DOCUMENT RESUME

ED 115 304 IR 002 856

AUTHOR Freeman, James E.; Rubenstein, Albert H.
TITLE The Users and Uses of Scientific and Technical Information: Critical Research Needs.
INSTITUTION Denver Univ., Colo. Research Inst.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE Nov 74
NOTE 52p.

EDRS PRICE MF-$0.76 HC-$3.32 Plus Postage
DESCRIPTORS Conferences; Information Science; Research; *Research Design; *Research Methodology; *Research Needs; *Research Problems; Research Utilization; Sciences; Technology
IDENTIFIERS *Scientific Information; Technical Information

ABSTRACT

At a 1973 workshop held in Denver, Colorado, 21 participants familiar with the uses of Scientific and Technical Information (STI) services gathered to identify the system's major research needs. Initially, 50 research projects were suggested in the areas of design, management, operations, marketing, and global considerations. Using a priority weighting technique, the list was reduced to the 10 most critical research needs, and five of these were selected for discussion about appropriate research designs. The appendices of this document include the lists of researchable questions and the quantitative results from the allocation rating forms. (EMH)

THE USERS AND USES OF SCIENTIFIC AND TECHNICAL INFORMATION: CRITICAL RESEARCH NEEDS

—Prepared by—

James E. Freeman
University of Denver
and
Albert H. Rubenstein
Northwestern University

This project was supported by the National Science Foundation under Grant GN-40981. The statements and conclusions in this report are the responsibility of the authors and not of the Foundation.

November 1974

TABLE OF CONTENTS

INTRODUCTION

Interest in the needs and requirements of users and in increasing the involvement of users in the design of science information services has expanded rapidly over the past several years. Major reasons for this include the recent and sharp increases in the production, distribution, and cost of scientific and technical information (STI). Partly in response to these trends, many individuals and organizations have begun to study and to influence the ways that scientists, engineers, managers, citizen activists, and others use STI.

To help identify what user and use problems should be given highest research priority in the near future, the National Science Foundation arranged for a workshop in Denver in November 1973 at which 21 industrial, governmental, and academic representatives generated and set priorities on 50 critical research issues. Professor Albert H. Rubenstein of Northwestern University chaired the workshop. Participants also completed two post-workshop evaluations of the original set of STI user/use issues. Research economist James E. Freeman of the Denver Research Institute coordinated this followup activity and preparation of this report.

We hope the ideas presented here will stimulate discussion of the issues and how they might be studied. Persons with questions or suggestions concerning these issues, or with ideas concerning other issues that should be considered, are invited to contact any of us who participated in the workshop.

Joel D. Goldhar
Director, User Support Program
Office of Science Information Service
National Science Foundation
Washington, D. C. 20550

SUMMARY

Problem and objectives. Understanding the users and uses of scientific and technical information (STI) has become increasingly difficult during the past decade. At the root of this difficulty, five major trends have been operative: (1) an increased emphasis on socially-relevant research and development activity; (2) a concomitant escalation in the production of STI; (3) a proliferation of new STI systems and services (STI/SS's); (4) information overload; and (5) sharply increased costs in handling STI. The principal objective of the workshop project reported here was to identify a set of critical research needs and experimental possibilities related to the users and uses of STI. Results of this project should be of value to the entire STI community, including: (1) those responsible for proposing that particular research projects be undertaken; (2) those responsible for supporting and initiating new patterns of research on STI uses, users, and related services; and (3) those concerned with scientific and technical information policy.

Methodology. The project, under funding from the National Science Foundation's Office of Science Information Service, proceeded through three stages. In Stage I, a workshop was convened in Denver, Colorado on November 26, 27, and 28, 1973; 21 academic, industrial and government people generated and prioritized a set of approximately 100 "critical research issues and potentially researchable questions." Stage II, which occurred between January and March 1974, involved two post-workshop evaluations of the original set of issues and questions. Stage III, from March through May 1974, consisted of an effort by three participants to translate a subset of the critical issues into preliminary designs for potential experimental projects.

Principal results. Participants decided that *highest, but not exclusive, priority* should be given to research projects that treat marketing aspects of STI/SS's. In particular, they recommended that research be done: to find more useful ways of categorizing the users of scientific and technical information; to determine more effective means of familiarizing potential users with STI/SS's; and to learn how to apply other traditional marketing techniques (e.g., assessing share-of-market and competitive position) to the design and control of STI/SS's. *Other high priority* research issues selected by participants include: determining the relevance of STI to major social problem areas (e.g., energy, environment, transportation); improving the use of information concerning users in the design and management of STI/SS's; identifying new kinds of STI intermederiaries; analyzing the impact of copyright law on STI/SS's; and assessing the impact of innovations in computer technology on STI systems and services.

Three participants—Pauline Atherton, Theodore Melnechuk, and William Paisley—made an exploratory attempt to translate five of the critical research issues into potential research projects. Results of their efforts are presented in the body of this report.

CHAPTER I. PROBLEM AND APPROACH

On November 26, 27, and 28, 1973, twenty-one academic, industrial, and government people with special interests in the field of scientific and technical information (STI) participated in a workshop conducted by the University of Denver Research Institute under a grant from the National Science Foundation's Office of Science Information Service. The topic of the workshop was *The Users and Uses of Scientific and Technical Information;* its purpose was to identify and explore critical research issues and experimental possibilities related to this topic.

Participants qualified on one or more of four counts: (a) involvement in research on STI problems; (b) professional responsibility for designing scientific and technical information systems or services; (c) management of such systems or services; (d) formulating or implementing public policy related to scientific and technical information. Some of the participants fit two or more of these categories.

PARTICIPANTS

Pauline Atherton, Professor, School of Library Science, Syracuse University.

Alok K. Chakrabarti, Research Associate, Department of Industrial Engineering and Management Sciences, Northwestern University.

James E. Freeman, Research Economist, Denver Research Institute, University of Denver.

Joel D. Goldhar, Director, User Support Program, Office of Science Information Service, National Science Foundation.

Thomas A. Grogan, Manager, Market Research, McGraw-Hill Information Systems Company.

Joanne Hartley, Research Economist, Denver Research Institute, University of Denver.

James Kollegger, President, Environmental Information Center, Incorporated.

James P. Kottenstette, Research Economist, Denver Research Institute, University of Denver.

Nan Lin, Professor, Department of Sociology, State University of New York at Albany.

Theodore Melnechuk, Coordinator, Research Interpretation Program, Western Behavioral Sciences Institute.

John Murdock, Head, Energy Information Center, Battelle Memorial Institute.

William Paisley, Professor, Institute for Communication Research, Stanford University.

Donald Pelz, Project Director, Survey Research Center, Institute for Social Research, University of Michigan.

Martin D. Robbins, Senior Research Economist, Denver Research Institute, University of Denver.

Albert H. Rubenstein, Workshop Chairman, Professor, Department of Industrial Engineering and Management Sciences, Northwestern University.

Theodore W. Schlie, Research Economist, Denver Research Institute, University of Denver.

David Staiger, Director, Information Programs, Society for Automotive Engineers, Incorporated.

Clarence Sturdivant, Supervisor, Technical Information, Marathon Oil Company.

Charles Thompson, Associate Professor, Department of Industrial Engineering and Management Sciences, Northwestern University.

Peter Urbach, Deputy Director, National Technical Information Service, U. S. Department of Commerce.

Donald VanDyken, Manager, Product Development, Information Handling Services, Incorporated.

The following persons also contributed ideas to the workshop even though they could not attend the sessions: Wayne Boucher, Secretary, Senior Project Manager, The Futures Group; Walter Carlson, Manager, Advanced Marketing Development, International Business Machines Corporation; James May, Director, Center for Communication and Information Research, Graduate School of Librarianship, University of Denver; Joseph Szyliowicz, Associate Professor, Graduate School of International Studies, University of Denver; and John Welles, Head, Industrial Economics Division, Denver Research Institute, University of Denver.

BACKGROUND

The workshop, in one sense, was a partial response to several recent trends that have forced fundamental changes in the management and use of much scientific and technical information. Those trends include, but are not limited to, an increased emphasis on socially-relevant research and development activity; a concomitant escalation in the production of STI; a proliferation of new STI systems and services; information overload; and sharply increased costs of handling STI.*

An important factor underlying these changes has been the emergence of somewhat different, if not entirely new, needs for scientific and technical information systems and services (STI/SS's). What are those emergent needs? How do they differ from one audience or user group to the next? How effectively and economically are scientific and technical information (STI) systems and services responding to emergent requirements?

That adequate answers to these and related STI questions are yet to be found is reflected in the recent and thoroughgoing reorganization of the National Science Foundation's Office of Science Information Service. The establishment of the User Support Program was particularly relevant to the conduct of this workshop. The new program suggests that nontraditional research questions soon must be addressed concerning the variety of traditional and nontraditional STI users, uses, delivery systems, and service concepts.

---

*The nature and significance of these trends has been pointed out by the Committee on Scientific and Technical Information (*Scientific and Technical Communication*, Washington, D. C.: National Academy of Sciences, 1969); by J. E. Freeman, J. P. Kottenstette, and M. R. Robbins (*New Information Services in Social Problem Areas*, Denver: University of Denver Research Institute, 1973); and by W. T. Knox ("Systems for Technological Information Transfer," *Science*, 181, 3 August 1973, 415-419.

The National Science Foundation supported this workshop to help in (1) reviewing what progress has been made to date in identifying and treating STI use issues, especially barriers to effective STI use; and (2) providing researchers interested in investigating such issues with an opportunity to develop the beginning of a research "agenda" for the field.

PROCEDURE

The workshop itself was loosely organized around approximately 50 critical research issues which, in varying states of refinement, were formulated in advance by participants.* The first raw list, including a number of potentially researchable questions related to many of the issues, is presented in *Appendix A.*

Workshop participants decided late in the meeting to take part in two post-workshop evaluations of key STI issues and researchable questions. The prime purpose of the first post-workshop evaluation was to reassess the issues and questions after (a) redundancy in the original list had been reduced, and (b) the set of issues had been subgrouped into logical categories. The second evaluation round form is reproduced in *Appendix B.*

The second post-workshop round of evaluation served still another purpose, that of suggesting to potential STI research sponsors which of the issues might receive the highest funding priority in the near future. Each participant was asked to assume that a total of 1,000 points could be allocated across the thirty STI issues that had received the highest overall ratings in the previous two rounds of evaluation. *Chapter II* presents and analyzes the results of this "1,000 point allocation" exercise.

Identifying and evaluating the importance of STI use and user issues would be sterile if no attempt were made to demonstrate how those issues could be translated into experimental projects. To this end, three workshop participants—Atherton, Melnechuk, and Paisley—were asked to formulate a series of potential research projects related to a subset of STI issues identified and evaluated by participants as areas of critical research need. Their suggestions for possible experiments are presented in *Chapter III.* They are presented only as illustrations of the process of using the issues identified in Chapter II to develop research projects. It should be possible for readers of this report to replicate the process for any of the other issues that might be of interest.

CONCLUSION

What areas of concern relevant to STI uses and users should be considered of critical importance during the next three-to-five years? What research methodologies, in the form of field or administrative experimentation particularly, should be employed in efforts to facilitate progress in treating those issues? Given limited resources, what might be the tradeoffs when certain research initiatives are undertaken while others are not?

The Delphi-like technique employed in meeting the objectives of this project generated potential answers to these questions. By inviting participants to evaluate the original list of research issues and

*The phrase "research issue" connotes an unresolved problem amenable to systematic (often scientific) analysis and judgement. A "critical" issue is a problem that may be decisive in the scheme of things.

questions, and then to reevaluate subsequent revisions of that list, an appreciable reduction of initial divergences occurred. The three rounds of evaluation also permitted quantitative processing of essentially qualitative issues. From these deliberations, this report was shaped; hopefully, it will serve as useful input to current thinking concerning what research should be conducted into the uses and users of scientific and technical information.

CHAPTER II. CRITICAL RESEARCH NEEDS

The process of deciding what scientific and technical information issues are of critical importance is as much a product of history as it is of reason. Reason plays a part, of course, since persons making such decisions attempt to weigh the alternatives as effectively as possible. Their decisions, however, are limited by their opportunities which, in turn, are limited by history—that is, by existing commitments, by the types of institutions currently disseminating STI, and, in a more fundamental way, by the perspectives they have concerning the nature of "scientific and technical" information.

Midway through the workshop, a significant difference was discovered in participants' orientations to the STI area. This chapter analyzes the nature of the difference, describes the way the discovery of the difference led to the formulation of a new perspective, and, finally presents a list of top-priority research needs within the framework of the emergent perspective.

GLOBAL VERSUS FAMILIAR PERSPECTIVES

During the small group meetings that were interspersed between plenary sessions, participants suggested and reacted to dozens of different ideas. One participant, James Kottenstette, noted that his particular group was experiencing "communication difficulties" during the consideration of various STI issues and research needs. He further noted that others in his group, and in the other three small groups as well, shared his concern over such difficulties.

