billion bits**
Optical technology	Foreseeable	**100-10,000 billion bits**
Electron beam technology	Foreseeable	**100-1,000,000 billion bits**
SOME ROUGH COSTS		
Paper		**0.1-10 million (10^6) bits/dollar**
Microfilm		**1-100 million bits/dollar**
Present disks		**10,000 bits/dollar**
Future high capacity stores		**1-100 million bits/dollar**

The capacity for handling information will grow enormously in the next 30 years, judging from the technological innovations already in the works. Computers process information in "bits", each representing a "yes-or-no" answer, or the information represented by a single hole in a punched card. It may take several bits to express a word or number. Access to this information — taking it from the computer's storage capacity and bringing it to the area of the machine where it can be manipulated — is measured in the number of bits that can be retrieved in a given time. "On-line" capacity measures the amount of information that can be kept on the machine, comparable to the capacity of an automatic phonograph or a juke box. To get at more information you have to change storage units manually. The new technologies referred to utilize magnetic bubbles, lasers, holography or electron beams, which permit the packing of larger amounts of information into smaller spaces. As for the cost measure, a primary disadvantage of the microfilm or punched paper technologies is that the medium of storage cannot be renewed. Estimates are by John W. Weil, *Mass Storage and Databases — Technical Implications for the Future*, presented at Institut de la Vie Conference, Bordeaux, 1970.

side. This includes basic scientific, technical, economic and political information, demographic data, analyses of trends, and so forth, where well structured and reliably documented by the theories and methods of scholarly and professional disciplines. This information is augmented by other information available only from participants in the field, including self-descriptions, descriptions of the technological state of the art, analyses of actual situations, know-how, empirical data, and perceptions as to the relative weights of different factors.

The research group within Harvard University, on its own initiative or in response to the suggestions of others, frames issues and hypotheses, prepares background documents and analyzes data that are then taken to the participants in the field for review and criticism. This cycle may be repeated several times in the course of a project, intimately linking the conduct of research and the spreading of findings.

Personnel

Rather than bringing together people of different capabilities with equal managerial responsibilities, the Program brings together people with equal intellectual responsibilities, the reviewers, but with project management centralized in the project director.

Project directors and staff come from a variety of situations. They run the entire gamut of seniority from undergraduates to full professors or senior persons from outside the University. They may make themselves known to the Program as researchers with a topic in mind, or be discovered by the Program seeking someone to work on a set topic. More detail on the setting of priorities and topic selection is given on page 13.

Affiliation

The Program has built a network of affiliations with diverse individuals and organizations in the field. Organizations presently affiliated are listed on the title page.

In the best cases, affiliation is a working partnership. The affiliated organization is expected to supply to the Program some or all of the following:

O suggestions of topics for research which it considers significant and amenable to investigation;

O basic, non-confidential data, especially about itself;

O informal comments and criticisms on Program ideas and documents;

O financial support;

O dissemination of Program materials to the relevant people within the organization;

O presence of members of the affiliate on the review committees of projects of mutual interest;

O informal communication between the Program and affiliate staff members;

O informal referrals.

The Program in turn undertakes to supply to the affiliate:

O copies of each faculty seminar and colloquium announcement, and an open invitation to attend;

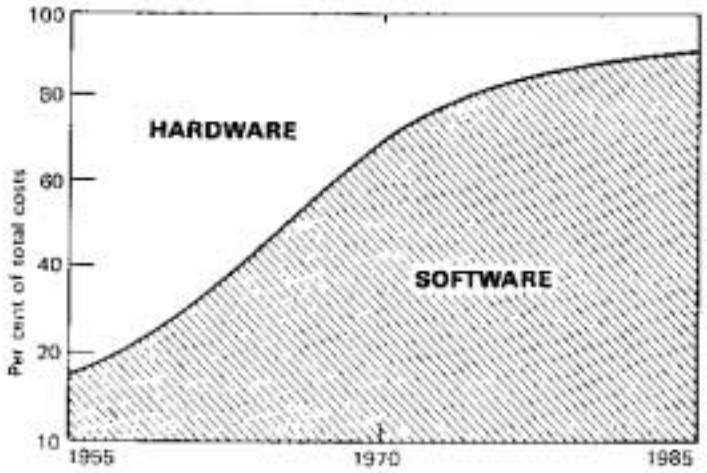
O one copy of each Program publication as it appears. Additional copies are available on request;

