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Defining an Information and Communications Program for the Institute for Scientific and Technological Cooperation

by

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PREFACE

At a level of effort of approximately two professional person months, I have been asked to review the fields of information and communications, and to suggest an orientation appropriate to the mandate and priorities of the Institute for Scientific and Technological Cooperation (ISTC). It was agreed that a broad-brush approach would be taken, and that recommendations would be general, subject to further elaboration and refinement at a later stage.

In that spirit, I have divided this report into three main topics, each with a section on basic conclusions, ISTC's first year, and its first five years. Considering the uncertainty of the Institute's program and budget, I have chosen to present more recommendations than the Institute may be able to respond to.

In order to enable the Institute to further expand and refine its program, I have attached a separate volume of appendices which includes key documents on scientific and technical information--the aspect of the information and communications field most directly related to ISTC's mandate. Since information on AID's activities is relatively easy for ISTC to obtain, I have concentrated on the activities of other development assistance agencies. This information-gathering effort was an integral part of producing this report.

SUMMARY

I. Introduction

A. In the "post-industrial" societies, information is increasingly considered a basic and a strategic resource, like energy or raw materials. Unlike other resources, however, the costs of information are falling as capacity to create, store, manipulate, and transmit information enjoys a sustained advance. Areas being affected by the technological "convergence of modes" are publishing, broadcasting, telecommunications, postal services, and computing. The implications for the developing countries are largely a matter of speculation.

B. Attitudes and orientation toward information in developing countries may differ radically from those of industrial countries. The prevalence of certain habits or abilities--including the following--should not be assumed:

- Aggressive seeking of multiple information sources on a given question.
- Evaluating and synthesizing various facts and perspectives to formulate one's judgments.
- Using information to guide behavior and decision making.

Some would argue that such information behaviors in themselves constitute the essence of development, and that many cultures place greater emphasis on personal contacts and on authority than on abstract and impersonal information. Therefore, information needs (and appropriate information services) should be investigated without preconceived notions.

C. Information and communications constitute a broad field. For ISTC's purposes the field can be divided as follows:

- Scientific and technical information as a support and catalyst for research and innovation.
- Media applications, including broadcast, two-way radio, telephone, and data communication.
- Communications and information policy making to shape the infrastructures which underlie all media applications and all scientific/technological information flows.

D. How should a problem-oriented R&D agency deal with a "solution area" or a resource such as communications and information, which cuts across its range of key problem areas? Unless they are well integrated into activities in key problem areas, communications and information often fail to be taken seriously. On the other hand, rapid advances in the field call for some mechanism for dealing with the subject on its own.

E. The field of information and communications has not benefitted from the previous large investments in ISTC development problem areas (agriculture, health, population) by development assistance agencies, or in global problems (energy, resources, environment) by developed countries. As a result, the research questions surrounding the role of information and communication in development are broader and less well defined than in other problem areas. ISTC may feel reluctant to tackle the large questions in this field with the rather limited resources on hand.

F. There are two approaches to this dilemma:

1. To focus upon the specific communication and information needs of ISTC as an organization: information support for ISTC staff and collaborating researchers, and dissemination of ISTC results.

2. To approach basic questions as an agenda setter and catalyst aiming at influencing larger agencies with more of a mandate in communications, by identifying gaps in knowledge, unwarranted assumptions, and blind spots.

Elements of both approaches will be dealt with. Since the program and funding parameters are unclear, more suggestions may be advanced (and in more general terms) than ISTC may be able to act on.

II. Scientific and Technical Information (STI)

A. Basic Conclusions

1. Massive research production in the industrial countries led to the creation of computerized information systems covering broad academic disciplines and government-sponsored R&D "missions." These systems abstract and categorize large numbers of published and unpublished information. Some international systems oriented toward development have been built, and others are under consideration. Familiarity with these systems (or expert assistance) is usually required for successful utilization.

2. Other less mechanized approaches include specialized "information analysis centers" whose services stress synthesis and judgment rather than volume. Another model is the network of specialized consultants, which responds to individual information requests. These approaches are more oriented toward the needs of individuals and client groups.

3. There is a surprising lack of in-depth research on the reach and impact of existing information services in developing countries. Although there are methodological difficulties in evaluating the impact of information, authorities agree that much more evaluation should be done.

4. Equally understudied are the information needs of various clienteles. Beyond the Western-educated elites in developing countries are many clienteles whose information needs and habits must be assumed to differ dramatically from the Western norm.

5. The above problems are brought into dramatic focus by the subject of information on appropriate or capital-saving technology, which covers a non-traditional subject, and benefits non-traditional users of STI. Liaison and support regarding the AT information services now under way is particularly important for ISTC.

6. Over the long term, developing countries must formulate comprehensive national policies and build national infrastructures and institutions for STI. Linkages between developing countries can stimulate technical cooperation among developing countries (TCDC) over time. These efforts should be grounded in detailed assessments of information needs and information habits of all concerned clienteles.

B. ISTC's First Year

1. Convene a meeting of developed country and LDC information specialists and information users to react to this report and to help to further define initial ISTC activities.

2. Devise and test a mechanism for providing information support to ISTC staff and LDC collaborators (and eventual dissemination of research in progress, and of research results). Reconcile:

   a. The need for integration into each problem area with the need to service the range of problem areas effectively.

b. The ability of ISTC headquarters to access Western information and the ability of ISTC regional offices to maintain closer touch with real information needs and habits.

3. Undertake a study of the access to existing STI sources enjoyed by a sample representative of ISTC's range of potential collaborators and the effects which STI has on their productivity.

4. Undertake a study of the habits regarding information seeking and information usage on the part of people representative of ISTC's range of clienteles; include investigation of their perceived needs now going unmet.

5. As ISTC projects in different problem areas begin to develop, incorporate experiences of ISTC collaborators into above studies, and ensure that appropriate information support is designed into these projects.

C. ISTC's First Five Years

1. Establish and build in-house capacity for information support and dissemination of results; include linkages to international systems, awareness of (and possible coordination of) U.S. information sources, and linkage to regional and national infrastructures in the developing world.

2. Based on the experience gained above, become a referral center for ISTC collaborating researchers and others like them about how to benefit from the world's existing information services:

   a. Provide addresses and descriptions of systems and services of major research institutes in the developing world.

   b. Provide practical information on idiosyncrasies, indexing systems, mailing problems, foreign exchange problems.

   c. List journals, with subscription information.

3. Based on first-year studies (and work by UNISIST), develop and refine methods for impact studies, needs assessments, and studies of information-seeking and usage habits; focus on modest approaches for data collection and analysis which can be used by non-Ph.D.s in developing world; conduct studies as requested by collaborators, and as they may serve to influence the larger STI community toward better performance.

4. Help to develop and implement methods for planning and evaluation of national STI infrastructures which build bridges between international systems (including specialized clearinghouses) and various clientele; here, the UNISIST notion of a chain of clienteles (from the Western-educated to field personnel) may come into play; however, this is a long-term, massive job.

5. In all these activities which extend beyond direct information support of ISTC's own work, emphasis should be upon producing leverage to influence national government and international organizations involved more deeply in STI. Perhaps one could think of this in terms of "lobbying" on behalf of ISTC collaborating researchers and people like them.

III. Media Applications

A. Basic Conclusions

1. There is extensive experience and literature dealing with applications of mass media to the support of specific development goals. Still, the overall use of mass media in developing countries has revolved around entertainment, cultural expression, news, and information. The basic principles of mounting a successful mass application are known, and have been known for some time. The reasons why success is not more common relate to other factors: political control of media, lack of incentives for success, lack of diffusion and utilization of existing knowledge.

2. There are some mass media for which adequate basic knowledge is not available, particularly rural community broadcasting and visual materials for illiterates in semi-literate audiences. Both media have not been tried or tested widely.

3. To speak of media, we must include not only mass media (which have received the most attention from development planners) but also of two-way radio, telephone, postal services, and data communications. Applications of these tools to support of development projects or broad development goals have been very few. Evaluation of their impact or broad research on their potential have been almost nil.

4. The question of how to use the telephone effectively in the administration of economic and social development programs, and in stimulating participation by client populations of such programs, has been largely ignored. This is true despite the fact that telephone systems are expanding rapidly in many developing countries.

5. The potential of two-way radio (where telephones are not available) as an administrative tool, for diagnostic support, and for in-service training in remote health posts or agricultural extension centers has attracted much interest, but has yet to be adequately tested.

6. The contribution which rudimentary text and data communication could make to administration of far-flung development projects needs much more investigation and trial. Applications of the microprocessor "chip" in simple data terminals and memory devices (coupled with management training and organizational development efforts) might help improve administration significantly in some circumstances.

B. ISTC's First Year

1. Survey project using decentralized rural media including: participatory radio broadcasting, simple visual media for illiterates, and educational games. The emphasis should be upon actively involving rural people, methods for doing so, and barriers to wider use of these techniques.

2. Survey of two-way radio in linking remote health posts to district hospitals and for on-site training, diagnostic support, and administration.

3. Survey research on project use of telephone, post, text, and data communications as tools for project's administration.

C. ISTC's First Five Years

1. Undertake field projects (possibly implementations as well as evaluations) to refine rural media--participatory and localized radio broadcasting, visual materials for illiterates, and educational games--as supports to development efforts.

2. If first-year survey reveals established project as yet unevaluated or suitable project in planning stages, undertake field studies of two-way radio's role in administration, diagnostic support, and training in health projects.