After some probing, it was hypothesized that two different perspectives concerning STI systems and services were at the core of these difficulties: one perspective was labeled *global,* the other *familiar.* Participants having a *global* view were concerned principally with STI user/use issues that ordinarily lie beyond the control of STI/SS designers and managers. Examples of "global" issues include recent changes in copyright law and practice; the emergence of new priorities in research and development; and the trend toward finding and borrowing, rather than generating, scientific and technical information. STI/SS designers and managers must try to understand and cope with global issues; however, they typically do not regulate the forces that created or currently affect such matters. Globally-oriented participants tended to evaluate the criticality of issues, not surprisingly, with a set of criteria derived from the nature of the contexts or environments within which STI/SS's are operated.

In sharp contrast, participants with a *familiar* view of STI/SS's preferred to focus attention on user/use issues that characteristically fall under the functional control of STI/SS designers and managers. Illustrations of "familiar" issues involve, among other things, the use of information concerning user behavior in STI/SS design; the segmentation of STI markets; and networking. STI/SS designers and managers are fairly free, within resource limitations, to determine who should do what, how, and when to deal with the problems implied in familiar issues. Participants more interested in familiar issues assessed the importance of such issues on the basis of considerations essentially internal to the design and operation of STI/SS's.

Another interesting difference was discovered between "globals" and "familiars" when they were asked to define the basic components or elements of STI systems and services. Analysis of their written definitions revealed that "globals" tended to use nouns (e.g., media, sources, messages, users), while "familiars" more often used verbs and verbal derivatives (e.g., generation, acquisition, retrieving, using). The meaning or significance of this difference is not at all clear. One possible interpretation is that the language used in defining STI/SS's simply reflects the degree of control designers and managers perceive that they exercise over issues they confront: the *less* control they think they have, the more useful

"nounal" definitions become, since they capture the basically passive position of STI/SS's in the context of larger "external" forces. Conversely, the *more* control designers and managers perceive they can exert, the more appropriate "verbal" definitions are, because they underline the active ability of designers and managers to formulate and regulate STI/SS activity.

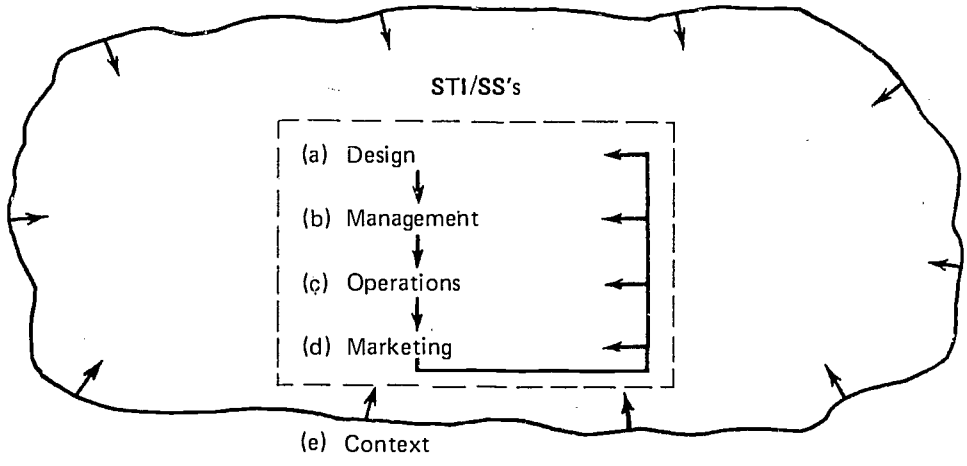
THE EMERGENT "FIVE LEVELS" PERSPECTIVE

The discovery of the different perspectives or orientations toward STI systems and services became a matter of major concern in subsequent considerations of critical STI research needs. Post-workshop analysis of the original list of issues, which are presented in *Appendix A,* revealed a 7-to-1 ratio of familiar-to-global issues deserving STI research emphasis in the immediate future.

To simplify the second and third rounds of evaluating and prioritizing the issues, a strategic decision was made to organize the familiar issues into four "internal" or "functional" levels of concern to STI/SS designers and managers: (a) design; (b) management; (c) operations; and (d) marketing. *Design* refers to the planning process that ordinarily *precedes* the establishment and operation of STI/SS's; this term connotes the specification of system objectives as well as selection of the methods, techniques, hardware, and other means to be used in accomplishing those objectives. *Management, operations,* and *marketing* concern various interrelated aspects of STI/SS's that *follow* the design process. *Management* includes the organization, financing, and evaluation of STI/SS's. *Operations* involve the procedural dimensions (e.g., training programs, publication, distribution) of STI/SS's. *Marketing* encompasses the subset of STI/SS activities related to identification of potential STI users, determining their preferred modes of obtaining STI, assessing the competitive posture of various information services, and the like.

These four functions, depicted in Figure 1, comprise issues over which STI system and service managers ordinarily exercise some degree of control. An additional level, (e) context, was added to cover global STI issues and questions related to STI uses and users, but typically beyond the control of STI system and service managers.

Figure 1. Five Levels of Concern Related to Uses and Users of Scientific and Technical Information Systems and Services (STI/SS's)*



*Not an attempt at a rigorous taxonomy or model of the STI/SS domain, but merely a convenient way of grouping issues and questions related to STI uses and users.

EVALUATION CRITERIA

The ground rules for assessing the importance of STI user/use issues were straightforward, but difficult to apply. First, *an issue that has a possibility of exercising a practical and significant effect on policy, design, or management aspects of STI/SS's should be rated as more important than an issue where such a possibility is judged to be remote.*

A second criterion concerned the researchability of questions related to each of the issues. (Appendices A and B list the questions for each issue.) *An issue for which highly researchable questions had been generated should be rated as more important than an issue for which highly researchable questions had not been formulated.* The obvious reason for this criterion is utilitarian: performing research requires the statement and treatment of specific questions. A recognized weakness of this criterion is that the ability to generate researchable questions does not, ipso facto, mean that the issue with which the questions are associated is important; conversely, an inability to structure researchable questions does not suggest that an issue is trivial. The important point of this second ground rule is simply that issues for which researchable questions exist can be translated more readily into specific projects.

A third, but only implicit, ground rule concerned the adequacy of previous research related to the issue. *An issue on which research had been conducted should be rated as more important when previous research could be shown to be overly narrow, untimely, methodologically deficient, or somehow otherwise inadequate.* A major bone of contention during the workshop, one that brings the central importance of this third criterion into sharp focus, dealt with the adequacy of previous STI user studies. One of the ironies uncovered in the discussion of this topic was the contrast between the large number of STI user studies and the general disregard of such studies by designers of many STI systems and services. This debate, and others like it, raised questions of basic significance to much future STI research; certain of those questions will be treated in some detail in Chapter IV. Suffice it to note here, however, that participant judgement of the adequacy of previous research was a nontrivial factor in assessing the criticality of issues.

CRITICAL RESEARCH ISSUES

Participants generated an initial set of 50 research issues that they judged to be of major importance. Using an 11-point scale of 0 (lowest) through 10 (highest), they then rated the relative importance of each issue and the researchability of any related questions. The original set of issues and questions is presented in *Appendix A.*

The reassessment of issues during the second round of evaluation led to a weeding out of 20 issues judged to be relatively less important. The rating form used in the second round is included in *Appendix B.*

Finally, in the third evaluation round, participants reexamined the 30 issues that survived round two and collectively assigned 18,990 points to those issues they felt deserve the *highest priority* in terms of future STI user/use research. Third round evaluation results are arrayed in *Appendix C.*

Quite significantly, *ten of the 30 surviving issues were assigned one-half (51.3 percent) of the total number of points allocated.* Those ten issues are identified in Table 1.

Analysis of the data in *Table 1* and *Appendix C* suggests that *no level of concern—design, management, operations, marketing, or context—has been adequately researched to date.* Each of these levels requires significant and prompt research attention.

TABLE 1. THE TEN ISSUES RATED AS MOST CRITICAL

Level of Concern	Issue Identifier*	Points Assigned	Issue
Marketing	D2	1,280	Market segmentation
Marketing	D1	1,240	Other aspects of STI/SS marketing
Design	A9	1,095	Relevance of STI to major social problem areas
Context	E3	990	Impact of copyright law and practice on STI/SS's
Operations	C4	930	Data base subsetting in social problem areas
Design	A3	915	Use of information concerning users in the design of STI/SS's
Management	B9	865	Evaluation of STI/SS impacts
Design	A7	845	Other kinds and potential kinds of intermediaries besides traditional kinds
Management	B1	805	Application of economic analysis techniques to the STI sector
Marketing	D6	770	User role in influencing the managment of STI/SS's

*The unique level identifier and number assigned to each issue in preparing the Second Round Evaluation Form *(see Appendix B)*.

Not all levels, however, are equally important. Data in *Table 2* indicate that, in the opinion of participants, *the four functional (i.e., "familiar") levels of concern should be given much higher priority than the contextual (i.e., "global") level.* Perhaps this is because of the low perceived researchability of questions, or the lack of researchable questions, associated with global issues. Then, too, this finding might reflect the basically passive character of STI systems and services when confronted by global issues.

TABLE 2. OVERALL RANKING OF STI USER/USE ISSUES BY LEVELS OF CONCERN

Level of Concern	Ranking in Thirds			Total No. of Issues
	Top Third	Middle Third	Bottom Third	
Design	3	2	1	6
Marketing	3	1	1	5
Management	2	3	2	7
Operations	1	2	—	3
Context	1	2	6	9
TOTALS	10	10	10	30

Among the four functional levels, major differences exist in priority concerns. *STI marketing, operational, and design issues outrank the management issues,* as shown in *Table 3.* This may reflect an assumption by participants that STI/SS management issues have been somewhat better researched than issues in the other three functional levels.

TABLE 3. OVERALL RANKING OF FUNCTIONAL ISSUES BY LEVEL OF CONCERN

Level of Concern	Average ($\bar{X}$) No. of Points	Number of Issues	Number of Points
Marketing	857.0	5	4,285
Operations	770.0	3	2,310
Design	753.3	6	4,520
Management	595.7	7	4,170
TOTALS	727.9	21	15,285

Finally, it should be noted that *one issue, market segmentation, stands out above all the other specific issues as the most important area of critical research need.* The significance of this issue will be explored in Chapter IV. The basic message, however, is clear: totally inadequate conceptions concerning STI users are guiding the thinking of many STI/SS designers and managers. Unless and until research is done that reshapes current "mental pictures" of who can or might use STI/SS's, hopes for seeing major improvements in the delivery and utilization of such systems and services are bound to be frustrated.

SUMMARY

In their effort to determine what research is needed on the users and uses of STI, participants first generated a tentative list of 50 key issues. The original list of issues was subdivided into five levels of concern: four "familiar" (i.e., STI/SS design, management, operations, marketing); and one "global" (i.e., context). Participants then reduced the number of issues from 50 to 30 during the second round of evaluation. Finally, they selected ten of the surviving 30 issues as the ones most in need of immediate research attention. All five levels of concern were represented by the top ten issues; however, familiar issues dominated global concerns, and marketing issues far outranked all others.

CHAPTER III. POTENTIAL RESEARCH PROJECTS

The goals of this project included not only generating a preliminary agenda of needed research, but also an exploratory testing of the agenda's usefulness. How would anyone interested in developing research projects treating STI user/use topics proceed with the list of critical issues as a base?

Three participants—Pauline Atherton, Theodore Melnechuk, and William Paisley—were asked to address this question. The guidelines they followed required simply that their development of potential research projects include: (a) the formulation of *specific research questions* to be addressed; (b) generating *illustrative propositions* that could be tested empirically; (c) citing *relevant literature* and other information sources; (d) suggesting appropriate *research methodologies;* (e) estimating the *cost* of conducting the research; and (f) assessing the *potential utility* of the research.

To provide for broader coverage of the issues, a decision was made *not* to have duplicate development of any single issue. Thus, the three participants treated five different issues as shown in *Table 4.* The breadth in coverage that resulted involved an important tradeoff: any one of the five issues selected could have been developed into potential research projects in many different ways. Resource limitations simply did not permit this luxury. *What follows, therefore, should be viewed as attempts to illustrate the process of using the issues identified in Chapter II and Appendices A, B, and C to develop possible research projects.* It should be possible for readers to replicate the process for other issues of interest.

TABLE 4. PARTICIPANTS' SELECTION OF FIVE CRITICAL ISSUES TO ILLUSTRATE RESEARCH POSSIBILITIES

Participant Responsible	Issues(s) Selected
Atherton	• STI/SS User Training (D4)* • Relevance of STI to Major Social Problem Areas (A9)
Melnechuk	• Other Kinds and Potential Kinds of Intermediaries Besides the Traditional Kinds (A7)
Paisley	• Use of Information Concerning Users in designing STI/SS's (A3) • Use of Information Concerning Users in managing STI/SS's (B6)

*The issue identifier, here *D4,* assigned to each issue in preparing the Second Round Evaluation Form (see Appendix B).