O informal communication between the affiliate and Program staff;

O data and comments on request;

Hardware/Software Cost Trends. **FIGURE 9.**

Hardware/Software cost trends in computer systems show a pronounced shift toward a higher proportion of software costs. The tasks that any particular computer system actually does are specified only in part by how the physical system (hardware) is built. Programs of instructions (software) must be fed into the system to complete the specification. This complementarity (and, indeed, interchangeability) of hardware and software blurs the boundary between technology suppliers and the computer software supply industry, which we count among the information industries. The trend estimates are by Barry Boehm, in *Software and its Impact: A Quantitative Assessment*, RAND paper P4947, December 1972, p. 5.



O referrals;

O opportunity for the affiliate to suggest research topics;

O use of the Program's review procedures on a highly selected basis.

Many individuals within affiliated organizations have said that the greatest benefit to them is the availability of our work to all parties in policy making processes. This, they hope, will help upgrade the quality of the decision-making process generally.

Affiliations usually begin with strong, top-level personal contacts between the affiliate and the Program. The affiliate then appoints someone to refer Program materials to those people most concerned with each specific document. The Program then sends out its materials as described above. When a match of interest is found, communication becomes as great as necessary: sharing data, reviewing drafts, exchanging opinions, pooling resources, etc. The most effective form of substantive exchange has been the review process.

Reviewing

The heart of the Program research and dissemination process is review of its materials by affiliates, by members of Harvard University, and by diverse other individuals.

Effective reviewing consists of getting candid criticism and appraisals from several sources repeatedly throughout the life of a project.

For any project, a group of reviewers is generally made up as follows:

O persons representing each scholarly discipline or field of expertise required for a thorough treatment of the subject. Since many Program topics cross conventional fields of knowledge, this frequently pulls together such usually disparate groups as, say, lawyers, engineers, and business economists;

O within each specialty, there is at least one person from within Harvard University, and at least one from outside;

O where material is potentially controversial, there is at least one representative from each likely party to the dispute.

The material is submitted for review several times during its life cycle. It goes out at least once while the work plan is being drawn up. It goes out at least once more during the course of the work. Meanwhile, informal communication between the project director and his reviewers is encouraged. The Program requires that its project directors take reviews seriously. The reviewers are considered to be an "intellectual board of directors" for the project. In many projects, at least one meeting of this group is scheduled.

The Program has developed considerable expertise in the packaging of material for review so that a reviewer can handle it without great demands on his time. Partly this means appropriate

Specific Business Questions. **FIGURE 10.**

What now determines . . . ?

Who shall deliver motion picture entertainment to the public? Movie houses, hotels, telephone companies, over-the-air broadcasters or cablecasters? Whether transportation or telecommunications shall be used to disseminate the pictures? Whether the service shall be paid for by advertisers, by the viewers directly, through private or public subsidies or by other means?

Whether data shall be carried from computer to computer or to and from terminals in businesses or homes by telephone companies, specialized common carriers, cable television systems, the Postal Service, or private information delivery services? Who shall own the terminals and maintain them to the users' satisfaction?

How services to learners will be allocated among the schools as we now know them, libraries, broadcast or cable television, publishers or new institutions, public or private?

Who among the banking, securities, telephone, telegraph industries, the Postal Service and private information delivery services shall perform which information services? (For example, some 40% of the mail deals with financial transactions, so that the fates of the Postal Service and of payment mechanisms are intimately linked.) With how much supervision by whom? The Federal Communications Commission, the Securities and Exchange Commission, the Federal Reserve System, associated Congressional committees or state authorities? Who shall set standards for media and formats of data transfer and storage?

brevity, partly taking the right level of question to the right level of reviewer, and partly asking people to comment on areas where they are already knowledgeable. Outcomes of the review process have been strategic commentary, such as indications of the relative importance of issues, and specific personal interactions and data.