3. If warranted by the first-year survey, undertake a field evaluation of impacts of telephone, post, text, and data communication on projects which have made significant use of them.

IV. Policy Research

A. Basic Conclusions

1. Due to rapidly increasing productivity and declining unit costs of information and communications, the field will have increasingly greater influence in society. Therefore, there is growing recognition worldwide regarding the need for comprehensive, long-range public planning of communications and information policies.

2. The importance of communication policy research has been recognized. However, comprehensive and practical approaches for developing country use are not generally available. Western countries have developed detailed methods of technological and economic analysis. However, different needs and resources of developing countries call for different research methods.

3. A solid research base for defining decision-making criteria (other than market criteria) is not available to developing countries. Therefore, decisions regarding how, where, and when to invest in information and communication infrastructures are being made without adequate consideration of non-market criteria.

4. Decisions about balance between investment in information communications as opposed to investment in other infrastructures cannot presently be made on a rational basis.

B. ISTC's First Year

1. Convene a meeting of LDC policy makers and researchers to validate and refine conclusions of this report as well as suggested activities.

2. Survey developing country efforts to conduct systematic communications policy research, especially pre-revolutionary efforts in Iran and Afghanistan, and efforts related to UNESCO regional meetings on communications policy.

3. Survey mechanisms whereby countries make hardware choices, as well as proposals in existence for creation of neutral information, evaluation, and adaptation mechanisms for hardware.

4. Explore with International Telecommunications Union (ITU) the possibility for multilaterally-funded research projects to investigate indirect benefits of rural telecommunications development and a proposed global domestic satellite system for developing countries.

C. ISTC's First Five Years

1. Assume an ongoing role in the consultative group on communications development: liaison with U.S. and other industrial-country agencies, participation in research and development activities of the group.

2. Participate in the effort to create development-oriented capacity for neutral evaluation, adaptation, and specification of needed but non-existent technology for information and communications. ISTC's participation could ensure that such an effort (called for in several non-aligned documents) includes the necessary attention to cultural and behavioral factors.

3. Participate in studies proposed by developing country researchers which develop and prove realistic methods for answering important policy-related questions. The PTTs of India and Colombia, for example, have research groups already active in this area.

4. Contribute an additional research perspective, if deemed useful and appropriate, to the incipient AID satellite initiative.

5. Participate in a comprehensive, long-term assessment of information and communication's role in development. Ideally, studies should be undertaken in at least one small "Fourth World country" and one advanced developing country. Ideally, the countries should reflect different development strategies: rural, "basic needs" orientation as opposed to urban, "trickle down" industrial orientation.

6. Attend November 1979 UNESCO/US sponsored meeting which will work toward creating a consultative group on communications development.

I. INTRODUCTION

In recent years, much has been written about the role of information and communications in modern society. From Marshall McLuhan's musings about mass media to Daniel Bell's descriptions of the computer-based post-industrial society, to Zbigniew Brzezinski's globally-oriented book on the technetronic age, there is the common feeling that information technology of all types is assuming a new importance. Events which touch us in daily life reinforce this message. Since computers were first put in service in the 1950s, the way in which institutions function has changed dramatically. Since the first geosynchronous communications satellite was launched in 1962, international telephone, television, and data transmissions have grown dramatically. With further "micro-miniaturization" and with "convergence modes" between broadcasting, telecommunications, and computing, further advances in technological capacity accompanied by declining costs are forseen.

As a result, information is the one basic resource whose supply is expanding; the others--energy and raw materials--are clearly becoming scarcer and more expensive. Eventually, telephone calls and teleconferencing may substitute for travel and thus save energy. Computers can allocate other resources efficiently and thus conserve them. Wide use of microprocessors and telecommunication links is expected to help create the highly productive "office of the future" and to allow many people to work part-time at home. Remote and broadly diffused access to scientific and technical information as well as computing services may contribute much to creativity, innovation, and productivity. These hopes and expectations explain much of the current enthusiasm for advanced communications and information services in the U.S.

Like previous technological dreams, the "information revolution" should be subjected to vigorous scrutiny before export to the developing world. In Broadcasting in the Third World, Katz and Weddell note how technology and institutional structures were transferred from metropolitan to Third World countries with little consideration of the needs of the recipient country. With the current and anticipated generation of technology, one can expect greater scrutiny of purely technical aspects, but such scrutiny should be actively promoted by concerned institutions. The question of designing institutional forms to suit local contexts deserves much more attention. However, more basic questions about cultural orientations and attitudes towards information may well fail to receive adequate attention. In addition to questions about making hardware function and ensuring that appropriate and relevant programming is developed, the cultural questions involve open-ended investigation of the developing world's information needs and its methods of obtaining information and using it.

In non-Western cultures, particularly those which lack a strong literacy tradition, people may have quite different orientations and attitudes toward impersonal mediated information than in Western cultures. At the risk of overgeneralizing, one might hypothesize that interpersonal communication may be much more highly valued than abstract information. The social status and the rank of the one providing information, for example, may carry much more weight with a receiver than detached and critical evaluation of the information.

In Western cultures, sophisticated habits regarding information seeking and use predominate, (or at least Western cultures like to think they do).

In the West, multiple information sources on important questions are aggressively sought. Facts and perspectives are critically evaluated and synthesized as individuals form independent judgments about important issues. Such processes are used to guide individual behavior and organizational decision making. The presence or influence of such information habits in other non-Western cultures should not be assumed. Unfortunately, such assumptions, which may be built into Western information technologies, information services, and institutional structures, are generally not taken into account by development professionals involved in information and communications. As the prospect of major transfers of technology is raised in international political forums and considered by development assistance agencies, such basic questions must now be considered.

For ISTC's purposes, the field of information and communications might best be divided into three categories: provision of scientific and technological information (STI), applications of mass media and point-to-point media, and information/communications policy. STI refers to all activities which attempt to provide scientists and technologists with information relevant to their work, and is probably the most directly related to ISTC's mandate. In addition to the established types of mass media applications for education, population, health, and agriculture projects, the interests of the development community have broadened to encompass the potential of two-way radio, telephone, telex, and data communication in development projects, especially their role in administration and training. Underlying both STI and media applications are basic questions of infrastructure development

and national policy. In referring to this broad set of concerns, I will use the term "information," which connotes all forms of message creation, storage, dissemination, and reception.

In confronting these topics, one has less past experience to draw upon than in most other ISTC problem areas because, in large measure, the field of communications and information has not enjoyed the levels of funding from development assistance agencies of agriculture, health, and population. Nor has it been funded by Western governments as have environment, energy, and other global projects. Information has developed on a largely commercial basis. As a result, research questions must be raised in rather basic and open-ended ways. ISTC planners may feel less comfortable with this problem area than with other areas where past investment has dealt with some of the basic questions and has led to a more focused set of questions.

Another complicating factor for ISTC is that information and communications do not really constitute a <u>problem</u> area so much as a <u>solution</u> area--or at least a resource area. For a problem-oriented agency, this can create further discomfort. The experience of AID and the World Bank illustrates the difficulty of integrating communications planning into problem-oriented and sector-oriented agencies. Communications tends to be taken more seriously when it is part of sectorally-based projects rather than free standing. On the other hand, rapid developments in information technology call for some mechanism for assessing the field on its own.

Two basic approaches to these problems will be proposed. One way to ensure that communications and information are integrated into work in

the various ISTC problem areas is to tie information activities to direct support of work in the other problem areas. Ideally, many of these activities would be funded out of the budgets of the other problem areas and viewed as a service operation. Still, there are other topics which need to be treated on their own. Procedures for information support of researchers in one problem area would probably be relevant to other problem areas. Questions which arise and seem worthy of ISTC investigation in STI would probably cut across most problem areas.

As mentioned above, the research questions in the information field are broad and unfocused. With its relatively small budget for information, ISTC should view its role as that of constructive critic of established institutions in the field and as a catalyst and "lobbyist" working in behalf of ISTC's own and other collaborators. As a newcomer to the information field, as a problem- and sector-oriented agency, ISTC may be able to make large contributions with a relatively small investment.

In the following sections, I will suggest some avenues which ISTC might pursue in the information field. The presentation will necessarily be general since a broad and diffuse field must be reviewed in a short time. I have chosen to concentrate on that aspect of the field--STI--which is of most direct interest to ISTC. Nonetheless, I will present some discussion of the importance of media applications and communications policy. In all areas, I will present more possibilities than ISTC may be able to act upon. My aim is more to present a perspective on the information field than a fully elaborated plan. Given the current uncertainty of ISTC program emphases and budget, this has been agreed upon as the most useful approach.

II. SCIENTIFIC AND TECHNICAL INFORMATION

A. BASIC CONCLUSIONS

All knowledge generation builds upon existing knowledge. Thus, an institution devoted to the stimulation of new research and development must be concerned with providing existing knowledge to researchers. Of course, most formalized scientific and technical knowledge is Western, and much of it is contained in massive information systems now serving Western scientists and technologists. Because access to these resources seems to be much in demand in the developing world, ISTC must subject the STI approaches to critical scrutiny.

A key premise behind the creation of ISTC has been the apparent inability of existing Western research and development to contribute sufficiently to meeting basic needs of the developing world or to solving global problems. Consequently, the importance of providing the results of such research and development to developing country researchers through conventional means must also be questioned.

A basic assumption is that STI in developing countries will be treated much as it is in the West--aggressively sought and systematically applied by scientists, technologists, technicians, and administrators. In fact, information usage Western-style may be more a consequence than a cause of development. Perhaps the "post-industrial" societies are uniquely qualified institutionally and uniquely suited culturally to use formal and impersonal information productively.