STI/SS USER TRAINING (D4) – ATHERTON

Some specific questions. (1) How are scientists, engineers, managers, and others trained to use STI/SS's? (2) What kind of training is needed to prepare scientists, engineers, and other STI users for interesting and successful use of STI/SS's? (3) How much do alternative approaches to STI/SS user training cost, who pays, and what are the results? (4) How can current approaches to STI/SS user education be improved?

Illustrative propositions. (1) There are no formal training techniques for scientists, engineers, managers, or others in the use of STI/SS's in general, or for particular systems and services which are widely used. (2) Specially designed user manuals, on-line tutorials, and seminars are needed to prepare scientists, engineers, managers, and others for interesting and successful use of STI/SS's. (3) Educational institutions, professional societies, governmental agencies, and industry can support training costs for STI/SS users with measurably beneficial results. (4) Instructional technology and evaluated message design can improve current STI/SS user education.

Relevant literature. W. Lancaster's *On-Line Information Retrieval,* particularly chapters on user instruction. J. Magnino's chapter in Volume 6 of the *Annual Review of Information Science and Technology,* especially pages 223 and 240 on user manuals and terminal assistance. H. Grobman's *Developmental Curriculum Projects.* The UNISIST *Handbook For Training Users of STI.* User manuals from the Educational Resources Information Center, the National Aeronautics and Space Administration, the National Library of Medicine, Lockheed, System Development Corporation, and other organizations operating STI/SS's. Guides to available training literature from professional and technical societies such as the American Chemical Society, the Society of Automotive Engineers, and the American Psychological Association.

Research approach. For *Question 1* above, required techniques include survey research, content analysis, and field measurement of STI users' skills. *Question 2* calls for an experimental design, under field conditions, which would test and measure a variety of teaching techniques for different user groups. *Question 3* requires a cost analysis of the results of research on Question 2, with a survey of possible funding sources and analysis of the effectiveness of alternative teaching methods. Finally, *Question 4* could be studied by combining analysis of existing educational methods with the results of research on Question 3 and consultation with instructional technologists and learning experts.

First cost approximation. Research on all four questions would require from three-to-four calendar years, and from five-to-six professional years of effort. Total cost would equal approximately $275,000: $30,000 for Question 1, $200,000 for Question 2, $20,000 for Question 3, and $25,000 for Question 4.

Potential utility. Results of the proposed research could help improve the strategy for achieving maximum utilization of government-supported STI/SS's. They also could provide guidelines to American government and industry on how to design, fund, and program STI/SS user training. Results also would be useful in efforts to coordinate industry-wide, national, and international training in the use of STI/SS's. Finally, such research would increase the marketability of U. S. instructional technology products for training STI/SS users world-wide.

RELEVANCE OF STI TO MAJOR SOCIAL PROBLEM AREAS (A9) – ATHERTON

Some specific questions. (1) How is STI integrated with other classes of data and information (e.g., legal, social) in the development of public policy? (2) How can STI generators be influenced to become more participative in responding to policy use requirements for STI? (3) To what extent has

STI from one field been integrated with STI from other fields; where and under what conditions? (4) What transformations in STI occur as innovations move along the research-development-commercialization continuum? (5) What strategies are employed by STI/SS users in extracting information relevant to emergent social problem areas?

Illustrative propositions. (1) The approach taken in atomic energy to integrate STI with other classes of data and information would be more useful than approaches take.. .n other traditional areas for deciding how to integrate STI with other information in emerging social problem areas like energy and environment. (2) Mission-oriented STI/SS's are more useful than discipline-oriented STI/SS's for understanding how to integrate STI with other classes of information. (3) Measurable and manageable transformations of STI occur as its use moves from research to commercialization and public use. (4) STI generators can do more than they have to date in facilitating the integration of STI with other classes of information in emerging social problem areas.

Relevant literature. G. Anderla, *Information in 1985.* E. Parker's chapter on "Information and Society" in Volume 8 of the *Annual Review of Information Science and Technology.* Various reports from the Science and Technology Division and the Legislative Reference Service of the Library of Congress. M. William's reports on Selective Dissemination of Information services for educational and industrial communities. Recent reports of annual meetings held by the Association of Selective Dissemination of Information Centers.

Research approach. *Question 1* would require field interviews. So, too, would *Question 2,* coupled with case studies. To research *Question 3,* it would be necessary to survey the literature on the development of specialized, cross-disciplinary STI/SS's. *Question 4* would require extending the work of Stanford University's Institute for Communication Research on writing STI for lay audiences; it would involve *field testing* STI transformations with different audiences in several emerging social problem areas. Finally, *Question 5* would require field interviews with representative samples of STI generators and the managers of STI/SS's.

First cost approximation. Investigation of all five questions would involve approximately two calendar years, and from 3.0–3.5 professional years of work. Total cost would approach $165,000: $25,000 for Question 1, $25,000 for Question 2, $15,000 for Question 3, $75,000 for Question 4, and $25,000 for Question 5.

Potential utility. Research on these questions should generate useful guidelines for government officials responsible for planning, designing, and operating information services in emergent social problem areas. In addition, the research should be useful for improving the integration of STI in areas like energy, environment and transportation. Finally, it should facilitate the development of a more rational basis for integrating STI across many fields.

OTHER KINDS AND POTENTIAL KINDS OF INTERMEDIARIES BESIDES THE TRADITIONAL KINDS (A7) – MELNECHUK

This analysis of nontraditional intermediaries between STI originators and users focuses attention (1) *on the intermediaries' involvement with originators of STI* as graduate students, authors of grant proposals, conductors of ongoing research, conference participants, authors of journal articles, and users of STI; (2) *on the intermediaries' involvement with other professional users of STI* (e.g., legislators, judges, journalists, TV personalities); and (3) *on the intermediaries' involvement with lay users of STI* (e.g., lecture attendees, citizen action groups, patients, children).

Originators as graduate students. Proposition A: Graduate students of science and engineering, who will eventually be the originators of STI, are not all required to take a course on when and how to write a journal article and other transforms of STI. *Question A:* How many faculty members offer explicit courses? How many and which graduate schools and departments require students to take such courses? *Relevant literature:* F. P. Woodford (ed.), *Scientific Writing for Graduate Students: A Manual on the Teaching of Scientific Writing,* prepared by the Committee on Graduate Training in Science Writing, Council of Biology Editors, New York: Rockefeller University Press, 1968. *Research approach:* mailed questionnaires.

Proposition B: Graduate students of science and engineering, who will eventually be the originators of STI, are not all required to take a course on how and when to write popular articles and other popular STI transforms, or on how and when to cooperate with public relations personnel and journalists. *Question B:* How many faculty members offer explicit courses? How many and which graduate schools and departments, if any, require students to take such a course? *Relevant literature: Science News Communication: A Guide for Scientists, Physicians, Public Relations Officers, and Information Specialists,* Sea Cliff, New York: The National Association of Science Writers, Inc., 1968. *Research approach:* mailed questionnaires.

Originators as authors of grant proposals. Proposition C: Some funding agencies (e.g., the Social and Rehabilitation Service of the U. S. Department of Health, Education, and Welfare) are requiring that grant proposals and grant renewal applications include an STI dissemination and utilization plan. *Question C:* Which funding agencies do this, public and foundation? What are their requirements and how do they differ? How have these requirements been changing? What kind of compliance have they been given? *Relevant literature: Special Instructions to Applicants,* SRS Form OFM-3, Washington, D. C.: Office of Planning and Research, Social and Rehabilitation Service, U. S. Department of Health, Education, and Welfare, 1974. *Research approach:* mailed questionnaires and telephone interviews.

Proposition D: A grant proposal is often the best, indeed the only, piece of literature to select a worthy problem, review its literature, and suggest a new way to tackle it. Albeit a piece of sales literature too, the grant proposal gives a coherent view of a problem, and those proposals that are funded have passed a critical review process. Therefore, a *Journal of Winning Proposals* in each field, which published at least the conceptual core of winning proposals, could be a valuable herald of forthcoming research, new concepts, and a model for applicants. *Question D:* What conditions would proposal authors place on publication? Would funding agencies be forced by the laws on access to information to cooperate? Would users really buy such an STI transform? *Research approach:* market research.

Originators as conductors of ongoing research. Proposition E: Directors of large industrial laboratories are not always satisfied with the monthly-written progress reports they receive. *Question E:* To what extent do large industrial laboratories employ people as systematic internal observer-reporters? What sort of people are good at this work (e.g., drop-out scientists, ex-English majors who like science)? *Research approach:* mailed questionnaires, telephone interviews.

Proposition F: Academic scientists are differentially willing to be telephoned or written to on technical questions, as a duty to colleagues, graduate students, and serious journalists. *Question F:* With what kinds of information would members of professional societies be willing to have their names indexed in the society directories (e.g., major problem of current interest, technique most expert at, substance or species most knowledgeable about, office or laboratory telephone number, days and times available)? What use has been made of directories that do index source people? To what extent could a national referral service supplement professional society directories and expedite communication between researchers and publics other than peers? *Relevant literature:* R. Lazzell, *Points of Contact: Scientific*

and Technical Information, Washington, D. C.: National Technical Information Service, 1972. *Research approach:* mailed questionnaires.

Proposition G: Department chairmen and institute and research directors are intermediaries between their faculty members, students, and staff members, and creative or learned experts, whom they select and invite to give seminars on ongoing research and unpublished information and ideas. *Question G:* How many such seminars are given in each field? How many of what kinds of persons attend? Would newsletters, trade journals, or primary journals publish lists of such speakers and the titles of their talks? *Relevant literature:* monthly lists of Sigma Xi lecturers published in *American Scientist. Research approach:* mailed questionnaires and analysis of departmental calendars.

Proposition H: The quickest way to get a grasp of the "hot" information in a field is to interview the leaders of research in it, who either originate, or get to hear about, most new developments in their field.

Proposition H': Grapevines can be tapped through structured telephone interviews by personnel at information and analysis centers who have done their homework. *Question H':* What does the literature of grapevine telephone surveying have to say about the willingness of scientists to be interviewed in this way? How can access be gained to information on privileged grapevines? How can grapevines be tapped most effectively for state-of-the-art surveys? How can early stages of science be tapped in advance of formal publication to obtain new concepts, new approaches, new data, new interpretations, and promising newcomers? How can invisible colleges be tapped for wisdom otherwise not evoked? *Relevant literature:* J. Jordan, "Dial G for Grapevine: A Conversation in Exceptional Child Research," in *Dimensions: Annual Survey of Exceptional Child Research Activities and Issues*—1970. *Research approach:* literature search and analysis.

Proposition H'': "Centers of Survey for Synthesis" (e.g., the Neurosciences Research Program founded in 1962 in Boston, Massachusetts) can convene leaders of research on hot topics as "sense-making bodies" to select relevant research findings from many disciplines; clarify major concepts, schemata, discrepancies, and controversies; state the latest positive and negative findings, and explain the logic of their interpretation; state claims explicitly, in summary form, and evaluate their reliability; make conceptual models explicit; attempt provisional synthesis, both intra- and interdisciplinarily; identify major gaps in knowledge and obstacles to progress; discuss new methodologies and new strategies of investigation, and give hunches as to outcomes; predict new developments; explicate implications for policy and action; and cite and give references to and annotate selected literature relevant to each of the above. At such centers, artistic mind styles—with their quicker tempo of project completion, ease with drafts and provisional visions, and impatience with inexplicitness—can usefully interact with slower-paced scientists uncomfortable with premature closure to produce early-stage maps of progress useful to those in and out of a field. *Question H'':* What was the experience of the Neurosciences Research Program, and is it generalizable? What role did it play in legitimizing an entity-based discipline, neuroscience, in place of a set of technique-based disciplines? In what ways did it fractionate the preparation of workshop reports between scientists as quality controllers and writers and editors as draft generators? To what extent and in what ways can artistic mind styles supplement scientific and engineering mind styles in facilitating STI generation and communication? *Relevant literature:* F. Schmitt and T. Melnechuk (eds.), *Neurosciences Research Symposium Summaries,* Volumes 1-7, Cambridge, Mass.: MIT Press, 1966 to 1974; G. Quarton, T. Melnechuk, and F. Schmitt (eds.), *The Neurosciences—A Study Program,* New York: Rockefeller University Press, 1967. *Research approach:* historical study.