On the dissemination side, the same process gets reviewers acquainted with Program work while it is in progress. They see not only the parts germane to their expertise, but the other parts as well. Along the way they gain the data and background thinking that goes into the work and also develop an informal relationship with the Program staff — themselves experts in the field.

Because of this interaction, the reviewers are involved with the work and aware of its findings; because of this interaction, the final report is a better product for wider audiences.

Certain operational difficulties have been faced in the past and solved or alleviated.

○ *Will they cooperate?* The Program has already built up a network of affiliated organizations. Cooperation is one of the terms of affiliation. The reviewing process has been tested and tuned to where it is quite productive for the Program and of great enough mutual advantage for "repeaters" to have become common among reviewers.

○ *Isn't much of any organization's "real" knowledge confidential and not given out?* The organizations and the Program are both aware of the dangers of leaking confidential information. The Program has security procedures to keep confidential information within its own doors, and has frequently been entrusted with it. In addition, when some information is withheld by organizations, their criticisms are nonetheless based on it. We are capable of inference. Whatever the intermediate processes, however, Program research is generally documented only from publicly available sources or from authorized and attributed quotations.

○ *Do the organizations "feed" advocacy information to the Program to make it an unwitting spokesman?* They may "feed" it to us, even intentionally, but we don't have to "swallow" it. We *want* their point of view. That is why they have been recruited as affiliates but, in any given research project, the points of view of *all* interested parties are sought; no project is so narrowly drawn as to allow its outcome to grossly favor — or to overlook — any special interests.

Topic Selection

Within the scope of the Program, more research is possible than will ever be done. Priorities are set by a topic selection process intimately linked to affiliation and reviewing.

Topics for research originate in either of two ways: they may be suggested to the Program (by an affiliate or by a government request for proposal, for example); or, a topic may be generated by the Program management.

Sometimes a topic comes simply as an idea, and sometimes it comes accompanied by an individual who wishes to pursue it. People and ideas are brought to the Program's attention at the approximate rate of one a week.

Whatever its origin, any promising topic goes through the following steps, any of which may lead to redirection or termination:

○ An initial project description is reviewed by the Program Director and Executive Director, who usually request the opinions of qualified reviewers inside and outside the University;

○ The author makes a presentation at a Faculty Seminar, including an advance draft for all participants;

What's in the Mail?

FIGURE 11.

What's in the mail? Using figures from *Toward Postal Excellence*, the 1968 report of the President's Commission on Postal Organization, we can deduce the existence of a large overlap between information handling in transactions and the mails. Some 60 percent of all mail is sealed letters. Thus, we see from this table that if sealed letters are primarily transactions and correspondence, two-thirds of the letter service may be devoted to transactions.

Transactions (Mail containing checks, bills, statements of account, purchase orders, etc.)		**40%**
Correspondence		**22%**
Personal	**13%**	
Business	**5%**	
Government	**4%**	
Advertising		**26%**
Magazines and Newspapers		**11%**
Merchandise		**1%**

○ Taking the seminar into account, the author revises the draft. This new draft in turn is reviewed by the Program staff, and may be returned to the author for further revision;

○ The draft is then formally circulated to reviewers. This is the beginning of the formal review process. Our instructions to reviewers are reproduced in the Appendix.

The successful outcome of this process is a work plan or proposal formally accepted by the Program management.

This process draws the line between proposal writing and project work very conservatively, by usually imposing a long gestation period on each project. Preparing a proposal generally entails acquiring additional knowledge, especially if the work is to be done with the breadth of competence called for by Program strategy. Such acquisition is usually indistinguishable from the early stages of research. Except for the deadlines imposed by requests for proposals, there is rarely a clearcut place to draw the line between proposal writing and project performance.

In essence, therefore, the Program asks its own questions and then, if necessary, seeks funding to address them. Program management must run the idea through the gauntlet of reviewers, but retains sole responsibility for accepting a project as the Program's.

Reports

Although it would be foolish to prescribe a standard format for Program reports, some loose guidelines reflect the Program's purposes and audiences.

The Program does not recommend policy. Academic recommendations seldom carry much force; more significantly, there is seldom only one policy to recommend. Instead, the Program wishes to inform the public and other players of the following:

FIGURE 12.

How is the Mail Paid For?