If this is judged to be the case, ISTC's involvement in STI should begin with thorough investigations of information needs, infrastructures, and habits in cooperating countries. The results might reveal solutions other than the libraries, clearinghouses, and data bases which serve Western scientists and technologists. Some possibilities compel consideration of a number of basic questions before ISTC's program in scientific and technical information can be formulated:

STI-1: How important is the provision of existing STI in promoting new research and development to meet development needs?

STI-2: Can information relevant to development be filtered cost-effectively from the entire store of Western STI?

STI-3: How broad a range of clienteles can be served cost-effectively by ISTC?

STI-4: How should the results of ISTC's research be disseminated?

STI-5: Can ISTC operate cost-effectively in providing STI while maintaining its commitment to building local capacity?

Each of these questions is discussed briefly below. Fuller consideration by ISTC will assist in determining what the institute can accomplish in STI with its limited resources.

STI-1: How important is the provision of existing STI in promoting new research and development to meet development needs? The preponderance of STI in the world is created by Western researchers in response to Western funding priorities. The largest categories may be military, space, medical, and corporate research, which often involve technologies too complicated and costly to be applied in developing countries. The basic questions

raised in such research are rather removed from basic human needs.

Still, the global problems to be addressed by ISTC (energy, environment, natural resources) may be reflected in Western stores of STI in more directly relevant ways. In the West, these problems are being investigated in relatively basic ways. Solutions in such problem areas may have more direct relevance to LDCs than might be the case in basic needs development problem areas. Even in the areas involving basic needs, Western knowledge should be taken into account by LDC researchers, if this can be done cost-effectively and without skewing research priorities.

In the 1950s and 1960s, the prevailing philosophy of development held that experience from Western modernization could, in many cases, be directly transferred and applied to LDCs. Transfers of STI played a major role in the attempt to "leapfrog." With the 1970s has come a much more concrete and realistic notion of development objectives. Insofar as LDC research is tied to national development objectives, greater scrutiny in STI flows may be possible than would have been the case in the 1960s.

This change in thinking is reflected in efforts to establish STI systems oriented toward development problems. Although these efforts suffer from generic problems of the STI field, to be explored below, they do represent important first attempts at redirecting STI flows toward LDC needs. The FAO's International Information System for Agricultural Sciences and Technology (AGRIS) receives contributions

from various nations, and indexes documents on computers. The Information Referral System for Technical Cooperation among Developing Countries (INTRES) grew out of UN meetings on technical cooperation among developing countries (TCDC) and is a referral service listing individuals and institutional capacities for consulting and technical assistance. Many small clearinghouses, specialized journals, and people networks now exist to service development problem areas. They are more completely described below and in the appendices to this report. Here the point is merely that work has begun on orienting STI flows toward the problems of developing countries.

STI-2: Can information relevant to development be filtered cost-effectively from the entire store of Western STI? Western libraries and data bases have evolved in accordance with Western needs and conditions. Their use presumes a clientele well versed in the ways of formal education and used to functioning in a society where information is actively sought and vigorously applied in virtually all areas of human endeavor. Librarians and information scientists quite properly define their professional role as that of helping others deal with the "information explosion." This is attempted largely through organizing and cataloguing information according to the professional specializations and disciplines of the advanced Western countries. Insofar as one departs from Western needs, Western users, and Western conditions, the need for filtering, repackaging, and, indeed, for reconceptualizing the role of information grows dramatically.

Of course, systems and services differ in their commitment to filtering, synthesis, and service to individual information needs. AGRIS and other computerized bibliographic systems are more oriented towards scanning huge volumes of information. A group such as VITA (Volunteers in Technical Assistance) works intensively with individual information requests. In addressing these requests, VITA draws more on its people network than on mechanized data bases. Still other approaches, such as the information analysis centers funded by the Canadian International Development Research Center, consider themselves "middlemen" operating between the major data bases and libraries on the one hand, and the individual user on the other.

All systems and services are expensive. Information is valuable only insofar as it addresses a user's real need. Therefore, the question of cost-effectiveness becomes primarily one of how well user needs are known by the information system or service. As will be discussed below, this may be a particular problem in developing countries, as one moves beyond user populations educated in the West.

Thus, the consideration of relevance of STI should involve not only computerized data bases and small non-automated services, but also people networks dedicated to interacting with clients to invent and adapt solutions to problems. A related consideration is the appropriate mix between investment in such people networks and investment in compilation and dissemination of pre-existing information. Clearly, each can complement the other, although all would compete for limited resources. At this point, we have discovered no systematic comparative research on effects or costs of these radically different approaches to STI.

STI-3: How broad a range of clienteles can be served cost-effectively by ISTC? The question of how to filter information makes sense only in relation to the clientele on whose behalf the information is being filtered. And there are numerous groups with a compelling need for access to scientific and technical information. They range from Western-educated agricultural scientists to administrators, extension agents, and even small farmers. Some may benefit from direct access to computer terminals offering abstracts of Western research and technology. As already noted above, many more will require extensive assistance in finding information and putting it in a usable form. Many more will require complete reworking of technical information into more practical and easily comprehensible materials.

The clientele of most immediate concern to ISTC is the group of scientists and technologists collaborating with ISTC, whose productivity will determine ISTC's productivity. Since many in this group may be Western-educated, information support for them may involve relatively little repackaging of information. Because appropriate institutions are not operating in collaborating countries, services may have to be supplied out of ISTC-Washington or ISTC regional offices.

As the focus moves to the broader science and technology community and to the long series of clienteles leading from research to practice, the task at hand becomes progressively larger. In a sense, the task also becomes more important in terms of ISTC's long-term goals of indigenous capacity-building and of making research and development pay off in concrete development terms.

In view of ISTC's limited resources, this expanded focus might involve very little additional operational involvement in STI. It would certainly include a study of the range of STI clienteles throughout the developing world. It would probe the feasibility and cost effectiveness of building institutions internally, nationally, and regionally to make more effective the flow, filtering, and adaptation of STI. It would deal with not only the lack of awareness of available information, but also with the information-seeking behaviors of different groups.

This kind of research would be welcomed by the more thoughtful members of the professional STI community. In fact, much useful guidance could be obtained from them regarding what is known and what deserves research. IDRC's Information Sciences Division and UNESCO's General Information Program, for example, have experience in grappling with these questions.

There would be a number of advantages to ISTC's conducting the research (of course after consultation with such established agencies). ISTC will come to the field with a fresh vision and without institutional biases or vested interests to protect. ISTC would be free to investigate basic questions whose answers are often taken for granted and to draw controversial conclusions, if necessary.

STI-4: How should the results of ISTC's research be disseminated? Research-oriented institutions often fail to devote adequate attention and resources to the dissemination of their results. In the case of developed country institutions, the existence of sufficient and accessible

information systems can correct this deficiency. This is not the case in the developing world, where information is scarce. Special dissemination efforts must be planned by ISTC, or its impact may be severely limited. Since its funding levels (relative to world research and development expenditures) will be small, ISTC's effectiveness may depend in significant measure upon dissemination of its results to those whose actions and decisions can multiply the impact of ISTC's investment.

There are many possible compo its to ISTC dissemination which must be considered. They range from contributing to existing information systems, to operating a general, in-house information service attached to ISTC's planned field offices, to building specialized systems (as has been proposed for nutrition). While the specifics must be considered at a later date in ISTC's evolution, the early recognition by ISTC of the importance of this function is crucial.

STI-5: Can ISTC operate-cost effectively in providing STI while maintaining its commitment to building local capacity? ISTC will probably have less than three-quarters of a million dollars for STI activities during the first year. Any increase in future years could be hard to obtain. Thus, the only affordable way to address the above issues may be to provide most services directly. Clearly, ISTC's collaborating researchers could receive their information support most inexpensively if this is the case. The creation or nourishment of national or even regional information centers would easily extend beyond ISTC's means.

Still, the creation of information centers close to ISTC clienteles is clearly a prerequisite to the institutionalization of STI usage

and thus to developing indigenous capabilities in the research and development field. Clearly, local institutions and infrastrutures must be built if the information needs of clienteles less cosmopolitan than ISTC collaborating researchers are to be served effectively. This means the training of information service manpower, the creation of institutions, and the development of adequate communications infrastructures (telecommunications and mails).

In other words, local capacity-building in STI may be a much more involved and more costly process than ISTC can contemplate being operationally involved in. However, to neglect this important long-term goal might mean to work against one of ISTC's prime objectives. The solution involves recognizing the tension between short-term needs (to support ISTC researchers, and to disseminate ISTC research results) and the longer term needs for helping developing countries build their internal capacity for information generation, handling, and application. The latter focus may be handled by initiating comprehensive studies of current procedures, gaps, and needs. The mere act of investigating the current situation and the steps which need to be taken may stimulate other institutions with more resources and with an operational mandate to become more effective.

B. ISTC's FIRST YEAR

The field of scientific and technical information for development is ex-

tremely broad, involving many institutions in the public and private sectors.* The field is also rapidly changing, partly because of political pressures such as those evidenced at the recent UNISIST II meeting, where developing country political representatives called for much freer flows of STI, unimpeded by "legal obstacles." For these reasons, it is particularly important for ISTC to consult with solid professionals from both LDCs and industrial countries to be up to date, comprehensive, and solidly grounded in its approach.