Originators as conference participants. Proposition I: A set of people exists who are experienced in planning, running, transcribing, reporting, and editing the proceedings of conferences. *Question I:* What unpublished hard-earned wisdom do they have about the mechanics of conferences? Are any stenotypists

especially trained for specific scientific fields? Is there a compendium of knowledge about the mechanics of various kinds of conferences? *Relevant literature:* F. Crick, "On running a summer school," *Nature* (1968) 220 (December 28): 1275–1276; M. Mead, "Conference behavior," *Columbia University Forum* (1967) 10 (2, Summer): 15–19; L. Kubie, "Problems of multidisciplinary conferences, research teams, and journals," *Perspectives in Biology and Medicine* (1970) Spring: 405–427. *Research approach:* literature search, study of programs of annual meetings and invited symposia, mailed questionnaires, and interviews with workshop chairmen, working staff, and hired staff.

Originators as authors of primary journal articles. **Proposition J:** *A Journal of Advance Abstracts* in each field could publish the abstracts of articles already accepted for publication in cooperating primary journals, but not yet published in them. This would give readers a preview of the forthcoming contributions to the literature of that field. It also would allow cooperating journals to receive preprint, rather than reprint, orders for increased economy of printing. *Question J:* What has been the experience of the first such journal, now known as *Abstracts and Reviews in Behavioral Biology?* What are the opinions of the editors of cooperating journals and of its subscribers? *Relevant literature:* Council on Biological Sciences Information, *Information Handling in the Life Sciences,* Washington, D. C.: Division of Biology and Agriculture, National Research Council, 1970. *Research approach:* mailed questionnaires and personal interviews.

Proposition K: Journal editors and the editors of conference programs can be persuaded to require that authors provide not only an abstract and key terms, but also a title that is a single sentence stating the main claim in their papers. *Question K:* How were journal editors persuaded to require abstracts and, later, key terms from authors? To what extent do incumbent editors already believe in the quantum-jump increase in informativeness such titles bring to the literature? How willing are authors to provide such titles? Can appended "major claim" statements be made a requirement of publication? Who should tag papers with the major claim statements? *Relevant literature:* J. Bernard and C. Shilling, *Accuracy of Titles in Describing Content of Biological Sciences Articles,* Washington, D. C.: American Institute of Biological Sciences, 1963; Center for Research in Communication, *The Role of the National Meeting in Scientific and Technical Communication,* Baltimore: Johns Hopkins University, 1970, particularly page 34.

Proposition K': Councils of Editors in each field of science could play a major role in requiring authors to provide title sentences, and in effecting other improvements and economics. *Question K':* How transferrable is the experience of the Council of Biology Editors in this area? What are the attitudes of incumbent editors in other fields to this idea? Could NSF-sponsored Councils of Journal Editors in each field require authors to provide the main claim? *Relevant literature:* Committee on Form and Style of the Council of Biology Editors, *CBE Style Manual,* 3rd ed., Washington, D. C.: American Institute of Biological Sciences, 1972; R. Day et al (eds.), *Economics of Scientific Publications,* Washington, D. C.: Council of Biology Editors, 1973; J. Woodford (ed.), *Scientific Writing for Graduate Students: A Manual on the Teaching of Scientific Writing,* New York: Rockefeller University Press, 1968. *Research approach:* historical study, mailed questionnaires, telephone interviews, literature searches.

Proposition L: The widespread communication of new concepts and new data stemming from new discoveries could be accelerated if the coining of new terms (e.g., maser, laser) associated with such discoveries were systematically sought for and the new terms periodically published. *Question L:* How many new terms enter the thesauri produced annually by each major indexing organization? What new terms have recently been unknown to translators of science literature in the major world science languages? What has been the experience of the American Institute of Physics in preparing its series of glossaries of terms used frequently in various hot branches of physics? *Relevant literature:* List of new terms in *Index Medicus;* possibly the publications of the American Translators Association; also the

series of glossaries of terms used frequently in various physics subfields, published by the American Institute of Physics since 1962. *Research approach:* literature reviews and telephone interviews.

Proposition M: The nation's indexing services rest on the labors of a set of people, the indexers of the literature, who are a precious resource, especially when papers still lack titles that are maximally informative: More and better indexers are needed. *Question M:* Have indexers been surveyed to learn what they think of their education and training, and the practices of their organizations? Could a compendium of their wisdom be prepared for the guidance of library schools and the employers of indexers? *Research approach:* mailed questionnaires, personal interviews, and literature searches.

Originators as users of STI. Proposition N: Graduate students of science and engineering, who eventually will be heavy STI users, are not all required to take an up-to-date course on how to use nationally available STI/SS's. *Question N:* How many faculty members offer explicit courses? How many and which graduate schools and departments require their students to take such courses? How are practicing scientists, engineers, managers, and others trained to use STI/SS's? *Research approach:* mailed questionnaires.

Intermediaries relating to other professional STI users. Proposition O: Congress, and the various state legislatures, pass and revise laws without the legal requirement that all law be consistent with the state of science at the time of passage and be reviewed for such consistency at periodic intervals. *Question O:* To what extent, and in what ways, do any legislatures have a requirement for law to agree with science? What effect on law has the Salk Institute Program on Biology in Human Affairs had (e.g., the revision recently of Massachusetts laws on drug use and abuse)? *Research approach:* personal interviews.

Proposition P: Judges make decisions and pass sentences according to their beliefs about behavior as well as their interpretation of the law. Some beliefs are, and others are not, brought up to date with behavioral and biological science. *Question P:* To what extent do legal journals attempt systematically to interpret new science for judges? Would judges welcome such a service? How do judges think such an updating process could best be fashioned? What has been the experience of state medical associations with updating physicians? *Relevant literature:* A new newsletter on social action and the law, Brooklyn, New York: Brooklyn College Center for Responsive Psychology.

Proposition Q: Many journalists who help shape public awareness and understanding of science and engineering appear to be unhappy with their experiences and the stereotypes that have come into widespread belief. *Question Q:* How many scientists regret having talked to the press? Why? How many journalists resent the treatment accorded them by scientists? Why? What structural and personality factors contribute to their regret? *Research approach:* mailed questionnaires, personal interviews.

Proposition R: Most of the public gets its STI from TV news programs and talk shows; thus, TV commentators, talk show stars, and their guests carry a heavy responsibility for the proper selection of subjects and interpretations. *Question R:* What principles guide the selection of topics and guests? Which scientists were guests on the major talk shows in 1973? Which books were plugged? What topics were mentioned by Cronkheit, Reasoner, and Chancellor? How many and what kinds of special programs were devoted to science and engineering topics during 1973? *Relevant literature:* program logs and scripts. *Research approach:* mailed questionnaires, personal interviews, analysis of program logs and scripts.

Intermediaries relating to lay users. Proposition S: Popular lectures on scientific subjects are marketed by lecture agencies; it is a flourishing business. *Question S:* What subjects were treated in popular lectures during 1973? By whom? What is the academic reputation of the lecturers? *Research approach:* mailed questionnaires, personal interviews, analysis of records.

Proposition T: Citizen action groups exist on some issues that require the use of scientific evidence; often scientists are involved in such groups. *Question T:* Do such groups tend to be started by concerned scientists, or by concerned nonscientists? In what ways do they communicate STI to people with political power or civic influence? *Relevant literature:* T. Vonier and R. Scribner, *Community Information Expositions: Issue-Oriented Displays and Popular Understanding of Social Problems,* Washington, D. C.: American Association for the Advancement of Science, 1973. *Research approach:* grapevine survey.

Proposition U: Surgeons require informed consent for operations from prospective patients to preclude malpractice suits and other forensic litigation. *Question U:* What constitutes "informed consent" in the 50 states? What printed materials are being developed to do the necessary "informing" and to record the "consent"? *Relevant literature:* New booklets for prospective patients published by Health Communication, Inc., Suite 434, Union Bank Building, San Diego, California. *Research approach:* survey of surgeons, state medical associations, and literature search.

Proposition V: Science books for children are published in large numbers, and TV children's shows often have episodes involving scientific claims. *Question V:* How many titles were published in 1973? On what? By whom? How were they reviewed before publication? After? Do any professional societies, some of which cooperate in producing textbooks, systematically assume the responsibility for issuing public evaluations of these books? *Relevant literature:* P. Morison's annual review at Christmas time of children's science books in *Scientific American. Research approach:* mailed questionnaires and telephone interviews.

USE OF INFORMATION CONCERNING USERS IN DESIGNING STI/SS's (A3) — PAISLEY

Some specific questions. (1) Viewing the STI/SS user as an individual "information processing system" with perceptual, cognitive, and affective subsystems, what are the major parameters of the *perceptual* subsystem that should affect the design of high-speed or high-density STI interfaces, such as proactive displays (via television-like tubes or improved computer-driven screen) that are intended to provide the user with a rapid purview of the structure and content of available document files, people files, and data bases? (2) According to various attributes of users (e.g., occupation, discipline), what are major parameters or factors of the *cognitive* subsystem that should affect the design of document files, people files, and data bases? (3) According to various attributes of users, what are the major parameters or factors of the *affective* subsystem that should affect the design of STI/SS's that maximize positive reinforcement and minimize negative reinforcement for users? (4) Across a sample of information-seeking sequences or episodes, what are the critical junctures at which the perceptual/cognitive/affective subsystems, either singly or interactively, are stressed or contravened by STI/SS hardware or software in such a way that the information search takes a false turn or is terminated prematurely?

Illustrative proopositions. (1) With high-speed, high-resolution, self-pacing displays and hierarchically structured or otherwise "chunked" files, the user's perceptual subsystem will prove to be capable of processing certain kinds of STI content at the rate of thousands of bits per minute. Kinds of content amenable to such presentations will include file overviews, characterization of average and outlying file elements, lists of terms that indicate the entrypoints of the file, and standardized graphic profiles that can serve as the distinctive "fingerprints" of different files. (2) When STI files are restructured to complement the individual cognitive structures and cognitive styles of users, the user's knowledge gain and actual use of information will both increase. (3) When STI interactions with users are designed to include token reinforcements (e.g., indications of progress toward the retrieval of specific

information), users will turn to STI/SS's more often as well as earlier in each information-requiring task. In this condition users will also persevere through more steps per search. As a corollary, information retrieved in this condition will be judged more relevant than information retrived from an identical STI/SS that lacks a planned "reinforcement schedule." (4) By shifting from a reactive to a proactive posture (i.e., by pacing and guiding the user) and by incorporating a "tenacity factor" in an STI/SS's response to all kinds of user demands (e.g., well-conceived and ill-conceived), the proportion of false turns and premature terminations of searches will be reduced, and as a consequence the adjudged relevance of retrieved information will be greater, relative to an STI system that provides access to the same files in a nonproactive, nontenacious manner.

Relevant literature. Two distinctive literatures converge in this research area. One is the psychological literature of perception, cognition, and affect. The other is the information science literature on the structure and content of files, their surrogation systems, interfaces, and use contexts. The psychological literature is best accessed through appropriate chapters in the *Annual Review of Psychology,* in addition to occasional benchmark compilations such as the Berelson and Steiner propositional inventory entitled *Human Behavior: An Inventory of Scientific Findings.* The information science literature is best accessed through appropriate chapters in the *Annual Review of Information Science and Technology.* No benchmark compilation is known to exist for these topics within information science.

Research approach. In *Question 1,* the perceptual subsystem would be studied via experiments involving alternative presentations of information on a high-speed display. Much generalizable information would be obtained from experiments varying the rate of presentation, the stimulus array, and the presentation procedure (e.g., scrolling versus total screen blanking and replacement). Experiments would be reminiscent of tachistoscopic studies of perception in the purely psychological tradition. Concepts guiding the experiments would be derived from the Gestalt theory of perception and from perceptual-capacity research.

Existing instruments for the study of cognitive structure and cognitive style would need to be adapted to STI content areas in studying *Question 2;* they could then be used for approximate classification of STI users into different cognitive structure/style categories. Transforms would be developed to restructure a medium-size file in ways that complement these different structures and styles. Experiments would present alternative file excerpts to groups of users in counter-balanced design, against the twin criteria of knowledge gain and actual use of information.

For *Question 3,* a single, relatively deep STI system would be adapted to several conditions of user reinforcement. Experiments would test frequency of use and perseverance of use across the several conditions, as well as the corollary criterion of retrieval effectiveness (i.e., relevance).

Finally, case studies of STI users in natural contexts would serve analysis of *Question 4* by helping identify critical junctures in information-seeking sequences or episodes at which searches take false turns or are terminated prematurely.

First cost approximation. Investigating *Question 1* would require about $50,000 to set up a hardware/software configuration that would be flexible enough for a full range of perceptual subsystem experiments. About $10,000 would be needed to cover the experiments themselves. Total: about $60,000.

For *Question 2,* about $25,000 would be required for software and multiple transforms of a medium-size file. Another $20,000 would be needed for the extensive subject measurement and data analysis that cognitive structure/style experiments require. Total: about $45,000.

Research into *Question 3* would cost about $25,000 for software, unless combined with work on Question 2 for some reduction of total effort. Another $5,000 would be needed for the relatively simple measures of use frequency, perseverance, and retrieval effectiveness. Total: about $30,000.