MAIL SERVICE	ATTRIBUTABLE COSTS IN $ MILLIONS	REVENUES (ATTRIBUTABLE + OVERHEAD COSTS) AS PERCENT OF ATTRIBUTABLE COSTS
1973 Total	4,903.1	200.7
First-class mail	2,414.2	189.6
Airmail	189.0	112.6
Priority mail	150.7	233.6
Second-class mail	362.2	51.4
Publishers mail	356.7	50.7
Outside the county:		
Regular rate publications	257.8	57.4
Other	68.4	27.2
Within the county and fees	30.4	46.7
Controlled circulation publications	20.5	179.5
Third-class mail	759.6	153.0
Bulk rate	624.3	159.3
Single piece rate and fees	135.3	124.0
Fourth-class mail	526.8	144.1
Zone rate mail	401.3	160.0
Parcels	386.0	158.6
Catalogs and fees	15.3	194.8
Special fourth class rate	116.0	97.2
Library rate and fees	9.5	43.2
Government mail	98.2	411.4
International mail	187.2	169.1
Special services	192.7	166.9
Other	2.2	

Controversies about postal rates are mainly about how fairly service benefits and price burdens are distributed over senders and recipients of the different types of mail service.

Overall, the U.S. Postal Service meets its costs through revenues from its users plus some direct Congressional appropriations. In postal accounting, attributable costs are those that vary with the volume of a service or are otherwise a fairly clear consequence of providing that service. Attributable costs for 1973 were 4,903 million dollars. Non-attributable "overhead" costs were 4,937 million dollars, making the total costs — hence the required revenues — 9,840 million dollars, or 200.7 percent of the attributable costs.

Attributing attributable costs is partly a technical matter, but assigning overhead burdens is wholly arbitrary. If proportionality of overhead costs to attributable costs is taken as the yardstick of fairness — itself a controversial policy choice — then, at the extremes, government and priority mail are seen to carry disproportionately high shares of overhead costs and publishers' and library mail disproportionately low shares. (Data from *Statistical Abstract of the United States*, 1974, p. 497.)

○ what are the background data on the area;

○ who are the significant players;

○ what are the forces on them;

○ what are the trends;

○ what are the policy options;

○ what are their likely consequences; who is likely to gain and who likely to lose by each.

Each finished report is made available in a version in English plain enough for laymen. If the report is lengthy, there is a short "executive summary".

APPROACH TO AUDIENCES

Since the Program wishes to make its findings known to the general public, the leading corporations producing or using information resources, and governments at all levels, the whole panoply from "rifle" to "shotgun" is used to target its findings. This includes the affiliation and reviewing process; conventional publication in scholarly or professional journals, in general magazines, and elsewhere; presentations at conferences, seminars or other meetings; and testimony at legislative or regulatory hearings.

APPROACH TO FINANCE

If the Program's contributions to policy players are to be both trustworthy and useful, then intellectual independence, relevancy and timely productivity are all essential.

In this light, the Program's approach to finance may be described as seeking intellectual independence through economic servitude to all.

To avoid the reality or even the appearance of being in the pay of any party with a stake in the policy issues it studies, the Program seeks a multiplicity of contributors, none with a majority or even a strong minority position; none with strings attached; and collectively representing a set of interests diverse enough for pressures to cancel themselves out. Conversely, the Program can survive only by being relevant and productive in the eyes of a large enough group interested in the scope of matters addressed by the Program.

In addition, the Program comprises two parts: the Core Program, and the Projects. The Core Program selects and sustains the activities of the Program as a whole. The Core Program sets priorities, defines new projects, maintains communication, and fosters coherence and synthesis in analyzing the problems of information resources policy. Each project is devoted to a particular research topic or set of topics, and follows a work plan prepared within the Core Program. The Core Program and the Projects are funded independently.