ISTC has wisely planned for a special meeting to treat the subject of information about appropriate (or capital-saving) technology (AT). In recent years, valuable experience has been gained about what types of information prove useful and how such information can be delivered to interested clienteles, which are often quite different in their orientation and institutional base from traditional users of STI. Groups from the U.S. (VITA, ATI, NTIS), Great Britain (ITDG), France (GRET), West Germany (TOOL), and Canada (Brace) should be involved in this meeting. ISTC is apparently considering a separate contract to deal in depth with this topic and support this approach.

A meeting of the "mainstream" STI providers and users, who would comment on and further refine the recommendations in this report, is also recommended.

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* For details see our "Selective Review of Systems and Services in STI for Development" in the Appendix.

STI professionals from the U.S. are generally open about gaps in their knowledge or their uncertainty about the next steps in developing more effective STI programs for development. U.S. public and private representatives, and directors of UNISIST and of the Information Sciences Division of IDRC should be invited along with LDC representatives who provide and use STI.

At this proposed meeting, initial attention should be given to ISTC's structure for providing information support to its staff and collaborating researchers. Advice should be available about integrating information activities into the substantive programs of the Institute. If information is handled merely as an add-on--that is, financed and managed separately from operational budgets--information activities may fail to be responsive to needs or fail to be taken seriously by potential users. A related issue is the mix between information capacity lodged in collaborating institutions, in ISTC field offices, and in ISTC headquarters. When capacities are located in the field, more intimate knowledge of local information needs and habits is possible, although access to information is complicated. A productive meeting of seasoned professionals in the field could yield very valuable guidance to ISTC and could avoid costly mistakes.

The meeting should also yield valuable advice about how to structure two studies which are recommended for ISTC's first year of operations. Key professionals in the STI community seem to agree that far too little evaluation of STI has been conducted to date. Candid commentary about the limited studies (based, for example, on questionnaires sent recipients of information) could be very helpful to ISTC. Suggestions could be sought about how best to involve ISTC staff and collaborating researchers in future evaluations, as ISTC's programs develop.

The first of two studies recommended for ISTC should examine the access to STI now enjoyed by ISTC's potential collaboraters in the Third World. The study should involve a small number of people representative of ISTC's various clienteles. It should also attempt an inventory of STI services relevant and available to developing country users. (In researching this report, I discovered no such inventory and was repeatedly told by specialists that none existed.)

The study should focus on the practical realities of the situation, which often contradict general or theoretical statements. For instance, I was recently told by the Dean of the Agriculture Faculty at a major university in a relatively advanced LDC of his troubles in obtaining real benefits from AGRIS. At a recent AID-sponsored meeting of Latin American leaders in STI, routine turn-around times of 60 to 90 days in receiving documents from NTIS were reported.* Such practical constraints upon access to STI should be probed and analyzed. In addition, the impact of STI upon the productivity of researchers and technologists should be assessed. While the methodological difficulties of rigorous and systematic analysis in this area are acknowledged, less formal investigation can certainly be of great value. Recent UNISIST field studies done in India and Tanzania (included in the appendices to this report) can provide valuable guidance, as can the recent UNISIST manual on user studies (also included).

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* Helen Ortiz, "Trip Report, NTIS Directors' Conference," February 22, 1979.

The second study which ISTC might undertake in its first year should not be tied to users of STI services. Rather, it should investigate in a much more open-ended way the means by which people in selected developing countries (and in relevant jobs) seek and use information. The study should be executed primarily by cultural anthropologists (mostly from developing countries), although some participation by information scientists could be beneficial. The study should compare reliance upon interpersonal communication with the tendency to seek and use mediated information. Since ISTC's potential clienteles are of prime interest, administrators', scientists', and technologists' use of interpersonal channels versus printed STI would be the prime focus. However, it is important that the approach be quite divorced from any preconceived notions, in order to gain perspective on the broad cultural factors influencing orientations and attitudes towards information. If, for example, results indicated a predominant reliance upon interpersonal contacts with authority figures, ISTC might consider involving in its STI work periodic personal contact between researchers working in related areas. Such results might also stimulate changes on the part of other larger institutions involved in the field.

C. THE FIRST FIVE YEARS

As ISTC's programs grow, the importance of creating in-house capacity for information support, for dissemination of research in progress, and later for dissemination of results will also grow. In addition to the question of where to locate this capacity within ISTC, the matter of the kind of service must also be stressed. In view of the high costs of STI work, the best so-

lution for most users will probably involve a referral service, and perhaps for ISTC staff and contractors a question and answer service. The creation of any new public information services (or even provision on any scale of copies of ISTC research reports) would probably extend beyond ISTC's available resources. Likewise, support for national or regional information services in collaborating countries would also be likely to cost too much. More detailed planning can be undertaken as events unfold. The important point at this juncture is to be aware of the need for the Institute to build some form of in-house capacity to support its own staff and contractors, and the high cost of any major operational involvements.

One way to lessen the institutional burden on ISTC to provide information to outsiders is to create an efficient referral service focused specifically on how LDC researchers working on development and global problems can benefit from existing information services. Many of the necessary components of this service would be learned in supporting ISTC staff and contractors, and in executing the studies recommended for the first year. With little additional investment, ISTC's information specialists could begin serving as informal "ports of entry" for other LDC researchers seeking to benefit from existing U.S. information services. By providing practical advice on how to use those systems (mostly through the mail), ISTC could supply informally the much needed (and currently lacking) focal point for U.S. international activities in STI.

The referral service should include pamphlets on the peculiarities of various indexing systems, as viewed from ISTC's problem areas. Advice on

how to obtain fugitive documents (since many systems provide only bibliographic references) could be of great assistance to the LDC research community. Addresses and capsule descriptions of relevant research institutes, university libraries, and journals should also be available.

Another way to lessen the institutional burden on ISTC to provide information could be through production of a practical manual indicating how researchers working on development problems and global problems can benefit from existing information systems and services. Much of the necessary information for such a publication would have been gathered in the inventory and impact study recommended for the first year. The manual could be published initially in English, for subsequent adaptation and translation by interested regional institutions into major languages (Spanish, French, Portuguese, Arabic).

The manual would extend far beyond the partial coverage given in existing directories of UN and TCDC resources. It would include information on peculiarities in various indexing systems (as viewed from various ISTC problem areas) on how to circumvent foreign exchange problems, and on how to obtain fugitive documents listed in those systems which provide only bibliographic information. Relevant research institutes, university libraries, and journals should also be listed with addresses, subscription information, etc.

Based on the studies recommended for the first year, ISTC would also be in a position to contribute to the methodologies available for LDCs to undertake their own impact studies, needs assessments, and studies of information habits. A focus on simple and affordable methods which can be employed by non Ph.D.s in field settings could be a most useful stimulant

to action. Recent publications on methodology published by UNISIST represent a useful point of reference.

Another useful contribution would be the elaboration of better methods for planning national STI policies and infrastructures. Valuable work has already been done in this area by IDRC, UNDP, and UNISIST. Attached to this report is information on a study of the STI needs of Pakistan undertaken in recent years. ISTC, after a few years of operation, might be in a favorable position to contribute to the store of methods for STI policy planning. With a fresh start, and a few years of field experience in cooperative research and development, ISTC's perspective may be particularly valuable.

In efforts which extend beyond information support of ISTC staff and contractors, the Institute should consider itself a catalyst and constructive critic of work which will be done in large part by organizations with larger budgets and more comprehensive mandates in STI. Perhaps it is fruitful to think in terms of "lobbying" on behalf of ISTC's clienteles and people like them. Although ISTC's financial and staff contribution to such activities might be minor, the results in terms of leverage and influence upon the STI community could be large and highly constructive.

III. MEDIA APPLICATIONS

A. BASIC CONCLUSIONS

In recent years, the potential for media in development has broadened dramatically. In addition to audiovisual media, publishing, and broadcasting (which have interested development planners for years), the potential contributions of two-way radio, telephones, telex, facsimile, and computing are beginning to be systematically investigated. The AID satellite initiative will affect some of these new areas. Consideration of a few basic questions can lay the groundwork for discussion of ISTC's orientation toward this area:

Application 1: How important is additional research and development to the effort to improve mass media applications in the developing world?

Application 2: Could more research and development improve the use of community media for development?

Application 3: Can the point-to-point media contribute significantly to training and administration of rural development projects?

Application 1: How important is additional research and development to the effort to improve mass media applications in the developing world?

With the publication of The New Educational Media by UNESCO in 1967, the basic elements of a successful mass media application began to be known. The importance of commitment on the part of a dynamic leadership was established. The perils of failing to stimulate cooperation between the subject matter specialists and the communicators were demonstrated. The importance of incorporating feedback from the audience as a guide to program production was also stressed.

The New Educational Media drew on some twenty case studies of existing projects which demonstrated varying degrees of success. In the early 1970s, the ETV project in El Salvador yielded more lessons about the operation and

management of formal education-oriented projects. The AID-funded Radio Mathematics Project in Nicaragua has resulted in refinement of methods for programming and evaluation. The 32 radio school organizations in Latin America offer a thirty-year history from which lessons have been drawn on how to program basic education for adult rural audiences. Newer cases such as the Dominican Republic's Radio Santa Maria have been studied exhaustively by UNESCO and have yielded further lessons in this area. In the adult education field, methods for tight design, pre-testing, and evaluation of educational messages for small farmers have been tried, proven, and disseminated by the AID-funded Basic Village Education Project in Guatemala.