About $100 per user would be needed under *Question 4* to collect case-study data on critical junctures in information-seeking sequences or episodes. Cost of the study would depend on the sample size. Assuming that a stratified sample of 250 users would encompass major attributes that differentiate user groups, total cost would be $25,000 plus $5,000 study preparation and data analysis or $30,000.

Potential utility. The major policy step of shifting STI/SS's from a reactive to a proactive posture depends on user data of these kinds. Present systems that are little-used or used with poor effect can be shown to stress or contravene users' perceptual, cognitive, and affective subsystems. New systems that are designed without user data will also fail in their missions.

USE OF INFORMATION CONCERNING USERS IN MANAGING STI/SS's (B6) — PAISLEY

Some specific questions. (1) What aspects of STI/SS management should be regarded as particularly interdependent with use patterns, relative to other aspects that can be regarded as engineering or business issues without reference to a particular user population? (2) How should patterns of user need or preference optimally guide a fixed-capital-commitment aspect like the development and maintenance of document files, people files, or data bases? (3) How should patterns of user need or preference optimally guide the variable-capital-commitment aspects of an STI/SS, like referral and question-answering services, repackaging and fresh publication, document duplication services, etc.? (4) What are the most reliable, valid, and useful ways to gather information about user need or preference, according to the aspect of STI/SS management being affected by the data?

Illustrative propositions. (1) Users regard STI/SS's as interfaces to information. Aspects of STI/SS management are arrayed along a continuum of concern/indifference for each user. Of greatest concern on this continuum are the content areas covered by the STI/SS, together with corollary aspects of comprehensiveness and timeliness. Of next greatest concern are the occasions and formats of service. Of less concern than either content or format is service cost, as long as it lies within one or two standard deviations of the average STI/SS cost in the user's field. (That is, within the plus-minus $2\underline{z}$ range, expensiveness will not lead to underutilization nor cheapness to overutilization.) At the indifferent end of the continuum lies a set of STI/SS management issues that users neither know nor care about. Across a sample of the user population, the amount of concern shown for management aspects can be shown to stabilize, with the consequence that STI/SS managers can provide themselves with a rank-ordered list of aspects that users are concerned about. The list advises managers to: (a) condition some decisions on user data; (b) proceed on other decisions without user data.

(2) Since decisions affecting fixed-capital-commitments like document files, people files, and data bases are related to such main trends of user behavior as number of queries, number of documents ordered, number of subscriptions placed, etc., clear guidance for acquisition, weeding, and peaking of files comes from longitudinal data provided by users in the course of conducting searches, ordering documents, placing subscriptions, etc. For example, acquisition priorities can be rank-ordered by file classification area according to users' prevailing demand for each area, while weeding decisions can be based on "half-life" statistics rather than subjective judgement about the value of file elements. Other decisions, ranging from file description to arrangement of materials for open access, can be based on conditional probabilities that can be shown to exist in users' joint use of file elements, rather than on *a priori* file dimensions or relationships that users don't care about. Use of the STI/SS will increase to the extent that its management reflects these main trends of user need and preference.

(3) Decisions affecting variable-capital-commitment are often unrelated to main trends of user behavior and require a different focus for collecting user data. That is, decisions to provide short-term, optional, or peripheral services cannot be conditioned by main trends of user behavior—such services do not create data series. Instead, it is the deviant trend in user behavior that often points to an opportunity to make a variable-capital-commitment with good effect. When a mechanism exists for capturing minor and deviant trends in user behavior, variable-capital-commitment decisions based on such trends have a greater probability of success than decisions based only on managerial experience.

(4) Mechanisms for collecting user data range from volume counts and observations of use to questionnaires and interviews that raise a user's perspective above an individual episode of STI/SS use. It will be found that volume counts and use observations are best adapted to decisions affecting fixed-capital-commitments, while questionnaires and interviews are best adapted to decisions affecting variable-capital-commitments. The power of questionnaire/interview data is such, however, that all management decisions that have a substantial user-input (see P1) will benefit from the collection of questionnaire and interview data from small samples of users, conjoint with volume counts and use observations based on the entire user population.

Relevant literature. Since this research area is a conceptual and procedural sequel to the use of information concerning users in the *design* of scientific and technical information systems and services (see A3 above), it draws upon the same literature resources.

Research approach. For *Question 1,* decisions affecting STI/SS management can be abstracted from composite management plans of several STI/SS's. Such lists of decisions can be reviewed by panels of users, whose task is to indicate their concern about the outcome of each decision. To create a range of hypothetical outcomes for each decision, a question format like the following can be developed: "In thinking about the consequences of a decision regarding X, how much would it matter to you if A happened rather than B? If A happened rather than C? If B happened rather than C?" Responses indicating relative concern would be summarized to provide a rank-ordered list of STI/SS management aspects according to user concern.

The records of well-managed STI/SS's provide many data series that should condition fixed-capital-commitment decisions, the specific concern in *Question 2.* Additional data series result from analyses of user activity that are not normally recorded but easily can be (e.g., number of orders per document title per year). Finally, a small amount of questionnaire and interview data should be collected to assure that trends in existing data series are not being misread.

Under *Question 3,* decisions affecting variable-capital-commitments should be guided by data that encompass a set of options at least as broad as the set that the STI/SS manager must realistically consider. The research approach needed in this case must in some sense upset users' expectations about the usual services of the STI system and cause them to speculate freely about desirable short-term, optional, or peripheral services. Generally speaking, an interview is the most effective data collection procedure to induce respondents to speculate beyond normal conventions and expectations. The sample to be interviewed in this case should be stratified by important attributes of users as reflected in their use of STI/SS's.

Finally, *Question 4* speaks to the need for statistical indicators of STI use that extend both across fields and across time for the sake of comparative data. A multiple-operationist paradigm is appropriate; that is, several candidate indicators should be tried for each variable (e.g., user satisfaction) and the joint data should be tested for convergent-discriminant validity. Different measurement approaches will prove to inform different variables effectively. Superior measurement approraches can be arrayed according to the aspect of STI management that is at issue.

First cost approximation. To investigate *Question 1,* about $10,000 would be needed to set up and conduct a study on the most effective role for user input in various aspects of STI management in a given discipline or field of research. Another $10,000 would be required to replicate the study in two additional, maximally contrasting disciplines or fields.

For *Question 2,* each STI/SS can maintain data series of main trends in user behavior with very little increment in operating costs. Counts and observations can be tallied into useful summaries for an average of $.10 per user transaction. Assuming a hypothetical STI/SS that has 100,000 user transactions per year, tallying and preparing annual summaries of the main trends of user behavior would cost about $10,000 (almost all of which is labor cost distributed across the year at times of user transaction, including the tallying of an average of 400 user transactions per working day).

Regardless of the size of the STI user population, a sample of N users is appropriate for *Question 3* according to subsample variances. A hypothetical STI/SS that has a user population of 5,000 may require a sample of 500 users if it consists of heterogeneous subgroups, or it may require a sample of only 200 if there is a considerable homogeneity across subgroups. Based on the need to collect data from 500 users, interviews would cost about $10,000, and overall study costs would be about $15,000. From one such study, however, an STI/SS could obtain input that leads to a number of variable-capital-commitment decisions.

The methodological aspect of *Question 4* is extremely hard to cost, because increased budget would lead to useful inclusion of diverse measures. To be worth doing at all, however, a statistical indicator study of this kind would have to include populations and measures that run the cost to at least $50,000.

Potential utility. At present there is no satisfactory method for incorporating user data into STI/SS management processes except within the simplest marketing paradigm of "produce what sells." There is no explication of STI/SS management aspects to differentiate those in which user input is crucial and those in which user input is unimportant. Within the next few years, the greatest need in this research area is for simple, packageable, user-monitoring procedures that can be adopted by average-size STI/SS's, costed to overhead, and drawn upon in a number of management processes.

CHAPTER IV. CONCLUDING COMMENTS

This project was undertaken for a very pragmatic reason: to identify those issues upon which there appears to be agreement among specialists in a number of STI-related fields regarding the most important problems confronting users of scientific and technical information. Analysis of project results presented in Chapters II and III reveals some progress in this direction, at least among workshop participants. As interested nonparticipants review these results, it is hoped they will find that a number of their own biases about needed research are reflected in the preliminary agenda that emerged.

The principal purposes of this final chapter are to state the intent of the emergent agenda, and to make some comments on the limitations of previous research on STI users.

THE EMERGENT AGENDA

The emergent agenda obviously is not the only appropriate, nor the "best," one for specifying what research is needed on the users and uses of STI. A number of alternative agendas could be formulated. They undoubtedly would differ in emphasis, form, and content from the "familiar versus global" perspective elaborated here. So why bother with this agenda?

First, because it is reasonably comprehensive, possesses internal consistency, and is fairly easy to use. A *second* reason for using the agenda is mechanical: it provides a kind of checklist, one that increases confidence that important problems are not being ignored. *Finally,* the agenda can provide colleague support for people undertaking research projects in the STI field.

As reasonable as these considerations may be in themselves, they are limited and transitory in comparison to the original purpose for generating the agenda, namely, working iteratively to identify some of the areas that should be investigated in this field.

PARTICIPANTS' DOMINANT CONCERN: RESTRUCTURING STI USER STUDIES

In their analysis of various issues, participants spent the greatest amount of time on two closely related matters: the limitations of previous STI user studies, and the need for developing new ways of classifying STI users.

The barefoot cobbler's children. "Can we explore the question of why the cobbler's children are running around barefoot?" With this metaphorical question, Urbach directly confronted the frustrations many participants had experienced with previous STI user studies. He continued:

> If all these studies we are doing are so good, if all this information we have to convey is so good, why don't people in the information business who are hungry for information about the user community *use* any of the studies . . ?

Three types of user studies. Responses to Urbach's question, though entirely qualitative, were quite provocative. Paisley and Melnechuk distinguished three types of "STI user studies": descriptive, predictive, and interventive. According to Paisley, the vast majority of previous user studies fall into the descriptive category. Results of such studies, he maintained, are *necessarily disappointing* to STI/SS managers who typically work in a predictive mode. Workshop chairman Rubenstein elaborated Paisley's analysis by pointing out that descriptive user studies mostly have been conducted by "academics" and,

predictably, have little or nothing to do with selling information products (i.e., STI systems and services).

Participants did not ignore the fact that a considerable number of predictive user studies have been conducted, particularly by commercial information firms, but that the results generally have not been available to academic researchers. Robbins noted that most such studies have been paid for by commercial information services that use the results for competitive purposes.

Few user studies involve intervention by the researcher. Melnechuk and Staiger both explored this point. In Melnechuk's view, the great challenge confronting STI researchers—and the managers for whom they work—is to invent information services and products that people don't even know they want. Invention, agreed Staiger, is the critical first step; the second is to risk the invention in a real situation. By "a real situation," Staiger meant one in which dollars, reputations, and ongoing systems are at stake.

The researcher's stakes in user studies. Staiger intimated that far too few researchers ever become involved in interventive studies. He went on: "How many people who have conducted a user study have profit and loss responsibility for a product?"

Staiger's challenge brought a strong rebuttal from Lin:

> I consider that a very impractical demand . . . We certainly cannot expect researchers to be also responsible for any specific application of their (information) product . . . If you really wanted to have the researchers to be responsible for *this kind of research,* then what you are asking for is to have thousands of user studies for each specific purpose, which is a waste of energy.

Market research methods needed. It became clear that many academically-based STI user studies have been conducted by investigators with similar, usually discipline-oriented, perceptions of users. It was at this point that the discussion finally moved from a general analysis of the problem to the formulation of a possible research question, one that came to be of dominant concern. Assuming it would be desirable to increase the number and quality of predictive and interventive studies, Goldhar asked: *"How do we get traditional, existing, well-proven consumer product market research techniques applied in the science and technology information business?"*

A BRIEF EDITORIAL

This report obviously does not contain answers to the many important and puzzling issues and questions that arose during and after the workshop discussions. The agenda of items identified, however, should help provide guidelines for further research into the relationships between STI users and the systems and services that are designed and provided to serve those users.

The total amount of money and effort spent on studies of STI user behavior has been quite modest compared with the amounts spent for the main scientific activities (e.g., R&D) that STI/SS's are supposed to support. If the evaluations of the participants are valid, however, much previous STI user research appears to have missed the mark in terms of (1) improving understanding of the phenomena, and (2) improving the design and management of STI/SS's.

One reason for the apparent inefficiency to date in STI research may be due to the lack of conceptual frameworks or theories within which different studies can be related. Approximately 100 empirical studies of STI user behavior are reviewed each year in Carlos Cuadra's *Annual Review of*

Information Science and Technology; it appears to be very difficult for the reviewers to reconcile some of the major results and to relate them to any systematic understanding of the underlying phenomena. Another reason for the noncumulative nature and the inconclusiveness of much of this research might be the methodologies used to collect the data and structure the studies. There seems to be very little systematic replication of specific studies. If such is the case, it is not surprising that the validity and significance of much research in the field can be questioned.