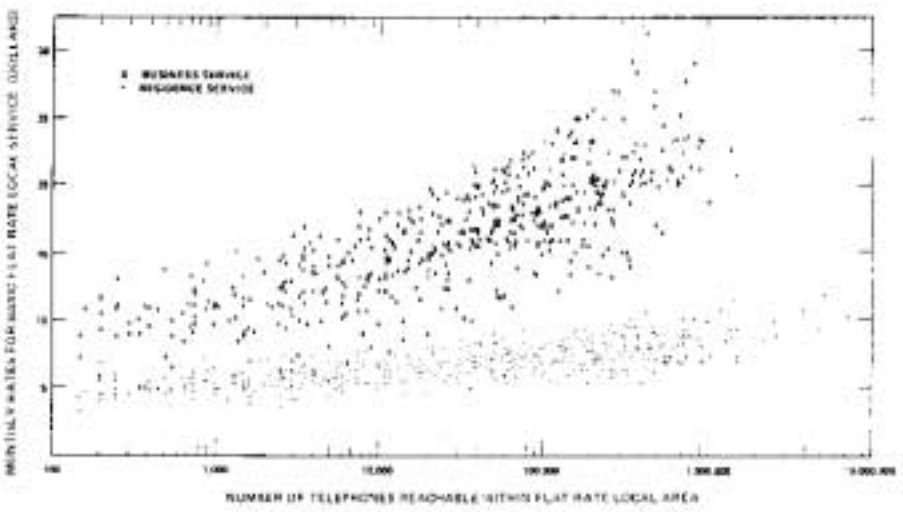
The Core Program is supported by the affiliates, in such a way that no supporter supplies a majority, or even a strong minority of the money. Money is only accepted with no strings attached other than the ties of substantive cooperation that bind the affiliation and reviewing processes. In seeking affiliates, the Program aspires to the following:

● each major information industry is represented;

How are Telephones Paid For? **FIGURE 13.**

In mid 1974, for about $5 a month, anyone in the United States could make an unlimited number of calls from his home telephone to any of the other telephones in his local service area, if these numbered 1,000 or less. If they numbered 1,000,000 or more, the price was closer to $10. For business telephones, which use essentially the same plant and personnel, the prices ranged from about $10 to $25.

Regulators set total telephone company revenues roughly equal to total company operating costs plus a return on their investment. However, as with the Postal Service (Figure 12), how fairly service benefits and price burdens are distributed entails controversial policy choices involving — to varying degrees — the actors listed in Figure 14. (Plotted from data in *Exchange Service Telephone Rates in Effect June 30, 1974*, National Association of Regulatory Utility Commissioners.)



- a competitor is represented for each contributor;
- a member of a competing industry is represented for each contributor;
- users are represented, as well as suppliers;
- and both public and private interests are represented.

A level of funding is sought so that the Program has enough cash on hand to sustain the safeguards embodied in the topic selection process described on page 13. Enough cash is also desired so that the Program may withstand lengthy contract negotiations. One such negotiation succeeded in removing restrictions on the Program's right to publish under a government contract. In addition, the Program wishes to build up a contingency fund equal to one year's operating budget, so that it may survive temporary lean periods or shut down gracefully.

The Program does not aspire to wealth beyond these amounts; it prefers continuing tests of its utility. Each affiliation is renegotiated periodically, and random attrition requires new affiliates to be sought out. The continual pressure to convince the participants of the need for the Program prevents a tendency to drift into irrelevance or non-productivity.

Each project must be funded on its own merits once a work plan has been prepared within the Core Program. This is another form of submittal to the acid test of the marketplace. Projects, like the Core Program, must avoid the appearance or reality of financial subjugation to a party at interest. Therefore, sources like the private foundations, the government, or groups of companies are approached with balances as for the Core Program.

An added virtue of the Program financial strategy is that organizations, having committed their funds to the Program, are more likely to give it serious attention. This means both attention to the substantive side of the affiliation, and attention to the Program findings.

FIGURE 14.

The Telecommunications and Teleprocessing Players.

The principal players in the U.S. domestic telecommunications arena are many and varied, sometimes at cross-purposes, sometimes coalescing.