In development sectors other than education, examples of successful projects are on hand. The Tanzanian Health Campaign of 1973 mobilized over 2 million of the country's 13 million people for grassroots study (by radio and print materials) and for action to improve basic health conditions. Population and family planning programs have made extensive use in many countries of radio and print media for persuasion, information, and education. All in all, the AID-funded Clearinghouse on Development Communication has found over 66 projects with enough of a claim to success (and enough available documentation of results) to warrant coverage with a "project profile." In short, there are many cases of mass media applications to be studied and many lessons which are quite readily transferable to increase the chances for successful implementation of a new project.

Therefore, it might come as a surprise that massive and successful applications of mass media (particularly radio) to development problems are not the rule in the developing world. In fact, figures from the UNESCO Statistical Yearbook 1974 indicate that educational and development programming probably comprise less than 5 per cent of total developing country broadcasting. The figures are based on reports from eighty-five countries. The category of educational programming encompassed out-of-school education for children, youth, and adults, as well as formal education. The other categories were informational (news and public affairs), cultural, scientific, entertainment, special audience advertising, and others. These non-educational and largely non-developmental uses of radio accounted for over 95 percent of total programming.

As Elihu Katz's new book notes, developing countries have cited as their expectations from broadcasting not only socio-economic development, but also cultural development and national integration. The latter objective (sometimes translated into the survival of the current regime) may tend to predominate in the minds of ministry officials. Other factors which may explain the relative lack of air time devoted to developmental broadcasting may be the frequent orientation of media professionals toward the professional values of Western media. Production values, self-expression, and the desire to impress other similarly socialized media professionals may outweigh commitments to communicating effectively with the rural masses. In addition, media professionals in developing countries are generally well educated, middle class urban dwellers, who may have little contact or empathy with the poor and rural masses.

It seems that factors such as these--much more than lack of technical knowledge--explain the disappointing limited use of the mass media as tools for development support. This is not to argue that more research and development might not be useful in some cases. Particularly in reference to specialized applications, certain research opportunities might prove to be of direct interest to ISTC. For example, the AID-funded Mass Media and Health Project will investigate the potential of radio spot messages in helping diffuse knowledge to mothers about treatment of infant diarrhea. This problem has been cited by ISTC documents as a key health research interest. Communicating remedies to mass audiences might be of interest to ISTC. Likewise, communication approaches of the AID-funded Radio Mathematics Project might be of interest to ISTC planners researching effective curriculum methods for basic science education. The rural satellite applicatior now being planned by AID may also be of great interest.*

Application 2: Could more research and development improve the use of community media for development?

Two media in particular--participatory community radio broadcasting and visual materials for illiterate and semi-literate audiences--could benefit in basic ways from new research and development. Both have been tried on an extremely limited scale and have generated exciting results. The Intermediate Technology Development Group has just published a study entitled Appropriate

*Since the AID satellite project relates more to policy-level concern, it will be discussed in the next section of this report.

Technology in Communications (portions of which are included in the Appendix) which support this concept.

Ever since the UNESCO-sponsored radio farm forums in Niger, there has been interest in incorporating field recording of peasant self-expression into rural community-oriented broadcasting. The well-known rural radio project in Senegal made extensive use of peasant expression as constructive criticism of government programs. The Tabacundo Radio School in Ecuador has, for several years, provided community workers with simple cassette recorders, and broadcast the edited tapes of music, commentary, and instruction to an audience of some 40,000. Radio Santa Maria in the Dominican Republic has used these techniques and has built a microwave relay for live coverage of rural news events. The transmitter covers one-third of that country but retains rural community flavor.

A study on Radio Santa Maria, soon to be published by UNESCO, will represent apparently the first systematic research on such approaches. Even after this study appears, however, many questions will remain about how to make participatory communication effective for development: What relationship should the field recordist have with the speaker/audiences? Who should edit tapes, and on the basis of what criteria? How can feedback and formative evaluation be built into such an approach without destroying its spontaneity and grassroots flavor?

Equally basic questions surround the creation of visual materials for communications to illiterate and semi-literate audiences. Documented experimental

programs in this area have been carried out in various parts of Africa (notably by Andreas Fugelsang of UNDP), in India (by John Bowers of Reading University in England), and in Nepal (by the National University). Methods and conclusions in each of the studies have been quite different. Perhaps illiterate and semi-literate populations vary broadly in their perceptions of two-dimensional images (photographic and non-photographic). If this is the case, countries might have to tailor visual materials to suit each ethnic, tribal, or cultural group. In this case, simple and inexpensive methods for pre-testing would need to be developed. Low-level technologies oriented toward localized and low-volume production of posters, slides, and other visuals would be needed.

On the other hand, there is also evidence that elements of visual perception may be relatively stable across widely varying populations. AID's standardized comic book series of family planning entitled La Familia Gomez was said to have been used successfully in most of Central America. The quality and depth of the research upon which such a judgment was based, however, is not known to me. If it is possible to produce visual materials centrally--or elements of a visual materials package--then the economies of scale in printing and message development would be most attractive. Without further field research, however, the feasibility of such plan cannot be known.

Application 3: Can the point-to-point media contribute significantly to training and administration of rural development projects?

Recently, questions about the potential utility of point-to-point (as opposed to one-point-to-many-points) mass media have been raised. The most

dramatic case is the telephone, whose worldwide expansion has proceeded largely as a commercial phenomenon without major attention being paid to social service applications. Although there has been considerable interest in this area, there is very little hard evidence to help one judge whether telephones (or failing that, two-way radio) can contribute substantially to:

- administration of development projects
- remote consultation and diagnosis
- in-service training of field workers
- participation by client populations

Probably the most interest to date has been in support of remote health clinics through radio links to district hospitals. This technique has been tried and evaluated in Alaska but not, to my knowledge, in developing countries. Several projects which might merit study are now in the planning stage in AID and WHO. Kenya's Flying Doctor Service has a radio component which has not been evaluated.

If basic point-to-point communication proves to make positive contributions, the conditions under which this occurred (organizational context, educational levels of administrators, technological infrastructure, etc) would have to be further investigated. Also worthy of further investigation would be methods for maximizing the development payoff: on-site training of users and use of more efficient technologies. Store and forward message systems using phone lines and simple data terminals have been suggested as a way of economizing on scarce circuits in instances where people need not actually interact and when written records are needed.

Related to such terminals is the question of rudimentary data processing and its potential contribution to accounting, inventory, and payroll. As microprocessor "chip" technology progresses, it may become possible to produce inexpensive, intelligent terminals, suited to developing country conditions--that is, rugged and easy to maintain. Advances in systems and software design might enable development planners to create tools usable by people in remote locations who do not have extensive computer training. Even if this can be accomplished, however, many more basic questions will have to be confronted.

The organizational skills required for effective use of telephones and message and data processing systems are easy to underestimate. The cost and complexity of programming is also hard to appraise in advance. Even more difficult, however, are the cultural factors affecting the use of information. Will developing country rural administrators, for example, feel as much at ease conducting business by phone as do their counterparts in the industrial societies? Will they use message systems or be reluctant to commit words to paper which might be used against them? Will they enter accurate information into data processing systems, or will they report only favorable and sometimes untrue information? While such considerations are taken into account in the design of all administrative information systems, the problems are certain to be more basic in non-Western cultures. Without rather intensive research, the potentials and the pitfalls of such point-to-point technologies simply cannot be known.

B. ISTC'S FIRST YEAR

As mentioned above, most project applications of conventional mass media probably will not be of direct interest to ISTC as research and development questions in themselves, nor in relation to the research questions posed in the Congressional Presentation. Still, there may be certain specialized applications which will be of interest: the Mass Media and Health Practices Project and the Radio Mathematics Project, for example. The AID-funded Basic Village Education project (BVE) is another possible instance. BVE stressed professional production of messages on specific agricultural practices, which were targeted to localized needs. ISTC researchers working on new crops for marginal lands may wish, at some point, to consider the role of media in dissemination information about recommended practices.

Thus, the Institute will need a mechanism whereby ISTC problem area specialists can hear of relevant mass media applications. This need not be a major undertaking but perhaps a component in the STI support service mentioned in the previous section. Decisions about whether to undertake any projects in the conventional mass media area should be made by those in relevant development problem areas and not by ISTC communications and information specialists. This will ensure that only those projects with real contributions to the problem areas are considered.

In the first year, ISTC should undertake an in-depth study covering project applications of several unconventional media which have potential for credible and effective communications with rural populations. The two media of most immediate interest are participatory and localized radio broadcasting,

and visual media for illiterate and semi-literate populations. Other relatively simple and decentralized technologies such as educational games and simulations should be included in the study as well. In this effort, close collaboration with Richmond Postgate and Peter Lewis of Britain's Immediate Technology Development Group--authors of the recent report, Appropriate Technology in Communications--might be particularly useful. The non-formal education center at the University of Massachusetts, which has developed many educational games for rural use, might also be considered.

Many of the cultural, geographical, and class barriers between broadcasters and rural audiences could now be dispensed with, at least insofar as technological impediments are concerned. Both production and transmission could be decentralized, "de-professionalized" and "de-studified."

Portable audio cassette recorders, easy to operate and quite capable of producing a broadcastable signal, might also be considered. In field settings, they have proven rugged enough for sustained use by extentionists and community leaders without training in media production. Inexpensive new mixing and editing equipment can facilitate production. Low-powered transmitters can allow for broadcasting to be localized and community-oriented. Projects such as Radio Mensaje in Ecuador and Radio Santa Maria in the Dominican Republic have combined participatory field recording with professional editing. Radio Voz de Atitlán in Guatemala is largely peasant-run and directed.