One of the hoped-for results of the workshop and this report is a change in the kind of research done in this important area, including the methods used for doing that research. We would like to see future research focussed on problems that are both *scientifically researchable* (that is, the methods used yield highly credible, communicable, and replicable results), and *practically important* (that is, they can be of direct use to people involved in designing, providing, managing, and using STI systems and services). Specifically, we hope the results of the workshop, as represented in this report, will be of some use to four different audiences in the following ways:

To researchers of STI user behavior. Many of the questions raised by participants present considerable intellectual challenge. The issues hopefully will stimulate STI researchers to continue or to initiate research in this field for scientific as well as practical reasons; to devote time and effort to replication of existing studies so as to improve the credibility and usability of studies that have shown promising, but not conclusive results; and to provide a relatively simple framework and context so that individual studies can be related to the overall STI process and other research in progress, completed in the past, or to be undertaken in the future.

To designers of STI/SS's. The workshop discussions suggested that very little direct use is made of the research results that are available and that appear credible in the design of new and improved systems and services for STI users. We hope that at a minimum this report will serve STI/SS designers by pointing up some of the key issues in the field and some of the needs their potential clients have and are concerned about. We also hope that this report can stimulate a dialogue, where none now exists, between system designers and their clients: both the managers of STI/SS's and the ultimate users (i.e., the scientists, engineers, and others engaged in R&D and related activities). We also hope that this report will stimulate some of the designers of such systems to undertake or expand actual R&D on user behavior aspects of their systems, and to thereby build up a capability for continuous improvement in our knowledge about user needs and behavior as well as a large data base for the design, evaluation, and management of STI/SS's.

To managers of STI/SS's. We hope that this report will stimulate STI/SS managers to carry out more in-house research on the user aspects of their STI activities both *before* they purchase new or improved STI/SS's, and *after* they receive and install them. For example, we hope to see a significant increase in "administrative experimentation" by STI/SS managers interested in improving system effectiveness and utilization. (STI/SS managers not familiar with, but seriously interested in, administrative experimentation could benefit from reading workshop participant Thompson's articles on this subject in the May-June 1974 issue of *Human Factors* and in the May 1974 issue of *IEEE Transactions on Engineering Management.)*

To ultimate users of STI/SS's. In the scientific spirit of intellectual curiosity, as well as for practical considerations, we hope that at least a few ultimate users will feel inspired to examine some of these issues, let us know their views on them, carry out some experiments on their own, and perhaps receive some consolation in knowing that their problems are not unique and that help may be on the way.

APPENDIX A

KEY STI ISSUES AND POTENTIALLY RESEARCHABLE QUESTIONS:

Form Used in Evaluation Round One

I-1. Need for techniques of economic analysis of STI sector. (PA)*

- Q-4. What kinds of economic analysis are potentially appropriate to STI? (CT)
- Q-5. Which types are most useful for STI? (CT)
- Q-42. Can the effect of a publication be measured by the degree to which it reduces the distance between the "current awareness" of a field held by its leaders and that held by its normals?

I-2. Need for economic models of communication of information. (PA)

- Q-6. How can the STI sector be modeled effectively for economists and managers? (JG, TM, PA)
- Q-8. How can the value of information *per se* be measured at various levels? (DS)
- Q-13. What are the cost/benefits of various STI/SS's? (AR)
- Q-39. How can the efficiency of doing STI operations be improved?

I-3. Inclusion of proprietary information/data in STI. (DS)

I-4. Interservice pricing. (JG)

I-5. Structure of STI/SS sector. (JG)

- Q-1. What are the incentives for influencing structure? (JG)

I-6. Content quality control. (DS)

- Q-2. What quality control mechanisms are feasible? (JG)
- Q-3. What kind of quality control mechanisms are desireable? (JG)
- Q-7. How can the value of information *per se* be measured at various levels? (DS)

I-7. Nontechnical STI users. (JM)

- Q-16. How do public interest groups acquire STI/SS's? (JKg)

I-8. STI systems and services for public interest groups. (JKg)

- Q-9. How will public interest groups respond to various types of STI/SS's and STI interpretations? (JKg, AR)
- Q-10. How will public interest groups stimulate various types of STI/SS's and STI interpretations? (JKg, AR)
- Q-16. How do public interest groups acquire STI/SS's? (JKg)

I-9. Role of community libraries in STI. (JKg)

I-10. User role in influencing the design and management of STI/SS's. (CT)

I-11. Use of information concerning users in the design and management of STI/SS's. (CT)

I-12. Integration, standardization, and tailoring of STI data banks (vertical vs. horizontal) for internal use in industry. (CS)

- Q-17. What alternatives exist for standardizing the structure of STI/SS's? (JF)

*Initials of contributors are in parentheses (see participant list in Chapter I).

APPENDIX A (Continued)

I-13. Market segmentation. (JG)
- Q-11. Who are the user groups and what are the bases for categorizing them? (TS)
- Q-18. What different ways can "market segmentation" for STI users be done?
- Q-19. What kinds of tertiary services are needed by different market segments?
- Q-29. What are (the information) purchasing behavior patterns of STI users?
- Q-40. By what principles are users segmented?
- Q-41. Within segments, what are the individual behavior patterns? What are the constraints? What systems meet these needs?

I-14. Choice of target areas for user studies. (TG)

I-15. Availability of proprietary user behavior information to STI academic researchers. (AR)

I-16. Inputs of users to user studies. (AR)
- Q-12. What methods would be appropriate for permitting users of user studies to feed into and evaluate such studies? (TG)

I-17. Should the federal government play an evaluative role for STI/SS's? (WP)

I-18. Enhancing diffusion of innovation through STI/SS's. (JG)

I-19. Risk-taking in STI innovation. (DS) (See also Issue #35.)
- Q-37. To what extent is market disaggregation a barrier to STI/SS innovation, and what mechanisms could overcome this condition?
- Q-38. How does the rate of change of the technological (interest) profile of users affect STI/SS's?

I-20. Organization and management of user groups to enhance STI use. (JG) (See also Issue #32.)
- Q-27. What are (the) ways to motivate individual users to use STI/SS's?

I-21. Design of STI/SS's to serve groups sized 100 to 1,000. (JG)

I-22. Design, management, and function of intermediaries. (JG)

I-23. Design and function of tertiary STI/SS's. (JG) (See also Issues #30, 31.)
- Q-19. What kinds of tertiary services are needed by different market segments?
- Q-20. How can tertiary services be created utilizing existing institutions to optimize return on investment?
- Q-43. Have any designed STI systems accomplished what they intended?

I-24. (Nature, importance of) the STI reward structure. (JM)
- Q-25. What kinds of reward structures could be used to influence the use of STI by users?

I-25. Improving feedback. (JKt)

I-26. Methodology of conducting user studies by designers of STI/SS's.

I-27. Getting the designers of STI/SS's to use the results of user studies. (AR)

APPENDIX A (Continued)

I-28. User security. (CS)

Q-14. What are the variety and effectiveness of user security measures? (JF, CS)

I-29. Data base subsetting in social problem areas. (CS, JF)

Q-15. What strategies are employed by the developers and users of STI/SS's in extracting information relevant to emergent social problem areas (e.g., energy, environment)? (JF)

I-30. Design and function of secondary services. (See Issues #23, 31.)

Q-21. What kinds of secondary services are needed by different market segments?

Q-22. How can these secondary services be created utilizing existing institutions to optimize return on investment?

Q-43. Have any designed STI systems accomplished what they intended?

I-31. Design and function of primary services. (See Issues #23, 30.)

Q-23. What kinds of primary services are needed by different market segments?

Q-24. How can these primary services be created utilizing existing institutions to optimize return on investment?

Q-43. Have any designed STI systems accomplished what they intended?

I-32. STI/SS user motivation.

Q-26. What are possible "personal retrieval tools" which could be used in STI/SS and how effective are they?

Q-27. What are (the) ways to motivate individual users to use STI/SS's?

Q-28. How can individual users be motivated to explore new fields of STI?

Q-44. What are the cognitive and motivational characteristics of different segments and what kinds and transforms of information will communicate to them?

Q-45. What are the cognitive and motivational differences between people who select different professions and roles in science and technology and (their use of) STI?

Q-46. How can people with a record of successful STI innovations be detected, encouraged and challenged?

Q-47. To what extent and in what ways can artistic mind styles supplement scientific and engineering mind styles in facilitating generation and communication of STI?

I-33. STI/SS marketing.

Q-29. What are (the information) purchasing behavior patterns of STI users?

Q-30. What successful marketing techniques might be applicable in STI/SS marketing?

Q-31. What new marketing techniques might be applicable in STI/SS marketing?

Q-47. To what extent and in what ways can artistic mind styles supplement scientific and engineering mind styles in facilitating generation and communication of STI?

Q-48. If a research field is dominated by one or a few companies, are there fewer kinds of STI systems than where there is competition?

APPENDIX A (Continued)

I-34. Design of STI/SS's.

Q-32. What needs to be done with information sources to improve efforts of suppliers to design STI/SS's more related to user behavior?

Q-36. What are existing industrial support practices for STI?

Q-37. To what extent is market disaggregation a barrier to STI/SS innovation, and what mechanisms could overcome this condition?

Q-43. Have any designed STI systems accomplished what they intended?

Q-47. To what extent and in what ways can artistic mind styles supplement scientific and engineering mind styles in facilitating generation and communication of STI?

Q-49. Could a computer be programmed to store high-frequency citations often used in one's papers and to change them according to the different styles of different journals?

I-35. STI/SS management techniques.

Q-33. What kinds of long-range planning techniques are needed by managers of STI/SS's, and how can they be acquired?

Q-34. What is the relationship between organizational structure/climate and individual STI behavior and use?

Q-35. How can organizational policies/structure/climate/etc. be changed to promote the use of STI by individuals?

Q-46. How can people with a record of successful STI innovations be detected, encouraged and challenged?

Q-47. To what extent and in what ways can artistic mind styles supplement scientific and engineering mind styles in facilitating generation and communication of STI?

Q-50. Will journal problems change as the decrease in population growth diminishes the size of higher education and lowers the pressure to publish?

Q-51. Could a national referral service supersede professional society directories?

Q-52. How can invisible colleges be tapped for wisdom otherwise not evoked?

Q-53. How can grapevines be tapped for state-of-the-art surveys?

Q-54. Will a *Journal of Winning Proposals* be accepted?

Q-55. How can all early stages of science be tapped in advance of formal publication for early warning systems as to new concepts, new approaches, new data, new interpretations and promising newcomers?

I-36. Other forms of indicia should be tested, besides condensations (as in absracts) and subject-matter (as in key words); other approaches include level, approach, kind of mechanism discovered, etc.

I-37. Every article should be tagged with a terse statement of its major claim, perhaps as its title. (See also Issue #47.)

Q-56. Can NSF-sponsored Councils of Journal Editors in each field require authors to provide the main claim?

Q-57. Can appended "major claim" statements be made a requirement of publication?

Q-60. Who should tag papers with the major claim statements?

I-38. Output measures are needed.

I-39. Professionals in the field should periodically make predictions.

APPENDIX A (Concluded)

I-40. Since the state of STI is a function of the state of current technology, OSIS should support experiments on large numbers of permutations of current components.

I-41. OSIS should encourage entreprenuers who couldn't afford trial innovations otherwise.

I-42. Other kinds and potential kinds of intermediaries should be recognized besides the traditional kinds. (See Issue #22.)

I-43. The change in generations requires longitudinal and historical studies of STI; a new demography is needed of how science is done in the USA.

Q-58. Do only burgeoning fields in ferment have STI problems?

Q-59. Of what special sort are their problems (e.g., recruiting)?

I-44. "Fugitive" files should be more accessible.

Q-59. What set of principles should guide development of "fugitive" files?

I-45. The social matrix of STI—directories, phone numbers of knowledgeable people, etc.—is important.

I-46. Technologists (who seek information on devices embodying solutions to problems) differ in information needs from scientists.

I-47. There are no STI problems in three fields: law, patents and mathematics. This is primarily because (a) precedent is important; (b) there are very precise forms and styles; (c) access tools are rigidly structured and well known; and (d) new developments are made explicit (i.e., explicit major claims are required). (See also Issue #37.)

Q-56. Can NSF-sponsored Councils of Journal Editors in each field require authors to provide the main claim?

Q-57. Can appended "major claim" statements be made a requirement of publication?

Q-60. Who should tag papers with the major claim statements?

I-48. Tapping into privileged grapevines.

Q-61. How can equity be obtained in STI services for those with STI problems?

Q-62. How can all get access to information on privileged grapevines?

I-49. User studies should be done not for the NSF but for client agencies who should retain STI researchers to serve them.