- **1** **American Telephone and Telegraph Company**
  (including Bell Laboratories and Western Electric)
- **21** **Bell Operating Companies**
- **1** **Western Union**
- **ca. 1800** **Independent telephone companies**
- **5+** **Specialized common carriers**
- x_1 **Value-added service companies**
- x_2 **Teleprocessing service companies**
- x_3 **Electronics and business machine companies**
- x_4 **Trade associations**
  (National Association of Regulatory Utility Commissioners, U.S. Independent Telephone Association, North American Telephone Association, Computer and Business Equipment Manufacturers Association, Electronic Industries Association, etc.)
- **1** **Congress of the United States**
- **1** **Federal Communications Commission**
- **1** **United States Postal Service**
- x_5 **Other federal executive agencies**
  (Internal Revenue Service, Rural Electrification Administration, Rural Telephone Bank, White House Office of Telecommunications Policy, etc.)
- x_6 **Courts**
- **49** **States**
- x_7 **Municipalities (in Texas)**
  (regulators, legislators, consumer agencies, etc.)
- x_8 **Municipalities (Nationwide)**
  (local taxation, pole rights and other rights-of-way, etc.)
- x_9 **Investors supplying debt and equity capital**
- x_{10} **Consumers**
  (including individuals, corporations, consumer groups, and governments)
- x_{11} **Foreign nations**

Review Guidelines

Review groups include both well-informed laymen and experts.

They serve as "intellectual boards of directors" and aim to:

- enable projects to pass muster in all disciplines and enterprises they touch on;
- help find pertinent collaborators and data;
- provide quality control;
- redirect or abort projects when necessary.

The reviewing process should avoid second-guessing authors or substituting the views of the reviewers for those of the authors. Reviewers can press their views as strongly as they wish, but the authors take the final responsibility for their product and may treat what the reviewers say as advisory only.

The organization and procedures of the review will in each case be worked out by the Program Director in consultation with the reviewing group and the authors. Experience has shown that at least one meeting between the authors and the reviewers is very desirable.

Matters of purely stylistic editing are most efficiently dealt with at the time of editing of a final draft. Thus this need

APPENDIX

Specific Political and Legal Questions. **FIGURE 15.**

What now determines . . . ?

Whether broadcast traditions, publishing traditions or telephone traditions respecting control over information content shall prevail in cable television?

Whether the school board would pass on educational materials to be shown on a TV channel in the way it now passes on textbooks used in the school? Whether the Federal Communications Commission's Fairness Doctrine would apply? What a teacher's rights to switch to a noncurriculum channel might be? A student's? A parent's?

If the use of private facilities for state-approved learning continues to grow, what shall govern the rights and the obligations of teachers when, traditionally, private employers have had much greater freedom in hiring and firing employees than school boards have?

What happens to rights of privacy or to rights of access to information when the information itself is transferred from an institution following one set of traditions on this score to one following another? When the allocation of an information function flows from one industry to another? When an information function flows from one industry to another? When information held by an international organization moves across national boundaries?

If satellite surveys of natural resources move from experiment to routine operation who shall operate such systems? Who shall have access to the information about natural resources and other data collected by these satellites? Whether operation and access shall be public? Private? National? International?

FIGURE 16. Underlying Questions.

What now determines . . . ?

How patterns of access to information will be distributed among nations? Among individual citizens? What the likely effects of different patterns will be on political and economic processes? Locally? Nationally? Globally?

How joint growth or tradeoff among information and transportation functions will affect the distribution of people and of material and energy resources?

How the very suppliers and users of information themselves will be altered by changes in the means of learning? By the changes in organizational structure and changes in the pattern of power in organizations associated with new patterns of flow and control of information?

FIGURE 17. Basic Policy Questions.

What are the implications for information users of jockeying among old and new information organizations for old and new information markets?

What are the likely effects on information users of increasing or decreasing competition among old and new information organizations?

How does the traditional mixture of private enterprises and public agencies serve information users? What would be the likely effects on users of shifting the allocation of any information functions from one industry or agency to another? From the public sector to the private sector or vice versa? From national to international control or vice versa?

How responsive are traditional patterns of governmental and other public intervention in information systems to the needs or demands of information users? What would be the likely effects of extending or curtailing intervention nationally? Internationally? What alternative patterns are available? With what likely effects?

What governs the nature and the rate of technological innovation in information systems; and with what likely effect on information users?

not seriously concern the review group.