Topics covered in these projects have included literacy, health, farming, political organization, and cultural self-expression. The establishment of a local media voice seems, in itself, to constitute a powerful motivation

for grassroots organization and action. Better documentation and analysis of these and similar projects--their methods, program formats, and impacts--should be a key component in ISTC's first-year survey of decentralized rural media. Furthermore, the impediment to further use of such techniques--desire for centralized political control, conceptions of media, "professionalism," and other disincentives--should be studied with equal vigor.

Simple and permanent visual media such as posters, illustrated pamphlets, and photonovels can complement the ephemeral broadcast methods. Several African countries regularly place logos, pictures, and slogans on cloth made into clothing, in the context of mass mobilization campaigns for development. Feed and fertilizer bags have carried visual instructions about proper use of their content. If done properly, such visuals can help illiterate audiences recall detailed procedures which may have been presented by extentionists or over radio.

Pre-testing and formative research should be part of the process of creating such visuals. More general research on the perception of two-dimensional abstract images should also be conducted. However. the experiences and findings to date in such research are spotty and inconclusive. More accounts of dismal failures with simple visual media are probaly in circulation than are success stories. The most successful cases may involve groups who are not known for such work and do not publicize their successes. For example, England's International Extension

College (IEC) is probably best known for its formal education work in correspondence methods and radio teaching. However, IEC has now produced materials for adult basic education in several African countries, and has developed great expertise in this area. Thus, ISTC's survey would nave to venture far and wide in order to be comprehensive.

Other media which may merit inclusion are educational games and simulations. Approaches used in rural development have ranged from simple card games (for practicing market mathematics) to elaborate board games (based on Monopoly, but oriented toward agricultural economics and community development). In the case of all media mentioned above, the survey should aim at defining the state-of-the art in communications which actively involve rural people.

The potential role of two-way radio in rural health care delivery has attracted much interest of late. This medium, which does not depend upon the existence of a telephone infrastructure, has been used for connecting remote health posts with district hospitals. Improving administration has been a major focus. Providing expert diagnostic support to front-line rural health care providers has been another. Two-way radio has also been considered a useful tool for on-site training of health workers. Some of these techniques have been tried in remote settings in Alaska and Kenya. AID and the World Health Organization (WHO) are both planning several additional projects which will use two-way radio. ISTC should collect all available information on these relatively well-known projects and should seek information on other existing projects which have not been publicized.

Another practice which ISTC should survey during its first year is the use in project management of post, telephone, telex, and data communication. While modern Western institutions could not operate without these tools, many LDC institutions must. The use made of such media when they are available only sporadically, or at costs which prevent frequent use, needs to be known. Equally important are the changes which may occur when these tools become inexpensively and reliably available. Training and organizational development efforts which may have sometimes accompanied the introduction of these tools are also important to survey. Much of the experience and knowledge in this area is probably to be found in government circles, in consulting firms, and in schools of public and business administration. The information may not have found its way into the development literature, and may be difficult to pull together. However, the incentives for doing so are indeed great.

C. THE FIRST FIVE YEARS

Based on the surveys recommended for the first year, ISTC will be in a better position to determine where the gaps in knowledge are, and how important they seem in relation to other aspects of the Institute's program. During the course of the work, ISTC will also become acquainted with the key LDC groups involved in these areas and their priority concerns. Several types of activity could grow out of the first-year surveys.

Analysis of field evaluation of the methods, formats, and impacts of decentralized rural media might be called for. Except for a forthcoming study of Radio Santa Maria, I am not aware of any in-depth studies of participatory

and community broadcasting in the developing world. Many of the private local stations in Latin America may be involved in grassroots, development-oriented broadcasting, which could yield valuable lessons. If such efforts are discovered in the first-year survey, consideration could be given to in-depth study of them. If appropriate collaborating institutions present themselves, ISTC might also consider taking part in implementation and evaluation of a field project.

In like manner, visual media for illiterates, and educational games may be candidates for field evaluation or possibly field experiments. Although less "glamorous" than broadcasting, and although requiring physical distribution, these media can communicate in ways which broadcast cannot. ISTC could do a service by seeing that they are given consideration alongside broadcasting as media for reaching rural populations. Well-planned and well-executed projects to evaluate may be hard to find. Often the best work may be contained within larger projects and not publicized on its own. Of course, such communication efforts may also tend to be conducted without adequate attention to pre-testing and formative evaluation. In this area,too, ISTC may wish to consider a field experiment ideally tied in to work in one of the ISTC development problem areas.

The survey of two-way radio applications may reveal several existing projects worthy of further study. In addition, AID and WHO are planning projects in this area, to which ISTC research efforts might be appended. Such collaboration could tie in to special ISTC interests in the health field, and to the questions raised in this report regarding cultural attitudes toward information.

The survey of major administrative media--post, telephone, and data communication--could yield interesting possibilities for further study or operation. Consulting firms and schools of public and business administration may be conducting organizational development efforts relating to effective use of these media, which ISTC might participate in. The Institute might undertake a longer term, more anthropologically oriented study than the implementing organization. Such a study of the subject might be very useful in helping countries assess realistically the importance of telecommunications investment to development administration.

At this point it is difficult to say how important the facets of the media applications field should be to ISTC. Unlike scientific and technical information (which is integrally related to the conduct of collaborative research and development) media application functions as a support to operational development projects. The role of further research in improving media applications may be great. But its importance to ISTC is best assessed after the initial surveys recommended for the first year.

IV. POLICY RESEARCH

A. BASIC CONCLUSIONS

Underlying both scientific and technological information flows and applications of media to development problems are basic questions of infrastructure and of information and communications policy. Without favorable communication resources, neither STI nor telephones nor mass media can contribute significantly to development.

- Effective utilization of STI systems depends upon reliable telephone lines, upon working data terminals, upon the presence of trained information specialists, and upon reliable mails to deliver the documents requested after a computer search.
- Effective use of telephones for aiding administration at the ministerial and project levels depends upon economical access to the phone system by all concerned and upon sufficiently plentiful and reliable circuits to permit frequent communication.
- Effective use of mass media presumes coverage of target populations with both signals and receivers, competent management of media organizations, and dedication to serving development needs rather than commercial audiences or insecure governments.

Ironically, the basic concerns of infrastructure and policy which underlie these factors have been virtually ignored by project-oriented development assistance agencies. Writing in 1974, Ithiel de Sola Pool announced the incipient "rise of communications policy research." Writing in 1976, Sayed Rahim noted that only 0.7 percent of the articles appearing in seven major communications journals in the last ten years had contained the words "policy," "planning," or "strategy " in their titles or subtitles. Also, in 1976 Luis Ramiro Beltran noted that developing countries were only beginning to focus on the need for national communications policies.

Since communications policies have generally not received wide public attention, major decisions have often been made piecemeal by institutions not primarily concerned with the developmental impacts of communications.

In fact, the Ministries of Information, which often control broadcasting, may stress the survival of the current regime more than the provision of development information to the poor masses. Ministries of Post, Telephone, and Telegraph (PTTs), which control other basic communication resources, are notoriously conservative organizations which tend to favor profitability in telecommunications services over broader criteria. This is justified as necessary in order to subsidize money-losing postal operations.

Print media have also had prime objectives other than basic needs development or global problem solving. Thus, contributions of information to development may remain isolated exceptions to the rule until policies begin to be formulated at the highest levels of government with input from both "user" and "supplier" ministries.

There are compelling reasons why information and communications policy should be--and is beginning to be--handled explicitly and comprehensively. In most of the developing world, communications investments are by and large public investments. Therefore, communications can rightfully be called upon to assist in programs to meet major public needs. While these are controversial statements in the U.S.--where media are overwhelmingly in private hands, and constitutionally separated from government--this is not the case in most of the rest of the world. In LDCs, the consideration of new technologies takes place against a backdrop of increasing frustration over the mixed contributions to date of communications to development.

UNESCO and some academic institutions have stressed the importance of national communications policies. However, affordable methods which would allow countries and international agencies to address increasingly important basic questions are still largely unavailable:

CPR-1: What are the current arrangements regarding access, control, and management of communication resources?

CPR-2: In what ways is communications now promoting (or impeding) development?

CPR-3: What kinds of institutional and operational changes might significantly increase the contribution of communications to development?

CPR-4: Within the information/communications field, what mix of future investments in print media, telephone, broadcasting, libraries, and data communications could maximize the contributions of communications to development?

CPR-5: What are the optimal investment priorities between information/communications and other infrastructures such as transportation, electrification, and water supply?

Discussion of these questions from ISTC's perspective should help in planning the Institute's involvement in communications policy research.

CPR-1: <u>What are the current arrangements regarding access, control and management of communication resources</u>? In most countries, adequate information regarding the extent of coverage enjoyed by various media may not be available to policy makers. For example, near universal access to radio often tends to be assumed without justification. In fact, large mountainous areas of the world are still unpenetrated by radio signals. Other regions suffer from unstable and unreliable signals. Even more constraining are linguistic barriers which prevent some cultural groups

from understanding broadcasts, and economic barriers which prevent people from obtaining receivers and batteries.

Other less dramatic examples are populations excluded from mails, telephone,and telegraph service. Studies on communications behaviors would be required in order to know whether provision of those media to a community will lead to their use by poor populations in bettering their quality of life.

Other gaps in factual information may include inventories of trained communication personnel and of the equipment in the country which they must operate and maintain. Neutral information on shortcomings and inefficiencies in the management of the national communications system also may be difficult to obtain. Affordable and workable methods for obtaining such information are not generally available. Such methods would have to balance requirements for detail and rigor needed for effective policy making with the difficulty of collecting information in developing country environment.