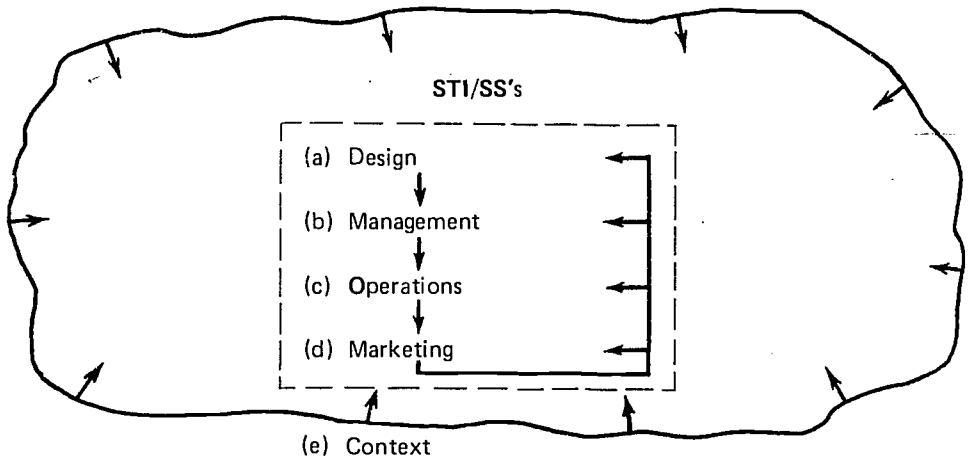
I-50. On nonpatentable but desireable innovations, profit organizations should be aided by NSF to cost-share.

APPENDIX B

KEY STI ISSUES AND POTENTIALLY RESEARCHABLE QUESTIONS: Form Used in Evaluation Round Two

Introduction. More than 200 scientific and technical information (STI) issues and questions were identified by persons contributing ideas to the workshop. For analytical convenience, most of the issues and questions are grouped into four functional levels depicted in the following figure. The four functions include STI system and service (a) design and redesign; (b) management; (c) operations; and (d) marketing. An additional level, (e) context, is used to pinpoint issues and questions normally outside the control of STI system and service managers.

FOUR FUNCTIONS WITHIN THE CONTEXT OF SCIENTIFIC AND TECHNICAL INFORMATION SYSTEMS AND SERVICES (STI/SS'S)*



*Not an attempt at a rigorous taxonomy or model of the STI domain, but merely a convenient way of grouping the STI issues and research questions.

Rating. Please rate the *importance* of each issue (I) and the *researchability* of each question (Q) on a scale from 10 (highest) to 0 (lowest). Note that in most cases initials of contributors are included in parentheses after each issue and question.

APPENDIX B

YOUR RATING 10 . . . . . 0 (Highest) (Lowest) Issue (Importance)	Question (Researchability)
	LEVEL A. STI/SS DESIGN AND REDESIGN
_____	IA1. Design of STI/SS's.
_____	QA1. What needs to be done with information sources to improve efforts of suppliers to design STI/SS's more related to user behavior?
_____	QA2. What kinds of STI/SS's (e.g., primary-secondary; horizontal-vertical) are needed by different market segments?
_____	QA3. How can new STI/SS's be created utilizing existing institutions to optimize return on investment?
_____	QA4. How can existing STI/SS's (e.g., periodicals, computerized data bases, libraries) be modified to meet emergent information needs in major social problem areas (e.g., energy)? (JF)
_____	QA5. To what extent have existing STI/SS's accomplished their objectives? (MR)
_____	QA6. What STI/SS design alternatives exist for meeting needs of different sized groups (e.g., 100-1,000)? (JG)
_____	QA7. To what extent and in what ways can artistic mind styles supplement scientific and engineering mind styles in facilitating generation and communication of STI? (TM)
_____	QA8. Could a computer be programmed to store high-frequency citations often used in one's papers and to change them according to the different styles of different journals? (CT)
_____	QA9. How can existing STI/SS's be redesigned to become the "knowledge workshops" Doug Englebart at SRI talks about? (PA)
_____	QA10. Why has research in artificial intelligence, automata, and problem-solving been largely ignored in the development of large-scale, integrative data bases (both primary and secondary)? What has prohibited transfer of this theory in mathematics to practice in designing STI/SS's? (JMa)
_____	QA11. Which journal problems will change as the decrease in population growth diminishes the size of higher education and lowers the pressure to publish? (MR)

YOUR RATING 10 . . . . . 0 (Highest) Issue (Importance)	(Lowest) Question (Researchability)

LEVEL A. STI/SS DESIGN AND REDESIGN (Continued)

QA12. To what extent could a national referral service supplement professional society directories and expedite communication between researchers and publics other than peers? (CT, PA)

IA2. Risk-taking in STI/SS innovation. (DS)

QA13. To what extent is market disaggregation a barrier to STI/SS innovation, and what mechanisms could overcome this condition? (DS)

QA14. How does the rate of change of the technological interest profiles of users affect STI/SS's?

QA15. What are existing industrial support practices for STI?

QA16. How can people with a record of successful STI innnovations be detected, encouraged and challenged? (TM)

QA17. What can be done to encourage STI/SS entreprenuers who cannot otherwise afford trial innovations? (PU)

QA18. How can totally new STI/SS's and content evaluations be introduced into the STI sector? (TM)

QA19. Will a *Journal of Winning Proposals* be accepted? (TM)

IA3. Use of information concerning users in the design of STI/SS's. (CT)

IA4. Getting designers of STI/SS's to use the results of user studies. (AR)

QA20. How much account do designers of STI/SS's take of actual user attitudes and behavior in designing their systems and services? (AR)

QA21. How do STI/SS designers use the results of user studies? (AR)

QA22. What changes in STI/SS design result from direct and indirect user feedback (e.g., through complaints initiated by users or systematic user studies)? (AR)

QA23. What problems (attitudinal and behavioral) trouble STI/SS designers and managers? (AR)

QA24. How do STI/SS designers and managers evaluate the effectiveness of operating or planned systems and services? (AR)

QA25. What cost/benefit ratios do managers of R&D and other users employ to evaluate or plan the size and/or complexity of STI/SS's? (AR)

37

APPENDIX B (Continued)

YOUR RATING 10.....0 (Highest) (Lowest) Issue (Importance)	Question (Researchability)	
		LEVEL A. STI/SS DESIGN AND REDESIGN (Concluded)
_____		IA5. Availability of proprietary user behavior information to STI academic researchers. (AR)
_____		IA6. Choice of target areas for user studies. (TG)
_____		IA7. Other kinds and potential kinds of intermediaries besides the traditional kinds. (MR)
_____		IA8. Integration, standardization, and tailoring of STI data banks (vertical vs. horizontal) for internal use in industry. (CS)
	_____	QA26. What alternatives exist for standardizing the structure of STI/SS's? (JF)
_____		IA9. Relevance of STI to major social problem areas (e.g., energy, environment). (JF)
	_____	QA27. How is STI integrated with other classes of data and information (e.g., legal, social) in the development and implementation of public policy? (JF, JMa)
	_____	QA28. How can STI generators be influenced to become more participative in responding to policy use requirements for STI? (JF)
	_____	QA29. To what extent has STI from one field been integrated with STI from other fields? Where and under what conditions have subsets of STI across fields been constructed? (JMa)
	_____	QA30. What transformations in STI occur as innovations move along the research-development-commercialization continuum? (JF)

APPENDIX B (Continued)

YOUR RATING 10 . . . . . 0 (Highest) (Lowest) Issue (Importance)	Question (Researchability)	
		LEVEL B. STI/SS MANAGEMENT
_____		IB1. Application of economic analysis techniques to the STI sector. (PA, WC)
	_____	QB1. What kinds of economic analysis are potentially appropriate to STI? What kinds of economic analysis are most useful for STI? (CT)
_____		IB2. Economic modeling of scientific and technical communication. (PA, CH)
	_____	QB2. How can the STI sector be modeled effectively for analysis and understanding by economists and STI/SS managers? (JG, TM, PA)
	_____	QB3. How can the value of information be measured at various levels? (DS)
	_____	QB4. What economic factors affect the impact of STI/SS's? (AC)
	_____	QB5. Do the economic forces of supply and demand operate at the level of an international market? If so, are the patterns similar to the mechanisms of mircoeconomic analysis? Are similar measurement techniques applicable? (JH)
_____		IB3. STI/SS management techniques.
	_____	QB6. What kinds of long-range planning techniques are needed by managers of STI/SS's, and how can they be acquired? (PU)
	_____	QB7. What is the relationship between organizational structure/climate and individual STI behavior and use? (AC)
	_____	QB8. How can organizational policies/structure/climate/etc. be changed to promote the use of STI by individuals? (AC)
_____		IB4. Financing STI/SS's. (JG)
	_____	QB9. What are the pricing policies of various STI/SS owners? (PU)
	_____	QB10. What are the costs and benefits of various STI/SS's? (AR)
	_____	QB11. How can the efficiency of STI/SS's be improved? (JF, DS)
	_____	QB12. What are the financial incentives for influencing the STI/SS structure? (JG)

YOUR RATING 10.....0 (Highest) Issue (Importance)	(Lowest) Question (Researchability)	
	_____	QB13. What will new STI handling methods cost compared to the old? That is, are there cost savings or increased costs? (WC)
	_____	QB14. How do capital requirements and profit potential affect the growth of STI/SS's? (AC)
	_____	QB15. What approaches are taken to interservice pricing? What are the consequences of different interservice pricing options for participating STI/SS's? (JG)
_____		IB5. The management of intermediaries. (JG, PU)
	_____	QB16. How can STI relayers and service agents best perform their activities? (NL)
	_____	QB17. How are reviewers selected? Is their selection more geared to the needs of the particular disciplines or problem areas, or do politics play an overriding role? (JMa)
_____		IB6. Use of information concerning users in the management of STI/SS's. (CT)
	_____	QB18. What methods would be appropriate for permitting users of user studies to feed into and evaluate such studies? (TG)
_____		IB7. International cooperation in the development and management of STI/SS's. (JH)
	_____	QB19. What international policies and programs relate to the operation of STI/SS's? (JH)
	_____	QB20. To what extent do such policies and programs facilitate or inhibit international information exchange among more prosperous and less prosperous nations? (JH)
	_____	QB21. To what extent do political processes reinforce and perpetuate the concentration of STI/SS resources? (JH)
_____		IB8. Reduction in journal subscriptions. (AR)
	_____	QB22. To what extent are different STI users cutting the number of their journal subscriptions? (AR)
	_____	QB23. What factors (e.g., rising subscription charges) are associated with cuts in journal subscriptions and what alternatives, if any, can be developed to counteract such cuts? (JF)

LEVEL B. STI/SS MANAGEMENT (CONTINUED)

APPENDIX B (Continued)

YOUR RATING 10.....0 (Highest) Issue (Importance)	(Lowest) Question (Researchability)	LEVEL B. STI/SS MANAGEMENT (Concluded)
_____		IB9. Evaluation of STI/SS impacts. (MR)
	_____	QB24. What should be the government's (e.g., federal, state) responsibility in evaluating STI/SS's? (WP)
	_____	QB25. How can the "current awareness" effect of STI/SS's be measured? (MR)
	_____	QB26. What will be the change in productivity of individuals served by introducing new information/data handling methods? (WC)
	_____	QB27. What will be the perceived changes in the overall performance (e.g., profits) of the organizations within which new STI/SS's are embedded? (WC)
	_____	QB28. What factors affect the stability and continuity of STI/SS's? (CH)
	_____	QB29. What affect does the introduction of new STI/SS's have on the use of existing STI/SS's (e.g., increased or decreased use)? (JF)

APPENDIX B (Continued)

YOUR RATING 10.....0 (Highest) (Lowest)	
Issue (Importance)	Question (Researchability)

LEVEL C. STI/SS OPERATIONS

IC1. Editorial practice. (JF)

QC1. Can NSF-sponsored Councils of Journal Editors in each field require authors to provide the main claim? (TM)

QC2. Can appended "major claim" statements be made a requirement of publication? Who should tag papers with the major claim statements? (WP, TM)

QC3. How useful is the abstract as a tool for assessing the potential relevance of an article? What alternatives to the abstract (e.g., using only the first or last paragraph) exist and what would be the technical and financial impacts of employing them? (JMa)

QC4. What other forms of indicia should be tested, besides condensations (as in abstracts) and subject-matter (as in key words)? Other approaches might include level, approach, kind of mechanism discovered, etc. (TM)

QC5. To what extent does the use of professional jargon, acronyms, and complex supporting mathematical formulae inhibit the readability and use of material by users not in a profession or the non-specialist within a profession? How would elimination of such language hamper the specialist? (JMa)

IC2. Content quality control. (DS)

QC6. What quality control mechanisms are feasible? (JG)

QC7. What kind of quality control mechanisms are desirable? (JG)

QC8. How can the value of information *per se* be measured at various levels of usage? (DS)