The key questions that reviewers should bear in mind are as follows:

a. When reading work plans:
- O Is the context of the plan clearly described?
- O Are tasks and products explicitly defined in the plan?
- O Are resources specified in the plan consonant with the tasks?
- O Is the proposed budget realistic?

b. When reading report drafts:
- O Is the report clear and concise?
- O Is the report convincing?
- O Is the report complete?
- O Is the report fair?
- O Could a conflict of interest harm the report?

a. Plans

Is the context of the plan clearly described?

Are the current policy issues or the gaps in our knowledge to which the plan is addressed clearly specified? Are the assumptions on which the work will be based stated explicitly? Is there concrete evidence of the basis in existing knowledge on which the proposed work will build? Is there satisfactory evidence that related or similar research efforts are known to the investigators? Is a solid case made for the need for the work? Is the work consistent with the goals of the Program on Information Technologies and Public Policy? Does the work naturally match the interests of any prospective sponsors? Could the work be done at least as well elsewhere? Are the audiences for the work (and the expected value of the work to these audiences) clearly identified?

Are tasks and products explicitly defined in the plan?

Is the work organized? Are tasks spelled out enough to provide clear guidance to those who will be carrying them out? Are clearly identifiable products specified for

Policy Instruments.

FIGURE 18.

Although attention to government regulation has tended to focus on such means as the copyright laws or the Federal Communications Commission, the range of the tools of government that may or may not be exercised is far wider. (Listing adapted from Joseph F. Coates, *Structural Failure: The Case of Local Government*, an unpublished paper.)

- **Laissez-faire**
- **Taxes**
- **Tax write-offs**
- **Regulation of price, quality and entry**
- **Standards**
- **Research and development**
- **Prohibitions; financial and criminal sanctions**
- **Subsidies**
- **Rewards for innovation and invention**
- **Incentives, e.g., matching funds**
- **Model legislation**
- **Import/export trade management**
- **Information exchange**
- **Establishing or supporting an industrial base by government purchase**
- **Establishing new institutions**
- **Government control or monopoly**
- **Building civil works**
- **Propaganda**
- **Fear**

each task? Is a procedure for further defining a subsequent phase and for deciding whether or not to undertake it clearly specified as a task in the preceding phase?

Are resources specified in the plan consonant with the tasks?

Are the resources of Harvard University and of the Program on Information Technology and Public Policy appropriate to the tasks? Is there a clear, adequate commitment of qualified faculty and Program administration time to the tasks? Is there a reasonable plan for recruiting talents not already in place and committed to the tasks? Is there reasonable assurance that proposed information sources are adequate and accessible enough to assure a solid factual base for the work in each task?

Is the proposed budget realistic?

Can all tasks in the first phase be completed within specified time and dollar budgets? Is there a reasonable allowance for detailing subsequent phases?

b. Reports

Is the report clear and concise?

Are the arguments and expositions intelligible to the intended audience? Is the style of the report consistent throughout or, if not, is there a good reason? Are there statements that are ambiguous or may be misunderstood? Are technical terms explained? Do figures and tables support inferences made from them? Does each figure or table have a function? Are additional figures or tables needed? Are the style and organization adequate?

Is the report convincing?

Are the arguments likely to be convincing to the layman? Has a thorough effort been made to marshal reliable data? If there are strong or extreme statements, are they adequately supported and documented? Are there arguments that should be recast and made more cogent? Are there illogical or incomplete arguments? In short, do the authors make a good case for their views from the standpoint of a less involved or committed audience?

Is it complete?

Are important relevant points omitted? Are some topics slighted and others overemphasized? If so, does this bias the report?

Is it fair?

Are the viewpoints of others fairly presented? If there are strong criticisms of institutions or individuals, are they adequately documented? If a policy or action is attacked, is the policy in question fully understood or described? If a highly novel and not generally accepted viewpoint is expressed, is it identified as such?

Conflict of interest?

Is there material that is likely to appear as excessive special pleading? Are recommendations being made for expenditure of funds that will benefit institutions (including Harvard University) with which the authors are connected?

c. Conclusion

Virtually none of the questions listed above elicits simple answers. Exercise of sensitive judgment is essential. The authors should be given the benefit of the doubt unless the possibility exists that the report will not creditably represent them or the Program on Information Technologies and Public Policy.