CPR-2: In what way is communications now promoting (or impeding) development? Although much remains to be investigated, different strains of research have considered two aspects of this question. The first major type of research was on the relationship of general mass media exposure to the formation of "modern" attitudes. Landmark studies by Daniel Lerner, Alex Inkeles, and David Smith* (echoed by large numbers of replications

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* Danier Lerner, The Passing of Traditional Society, Free Press, Glencoe, 1958; Alex Inkeles and David Smith, Becoming Modern, Harvard University Press, Cambridge, MA, 1974.

and derivative studies) demonstrated positive correlations.

Another strain of research focused upon impacts of purposive applications of mass media to development problems. Researchers associated with UNESCO, the World Bank, AID, Stanford University, Michigan State University, and other institutions have demonstrated that the media can improve the quality of information transfer, teaching, and training at affordable costs under certain circumstances.

While the vast store of research and experience may have convinced many that increasing overall mass media exposure is "a good thing" and that consciously planned media applications to development problems can succeed, much remains to be learned in this area. For example, recent doubts about the developmental impact of imported news and entertainment programming needs to be investigated dispassionately. Questions remain about the institutional arrangements and policies necessary to see that media applications contribute on a much larger scale than in the past. In addition to these questions in the areas which have been researched, massive gaps in knowledge exist. Apparently no systematic evaluations of the impact of the transfer of scientific and technical information from developed countries upon the productivity of developing country research and development have been undertaken. The social impact of the telephone remained a largely unresearched topic even in the industrial countries until the late 1970s. I know of only two studies (by the World Bank) of the telephone's impact in the developing world, neither of which has been released publicly. Much better knowledge about the developmental impacts of STI and telecommunications must be developed as a basis for effective policy making.

Another important consideration is the matter of costing the current communications industries in developing countries. Cost studies by the World Bank and others have shown how difficult accurate costing is, even at the project level and assuming early involvement of the evaluators. Cost comparisons across projects are extremely difficult, since accounting practices differ widely. These problems are magnified at the sectoral and national levels. However, information on effects will be much more useful if meaningful information on associated costs can be developed.

CPR-3: What kinds of institutional and operational changes might significantly increase the contribution of communications to development? In Broadcasting in the Third World, Elihu Katz stressed that the broadcasting institutions in each developing country were fashioned after those of the most influential industrial country. The goals and methods of media producers and managers grew to reflect the concepts of professionalism in the relevant metropolitan country, although generally with and overlay of influence deriving from the presence of U.S. and British radio, film, and TV programming. As a result, broadcasting in widely varying countries has tended to follow a relatively small number of models fashioned mostly after the U.S., French, and British systems. Media professionals often emulate western formats and styles, seemingly showing less interest in understanding and reaching poor and rural audiences.

Systematic audience research as a component in broadcast program decision making is rare in developing countries. Since objectives often vary from the predominant U.S. emphasis upon maximizing audiences, standard

U.S. research approaches might be inappropriate. However, the formative evaluation techniques pioneered by the Children's Television Workshops (CTW) may give some indication of the approach to research which would be fruitful. Measuring comprehension and learning as well as appeal, the CTW methods have already been adapted and tried in several countries. If such approaches to research were built in to the production process and into programming decisions, media professionals might be induced to place higher value on educational and developmental success with the audience rather than on the appraisals of their peers in achieving "professional standards."

Another approach to increasing the contribution of communications to development calls for more involvement of development professionals in broadcasting. Various relationships between development-oriented ministries (such as agriculture, health, and education) and the broadcasters have been tried. Some efforts have lodged a special broadcasting capability within the relevant "user ministry." For example, educational television in El Salvador is entirely under the Ministry of Education, and is entirely staffed by ex-teachers, who are presumed to know the situation of the classroom better than would the professional broadcaster.

Another model has involved the creation of a "development communication unit" within or above the broadcasting organization, which is supervised by a council of high level representatives from user ministries, the national planning organization, and the Ministry of Information. The unit itself works with various development projects as its clients. With such an integrated structure, there are always risks that centralized

political control will extend downward, and that development projects will be used for more narrow political purposes. However, without such a mechanism, it is difficult for the necessary type of inter-ministerial cooperation to occur in order for broadcasting to serve development efforts.

Some additional study of the consequences of various approaches would be a useful investment, although it should be recognized that the arrangements in any one situation may be culturally or institutionally unique, and subject to political constraints which can limit the feasibility of any changes called for by research results.

Beyond the difficult question of how to make communication resources effectively serve national development projects, there are a number of even broader policy questions. How should the basic telecommunications services (telephone, telegraph, telex) be developed, priced, and managed so as to contribute optimally to development? For example, what balance should be drawn between provision of profitable intra- and inter-urban services, and the more costly yet perhaps socially desirable service to and between rural areas?

The impacts of alternative actions in these various spheres upon basic needs - oriented development and global problem solving are sufficiently clear. UNESCO has sponsored a number of monographs offering comprehensive descriptions of communication policies in several countries. However, comparative analytical studies have not been undertaken. In spite of the inevitable political constraints, such studies could be very useful in an effort to work toward operational and institutional arrangements more productive for development and global problem solving.

CPR-4: Within the information/communications field, what mix of future investments in print media, telephone, broadcasting, libraries, and data communication could maximize the contributions of communications. While a definitive answer to such a question is impossible, analysis relating particular development strategies to the information needs of various groups could help guide investment policy. For example, a development strategy based on grassroots development might stress localized rural broadcasting and rural telecommunications. An urban-oriented, "trickle-down" approach might invest more heavily in print media, libraries, and possibly even data communication between industrial centers.

Analysis of such a question would call for knowledge of the implications of various available technologies as regards hardware costs, adaptability to developing country environments, and manpower requirements for both hardware operation and maintenance as well as for programming. Currently, impartial information about alternative technologies is very hard for developing countries to obtain. The question becomes much more complicated when one thinks of entire information and communications systems consisting of large numbers of pieces of equipment, materials, and human resources. However, impartial information on such matters is crucial to effective planning for future investments.

As the time frame under consideration stretches out ahead, assessing alternative technologies becomes much more difficult. In the developed countries the communications and information industries are now undergoing basic restructuring as technology obliteratives old boundaries

between print, broadcasting, and telecommunications. Two of the technological levers forcing such change are the communications satellite and the computer. Both of these technologies offer developing countries quantum leaps in communications and computing capacity. Although long-term cost curves will trend downward, the rate of decline is hard to predict. The manpower requirements for operating such systems successfully are daunting.

The promise of these technologies, particularly in combination, is truly staggering. Satellites make communications costs virtually distance-insensitive. The new generation of high-powered satellites (which can function with cheap simple ground stations) makes it possible to blanket a nation with service which extends into relatively remote and rural locations. Another favorable aspect of satellite systems is that failure in one ground station affects service only at that point--and not all along the network, as is the case in microwave technology.

By their nature, satellites are information super-highways, which flexibly combine telephone, telex, data, radio, and TV transmissions. With digital technology which is now emerging, these functions can be accomplished extremely efficiently. Digital technology also enables satellite technology to incorporate data communication and processing, as well as electronic mail. Ithiel Pool of MIT has argued that computer store and forward message systems--with simple terminals distributed widely--may represent one of the most important commuication technologies for countries short on telephone circuits. While a telephone call requires that two parties be present at the same time, store and forward systems

transmit textual messages between terminals, where they are stored until read.

Another favorable feature of the coming technology of satellites and computers is the ability to concentrate the complexity of the system at points where maintenance and repair is easiest, and to make remote installations consist of relatively simple and modularized equipment. The emergence of the microprocessor has allowed for data networks which install a certain amount of "intelligence" in the many terminals of the system, and draw upon the computing resources of a remote "mainframe" for major jobs.

In like manner, the satellites of the 1980s will place most of the sophistication in the sky (with a back-up satellite in orbit) and with ownership, management, and repair handled by regional or international consortia. Terminals in rural areas may often involve simple voice channels for telephone and two-way radio service. Work on solar power is approaching the point where simple terminals may be feasible and and economical, in some instances, in locations without reliable electric power.

However, enthusiasts often fail to evaluate critically the questions raised by this technological promise. Although there is general agreement that unit costs of these technologies will decline dramatically, this will occur only when operational systems have been developed, and when relatively large-scale production of components has been underway for some time. It would not be appropriate for developing countries to invest too early, and thus to pay the research and development costs

which are better borne by rich country institutions.

A second, more involved question concerns recognition that these technologies have been developed in the rich countries in response to their needs. It is crucial that the full implications of this fact be considered by the developing countries before investing in major systems. For example, the requirements which are taken for granted in the developed countries may represent significant problems in the developing countries. The number of trainable personnel (with a basic scientific outlook, and analytical and mechanical ability) may represent a serious constraint. The accessibility of tools, materials, and transport may need upgrading, with the implied costs. The programming requirements of computers, radio, and television grow dramatically as a system is expanded. The costs of "software" production often dwarf the initial hardware investment and its operational costs. They have frequently been underestimated in the planning of past projects.

A broader but no less real concern involves the organizational requirements for effective use of telephone, data, and broadcasting. These technologies emerged in societies which possessed competent and modern institutions already discharging functions which were simply made more efficient by new information technology. Developing countries should assess their needs and capabilities realistically. Institutions which attempt simultaneously the mastery of new technology and the basic underlying organizational roles should recognize the magnitude of the task they are embarking upon.