IC3. Inclusion of proprietary information/data in STI/SS's. (DS)

IC4. Data base subsetting in social problem areas. (CS, JF)

QC9. What strategies are employed by STI/SS users in extracting information relevant to emergent social problem areas (e.g., energy, environment)? (JF)

IC5. STI/SS networking. (PA)

IC6. Centralization versus decentralization in STI delivery. (TM, PU)

IC7. STI packaging. (JF)

YOUR RATING 10.....0 (Highest) Issue (Importance)	(Lowest) Question (Researchability)	
	_____	QC10. What is the feasibility of breaking down the documents in a publication service into parts that can be used to compose new information packages? (JF)
	_____	QC11. What are the cost/effectiveness ratios of different ways of packaging STI? In particular, what are the most useful and least useful packaging practices for presenting the results of computerized literature search services? (JF)
_____		IC8. Restrains on information flow. (JMa)
	_____	QC12. How do different STI media restrict the transmission of information to potential end users? How amenable are those restrictions to modification? (JMa)
	_____	QC13. In what ways do workshops/seminars/conferences facilitate and inhibit scientific and technical communication? (JMa)
_____		IC9. Industrial user security. (CS)
	_____	QC14. What are the variety and effectiveness of user security measures? (JF, CS)

LEVEL C. STI/SS OPERATIONS (Concluded)

43

APPENDIX B (Continued)

YOUR RATING 10.....0 (Highest) (Lowest)	
Issue (Importance)	Question (Researchability)

LEVEL D. STI/SS MARKETING

ID1. STI/SS marketing. (JF)

QD1. To what extent have STI/SS managers used market research techniques to pinpoint potential user groups and to develop promotional appeals? (JF)

QD2. What incentives and responsibilities motivate STI/SS managers to make their SS's more useful? What incentives might be offered that would motivate STI/SS managers, in their own interest, to increase their market research activity? (JF)

QD3. What successful marketing techniques might be applicable in STI/SS marketing? What new marketing techniques might be applicable in STI/SS marketing?

QD4. How have market research efforts varied across different classes of STI/SS's? (JF)

QD5. If a research field is dominated by one or a few companies, are there fewer kinds of STI systems than where there is competition? (CT)

ID2. Market segmentation. (JG, JF)

QD6. Who are the user groups and what are the bases for categorizing them? (TS, MR, JF)

QD7. What different ways can "market segmentation" for STI users be done? (JG)

QD8. What kinds of primary, secondary, and tertiary STI/SS's are needed by different market segments? (DS)

QD9. What are the information and data purchasing behavior patterns of STI/SS users? (JF)

QD10. Within segments, what are the individual STI behavior (e.g., acquisition, use) patterns? What are the constraints? What systems meet those contraints? (MR)

QD11. What are the critical variables that cause variance in information requriements and uses? (PA)

QD12. How much time do different users invest in using various STI/SS's? (CH)

QD13. How much are users, as individuals or through their organizations, willing to pay for STI/SS's? (CH)

QD14. How do technology consumers and application consumers get their hands on STI and data they need when they want it and in a form they can use? (WC)

APPENDIX B (Continued)

YOUR RATING 10.....0 (Highest) Issue (Importance)	(Lowest) Questions (Researchability)	
	_____	QD15. What are the cognitive and motivational characteristics of different segments and what kinds and transforms of information will communicate to them? (TM)
_____		ID3. STI systems and services for public interest groups. (JKg)
	_____	QD16. How will public interest groups respond to various types of STI/SS's and STI interpretations? (JKg, AR)
	_____	QD17. How will public interest groups stimulate various types of STI/SS's and STI interpretations? (JKg, AR)
	_____	QD18. How do public interest groups acquire STI/SS's? (JKg)
_____		ID4. STI/SS user training. (JF)
	_____	QD19. How are scientists, engineers, managers, and others trained to use STI/SS's? (JF)
	_____	QD20. What kind of training is needed to prepare scientists, engineers, and other STI users for interesting and successful use of STI/SS's? (AR)
	_____	QD21. How much do alternative approaches to STI/SS user training cost, who pays, and what are the results? (JF)
	_____	QD22. How can current approaches to STI/SS user education be improved? (JF)
_____		ID5. Nature of and leverage points in the STI reward structure. (JM)
	_____	QD23. What kinds of reward structures could be used to influence the use of STI by users?
	_____	QD24. What factors influence end users' decisions to employ different STI/SS's? (JF)
	_____	QD25. What barriers to STI/SS access or use do different STI users encounter? How amenable are those barriers to control? (JF)
	_____	QD26. How can individual users be motivated to use existing STI/SS's and to explore the possibility of using new STI/SS's? (AR)
	_____	QD27. What personal retrieval tools do STI users employ in accessing STI/SS's and how effective are they?
_____	_____	ID6. User role in influencing the management of STI/SS's. (CT, AR)
	_____	QD28. How can users be integrated into the management of STI/SS's? (JMa)

APPENDIX B (Continued)

YOUR RATING 10 . . . . . : 0 (Highest) Issue (Importance)	(Lowest) Question (Researchability)	LEVEL D. STI/SS MARKETING (Concluded)
_____	_____	ID7. Access to personal files. (WP)
		QD 29. What principles should guide the development of personal files? (CT)
_____		ID8. Access to privileged grapevines. (TM)
	_____	QD30. How can equity be obtained in the STI services for those with STI problems?
	_____	QD31. How can all get access to information on privileged grapevines?
	_____	QD32. How can grapevines be tapped for state-of-the-art surveys? (CT)
	_____	QD33. How can all early stages of science be tapped in advance of formal publication for early warning systems as to new concepts, new approaches, new data, new interpretations and promising newcomers? (TM)
	_____	QD34. How can invisible colleges be tapped for wisdom otherwise not evoked? (TM)

YOUR RATING 10 . . . . . 0 (Highest) (Lowest)	
Issue (Importance)	Question (Researchability)

LEVEL E. STI/SS CONTEXT

IE1. The change in generations requires longitudinal and historical studies of STI; a new demography of how science is done is needed. (MR, WP)

QE1. Do only burgeoning fields in ferment have STI problems? (CT)

QE2. What special problems (e.g., recruiting) exist in such fields? (TM)

IE2. Enhancing the diffusion of innovation through STI/SS's. (JG)

IE3. Impact of copyright law and practice on STI/SS's. (PU)

QE3. What are (will be) the impacts of changes of copyright law or practice on STI/SS's? (DS, PU)

QE4. What mechanisms can be used for handling the economic problems arising from current copyright practice? (PU)

IE4. Impact of computer technology (e.g., ARPA, SRI Knowledge Center) on the STI sector. (PA)

QE5. To what extent is the critical mass of STI under control in existing information systems available in a computer-based, interactive retrieval environment? (PA)

IE5. Impact of new (e.g., nonlaboratory) modes of R&D and innovation on STI/SS's. (AR)

IE6. Impact of the trend toward finding and borrowing, rather than generating, STI on the STI sector. (DP)

IE7. Impact of changes in academic research on STI generation and distribution. (MR)

IE8. Impact of the trend toward cooperation, rather than competition, on the structure and functioning of STI/SS's. (TM)

IE9. Potential impact of newcomers to the STI field on the field. (TM)

IE10. Social matrix of the STI/SS sector. (MR)

IE11. Organization and management of user groups to enhance STI use. (JG)

APPENDIX B (Concluded)

YOUR RATING 10.....0 (Highest) Issue (Importance)	(Lowest) Question (Researchability)	LEVEL E. STI/SS CONTEXT (Concluded)
	_____	QE6. What organizational factors influence members to make use of STI/SS's? (AC)
	_____	QE7. What are the cognitive and motivational differences between people who select different professions and roles in science and technology and STI? (MR)
_____		IE12. Duplication of research and development effort. (PA)
	_____	QE8. To what extent is duplication of work occurring in areas of comparable research and development activity? (PA)

APPENDIX C

1,000 POINT ALLOCATION RATING FORM AND QUANTATIVE RESULTS

Introduction. Workshop participants assessed the relative *importance* of 47 STI issues in the second rating round, using a scale of 10 (highest importance) to 0 (lowest importance). For analytical convenience, the issues were grouped into four functional categories or levels: STI system and service (a) design and redesign, (b) management, (c) operations, and (d) marketing. An additional level, (e) context, was used to include issues normally beyond the control of STI system and service managers.

Rating. Please use the following four-step procedure in this third, and final, rating of STI issues.

- **First,** review the 30 issues selected. You'll note that they are the ones that received the highest importance ratings in the second rating exercise.

- **Second,** decide in your own mind how progress in this field might best be served by selecting a subset of the issues you think should be researched during the next three years. The key question you must address is just how much research effort should be invested in each of these issues between now and 1977.

- **Third,** assume that 1,000 points represent the total resources available for R&D on these issues during the next three years.

- **Fourth,** distribute 1,000 points in any proportion you deem appropriate across the 30 issues. Please *do not* let the total number of points you assign exceed 1,000.

Comments. (1) Issues are ranked under each level from highest to lowest according to the average ratings resulting from the second round evaluations. (2) Issues retain the same identifying numbers as the ones used in the second round. (3) Please refer to Exhibit III if you wish to reexamine the potenially researchable questions related to each issue.* (4) In most cases the initials of contributors are included in parentheses after each issue. (5) Please suggest any changes in language you may wish to make.

*"Exhibit III" was the term used to refer to the form employed in the second round of evaluation.

APPENDIX C (Continued)

YOUR RATING (Number of points; if none, so state)	LEVEL A. STI/SS DESIGN AND REDESIGN
915*	IA3. Use of information concerning users in the design of STI/SS's. (CT)
710	IA1. Design of STI/SS's.
1,095	IA9. Relevance of STI to major social problem areas (e.g., energy, environment). (JF)
530	IA4. Getting designers of STI/SS's to use the results of user studies. (AR)
845	IA7. Other kinds and potential kinds of intermediaries besides the traditional kinds. (MR)
425	IA2. Risk-taking in STI/SS innovation. (DS)
4,520	TOTAL POINTS ASSIGNED TO THIS LEVEL

* * * * *

YOUR RATING (Number of points; if none, so state)	LEVEL B. STI/SS MANAGEMENT
805	IB1. Application of economic analysis techniques to the STI sector. (PA, WC)
865	IB9. Evaluation of STI/SS impacts. (MR)
385	IB3. STI/SS management techniques.
385	IB4. Financing STI/SS's. (JG)
600	IB6. Use of information concerning users in the management of STI/SS's. (CT)
545	IB5. The management of intermediaries. (JG, PU)
585	IB2. Economic modeling of scientific and technical communication. (PA, CH)
4,170	TOTAL POINTS ASSIGNED TO THIS LEVEL

*Total number of points allocated to this issue by participants during the Third Round of Evaluation.

APPENDIX C (Continued)

YOUR RATING (Number of points; if none, so state)	LEVEL C. STI/SS OPERATIONS
665	IC7. STI packaging. (JF)
715	IC5. STI/SS networking. (PA)
930	IC4. Data base subsetting in social problem areas. (CS, JF)
2,310	TOTAL POINTS ASSIGNED TO THIS LEVEL

* * * * *

YOUR RATING (Number of points; if none, so state)	LEVEL D. STI/SS MARKETING
1,240	ID1. STI/SS marketing. (JF)
1,280	ID2. Market segmentation. (JG, JF)
430	ID5. Nature of and leverage points in the STI reward structure. (JM)
565	ID4. STI/SS user training. (JF)
770	ID6. User role in influencing the management of STI/SS's. (CT, AR)
4,285	TOTAL POINTS ASSIGNED TO THIS LEVEL

APPENDIX C (Concluded)

YOUR RATING (Number of points; if none, so state)	LEVEL E. STI/SS CONTEXT
990	IE3. Impact of copyright law and practice on STI/SS. (PU)
580	IE4. Impact of computer technology (e.g., ARPA, SRI Knowledge Center) on the STI sector. (PA)
405	IE2. Enhancing the diffusion of innovation through STI/SS's. (JG)
500	IE11. Organization and management of user groups to enhance STI use. (JG)
335	IE5. Impact of new (e.g., nonlaboratory) modes of R&D innovation on STI/SS's. (AR)
295	IE6. Impact of the trend toward finding and borrowing, rather than generating, STI in the STI sector. (DP)
210	IE12. Duplication of research and development effort. (PA)
290	IE7. Impact of changes in academic research on STI generation and distribution. (MR)
100	IE8. Impact of the trend toward cooperation, rather than competition, on the structure and functioning of STI/SS's. (TM)
3,705	TOTAL POINTS ASSIGNED TO THIS LEVEL

* * * * *

PLEASE CALCULATE YOUR FINAL POINT TALLY

LEVEL	NUMBER OF POINTS
A — Design	4,520
B — Management	4,170
C — Operations	2,310
D — Marketing	4,285
E — Context	3,705
TOTAL	18,990