CPR-5: What are the optimal investment priorities between information/communications and other infrastructures, such as transportation, electrification, and water supply? Currently, there is very little research which might guide policy makers in making such decisions. Although definitive answers probably cannot be found, some greater degree of rationality in decision making could be achieved. Practical research could help relate the communications requirements of particular development strategies to parallel requirements for other infrastructures.

Whereas communications has generally been considered a "lag" variable, introduced after other infrastructures, assertions are now being made that communications can play much more of a lead role. Until practical research methods are available, it is not possible to determine under what conditions and according to what development strategies this assertion may be true. Given the increasing visibility of communications as an international political issue, pressures may be building for heavy investments in satellite and other infrastructures. Given the rapid development of the technology, major decisions seem inevitable in the eighties. In order that these investment decisions have the most solid possible underpinnings, the type of research described above should be undertaken immediately. While these long-range policy matters may seem rather removed from ISTC's immediate project-level concerns, they have great long-term importance. Although ISTC may not be able to devote major resources to these questions, I will suggest below how a relatively small involvement could have a significantly impact.

B. ISTC's FIRST YEAR

The above questions are the most global and long-term questions relating to communication's role in development. Ironically, they are also the questions about which least is known. Both STI and media applications have enjoyed far more attention from the international development community. For that reason, an institution like ISTC need not shy away from these important questions. An intelligent contribution in this area need not depend upon a vast budget or a vast mandate in information and communications.

The first step which ISTC should take is to convene an international meeting of respected communications researchers and communication policy makers to elaborate upon the basic conclusions above. Informal discussions with Luis Ramiro Beltran of the International Development Research Center and with Syed Rahim of the East-West Communication Institute suggest that the questions raised above are increasingly recognized by LDC governments as crucially important but that little progress has been made in researching them. Further discussions I will hold with Asian participants at the East-West Advanced Summer Seminar on International Organizations and Communication Policy should give added evidence on this point and suggest possible participants in an ISTC meeting.

In conjunction with such a meeting, surveys should be undertaken of past and present LDC efforts to research these and other communications policy questions. The East-West Communication Institute itself has worked collaboratively with Asian countries on some such questions. This month consideration will be given to initial research results on the impacts of satellite-delivered television in Indonesia. Case studies now being conducted by the East-West Institute on communications planning by development ministries may

be relevant in this regard. In addition, UNESCO has been very active in communication policy research. The UNESCO planning work which took place in Afghanistan just before the recent change of government has been characterized as pioneering and should be studied by ISTC. Other research efforts related to UNESCO (such as the planning for Thai ETV) or which may have grown out of the regional meetings on communications policies held in San José (1976) and Kuala Lumpur (1979) should also be surveyed. Interesting work was also done in pre-revolutionary Iran in connection with planning for a domestic satellite system. Also to be included in the survey should be all available information on communications policy making in countries which have not undertaken significant policy research.

Another survey which would serve as a useful basis for future action should cover mechanisms whereby LDCs make information and communication hardware choices, as well as suggestions made to date to improve their information base. At present, equipment vendors and Western universities (where individual Third World planners were trained) may well be the major providers of information. In specific cases, Western consulting firms may have been called in to plan major investments. However, there is no impartial institution or mechanism providing ongoing evaluation of technologies, suggestions for adaptation, or specifications for needed but non-existent technologies. Proposals have come from several quarters for the creation of neutral information sources. They should be surveyed by ISTC.

During the first year ISTC could also profitably explore with the International Telecommunications Union (ITU) participating in a planned study of the indirect

benefits of existing rural telecommunication facilities for rural socio-economic development. While the ITU and the West German government are currently involved, a greater funding base and a broader participation in this study are desired by ITU. In combination with studies now being undertaken in Egypt, Colombia, and Indonesia, the ITU effort will attempt, for the first time, to quantify and assess the broad impact of rural telecommunications. A better understanding of these impacts would give much needed guidance to the course of telecommunications.

In the first year, ISTC should also stay in close touch with the AID satellite initiative and consider appropriate means of collaborating with this project. By testing the cost-effectiveness of satellite communication (primarily two-way voice) in rural development, this project will shed new light on the value of extending telecommunications into remote areas which are not economically reachable with conventional land-based telecommunications systems. While extensive evaluations are to be incorporated into this project, ISTC should observe how the project develops and consider whether they might contribute to it in some way.

At the 20th UNESCO General Conference, the U.S. proposed (and the Conference unanimously passed) a resolution inviting the UNESCO director general to convene a meeting to plan for consultative arrangements to harmonize existing programs of development cooperation and communications and to build consensus regarding priorities and needs for further cooperation. That meeting has now been scheduled for November in Washington. A larger intergovernmental meeting at UNESCO headquarters in February will take the work further by involving all UNESCO member states. Since research will most probably be recommended to underlie decisions about needs and priorities, ISTC should be involved in these meetings.

C. FIRST FIVE YEARS

Since research and development on the role of communications in development will most likely be a part of the planned consultative group's ongoing work, ISTC should consider assuming an ongoing function in the group. Another strong incentive for ISTC participation is the mandate to the proposed group to coordinate existing programs in the communications field. The group should represent an effective way for ISTC to liaise not only with private and public U.S. institutions active in the field, but also with their counterparts in other industrial countries as well. For this reason, the group could be a great help to ISTC in building a role in the information and communications field.

One of the needs most often voiced by non-aligned countries (and certain to be mentioned in the consultative group) is for unbiased information on technological options in information communications which are open to developing countries. After surveying existing information sources and outstanding proposals in its first year, ISTC might move the discussion ahead by initiating a multilaterally funded and internationally conducted feasibility study of mechanisms for creating and disseminating such information. As mentioned above, the service should involve much more than an international "consumers' union" for testing individual pieces of hardware. Also included should be a study of alternative systems, recommendations on needed adaptations, and specifications for needed but non-existent technologies. In all cases, software cost implications, organizational requirements, and built in cultural and value assumptions must be taken into account. As a newcomer to communications with a strong field-orientation, ISTC may be able to contribute particularly in the vital considerations which extend far beyond the hardware.

In its first five years, ISTC might decide to participate in policy studies proposed by LDC researchers and by the ITU. As stated above, little concrete work has been done in LDCs in response to the heightened interest in communications (in particular, telecommunications infrastructure development) policy. Egypt (in cooperation with MIT) has begun a study of rural populations' usage of postal services and telephones, a study which other countries may wish to replicate. India and Colombia's Post, Telephone, and Telegraph (PTT) administrations are said to be undertaking research on new rural telephone installations. ISTC should become acquainted with these and other LDC researchers interested in giving a firmer information base to major investment and policy decisions in their countries. Collaborative multicountry studies (assisted by partial ISTC funding) could help influence the international community towards communications investments which serve development better than in the past.

Also important in assessing these potential contributions of telecommunications in rural development will be the AID satellite initiative. Demonstrations and pilot projects in about six countries are planned. Although a major evaluation component is foreseen, ISTC may be able to contribute additional study of the broader question involved in the project. The appropriateness and nature of any ISTC involvement should be determined in consultation with project staff as the project develops.

Several industrial countries (including Canada, Australia, and West Germany) have undertaken comprehensive long-term studies of future societal information in communication needs. These efforts, to which representatives of various governmental and non-governmental institutions contributed, served

to broaden the focus on long-term, public policy considerations. To my knowledge, no developing country has undertaken such a study. If the opportunities present themselves, ISTC should consider participating in such studies in selected LDCs. The envisioned studies would concentrate on the requirements of development as designed by the particular developing country. Ideally, studies would be undertaken by several countries reflecting different sizes, income levels, and development strategies. When compared, these studies might reveal striking differences in terms of the types of information and communication investments recommended. They would certainly enrich the entire international discussion on future development requirements in information and communication.

V. CONCLUSION

My purpose has been to review a broad field of information and communications from ISTC's perspective as a problem-oriented, collaborative research institute. I have drawn basic conclusions in suggested first-year and first five-year activities in each of these three areas: scientific and technical information, media applications, and policy research. In view of the uncertainty of ISTC's program emphasis and budget, and in view of the small amount of time available (approximately two professional person months of effort), we have agreed to make more recommendations than ISTC may be able to act upon and to pose the recommendations in rather general terms.

The STI is that aspect of the field most directly related to the rest of the Institute's mandate. Effective information support for ISTC staff and contractors is a crucial factor in ISTC's internal productivity. Effective dissemination of ISTC results is crucial to its impact upon the rest of the development community. The needs of LDCs for comprehensive information policies to help build national information infrastructures should also be recognized by ISTC as essential to the achievement of the Institute's long-term goal: promoting the development of autonomous, self-reliant, scientific, and technological innovation and services.

The media applications area will be of less overall interest to ISTC. In this area, the emphasis is more on operation than research. Many groups are already active in this field. Still, there are certain applications directly related to other ISTC problem areas, about which ISTC researchers should be informed. Applications of decentralized rural media and of admini-

strative media (telephone, telex, two-way radio, etc.) also merit ISTC's attention.

The policy research area, which underlies both STI and media applications, merits special ISTC attention. Although it is of great current interest, little good research has been done, and few realistic methods are on hand. With major investments proceeding without research guidance, the area is truly overdue for development. ISTC could make major contributions with relatively minor investments.

These possibilities now need to be investigated in much greater detail. When ISTC begins operations, advisory meetings on STI and policy research should be held shortly thereafter. ISTC should participate in the UNESCO/U.S. meeting on communications development in November. These first steps will help to begin further definition of ISTC's appropriate role in information and communications.