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ABSTRACT

This review surveys the literature emanating from less developed countries (LDCs) and international agencies that deals with their perception of the needs of LDCs for scientific and technical information (STI) in relation to social and economic development. It explores five major areas: (1) recognition of STI as it is expressed through international and national STI systems and efforts; (2) availability of STI, including expression of needs for types of STI, selection and acquisition of STI literature, and awareness of STI resources in the United States; (3) accessibility of STI, including its intellectual organization, housing, dissemination, use of information technology, and building of networks; (4) utilization of STI, including use of STI systems, user education, user requirements, promotion, and marketing and evaluation; and (5) education and training of information professionals, including university and continuing education. The major findings and perceived obstacles are summarized in the concluding section. An appendix lists scientific and technical subjects covered by United Nations-related information systems and services. References are provided. (FM)

PERCEPTION OF THE NEEDS FOR SCIENTIFIC AND TECHNICAL INFORMATION IN LESS DEVELOPED COUNTRIES

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Executive Summary

The aim of this paper is to survey the literature emanating from less developed countries (LDCs) and international agencies and dealing with their perception of the needs of LDCs for scientific and technical information (STI) in relation to social and economic development. The paper surveys the perceptions dealing with:

1. Recognition of STI, including as it was expressed through international and national STI systems and efforts
2. Availability of STI, including expression of needs for types of STI, selection and acquisition of STI literature, and awareness of STI resources in the U.S.
3. Accessibility of STI, including its intellectual organization, housing, dissemination, use of information technology and building of networks
4. Utilization of STI, including use of STI systems, user education, user requirements, promotion, and marketing and evaluation
5. Education and training of information professionals including university and continuing education

The major findings and perceived obstacles are summarized in the concluding section.

These major themes emerge from the literature and particularly from UNCSTD related reports and recommendations (20% of consolidated recommendations for UNCSTD pertain to some or other aspect of STI):

1. Need for appropriate technology and related appropriate information
2. Need for policy, decision making and business information
3. Desire for more development and deployment of international STI networks and higher level of utilization of information technology for

STI; particularly embraced is the "territorial formula" that makes LDCs an equal partner in development of such networks

4. Need for assistance in building of necessary information infrastructure, particularly in education and training of information professionals.

5. Strengthening of regional approaches to STI and of links between LDCs in provision of STI.

The perception of STI needs clearly differ with the level of development. In the least developed countries needs for STI are inseparable from needs for technical training and general education. In countries at higher levels of development STI needs are perceived to also include policy-making and business information, as well as assessed (evaluated) information. In many instances needs are expressed for "repackaged" or "scalled-down" information and for information specifically created for given segments of population. There is considerable divergence in understanding what is encompassed by STI in LDCs from the understanding in USA.

There seems to be little awareness of specific details on U.S. STI resources, although there is a high recognition of U.S. being the prime supplier of STI and of STI systems and related methods. No appreciable discussion was found on economic aspects related to STI activities in general; there seems to be a lack of understanding on the economics of information in USA and the role of the private sector.

The major expectation from USA can be surmized from general expectations from developed countries:

1. Easier access to U.S. based STI systems

2. Greater involvement and contribution of U.S. STI systems to international systems and networks

3. Easier access to information technology and assistance in its applications for STI, particularly in the area of software and training
4. More opportunities for direct exchanges between LDC and U.S. scientists and technologists and STI professionals in LDCs aimed at information transfer
5. Assistance in building of national STI systems and particularly in education/training of necessary STI professionals
6. Assistance with costs of acquisition of STI
7. Easier access to hard-to-get information, particularly to policy-making, business and negotiable information

1. INTRODUCTION

1.1 Aims, Scope

The purpose of this paper is to survey and analyze the literature emanating from less developed countries (LDCs) and international agencies and dealing with their perception of the needs of LDCs for scientific and technical information (STI) in relation to social and economic development.

An attempt is made to synthesize the perceptions arising from three different vantage points and as formulated by three different constituencies (active in LDCs and/or in international organizations):

1. scientists, engineers, technologists as ultimate users of information
2. information specialists, information scientists, librarians, educators as purveyors of information that make the use possible
3. government officials, politicians, strategists for development as policy makers and planners that have to chose among alternatives in allocation of limited resources

Each of these constituencies is found to have a somewhat differing perspectives and emphases in their perceptions, primarily because of the differing role they play in relation to STI -- this effected very much the organization of this paper. Also, each show the effects of differing examples from developed countries that influenced the formation of their specific concerns:

1. Perception of scientists and engineers emphasizes more of the historical and traditional perspective related to the proven role of STI in the success of science and technology during the past few centuries in the development of many societies.
2. Perception of information specialists (librarians, information scientists and other professionals) emphasizes more of the present day, modern approaches to the problems of "information explosion,"

including building of new information systems and networks based on modern information technology.

3. Perception of policy makers (officials, politicians etc.) emphasizes more of the strategical aspects of the role of STI in development of science and technology, which is considered vital to national development; in particular these perceptions are predominant in the United Nations discussions, however, it is a mistake to assume that these are the only perceptions.

It is fully recognized that it is hard and even dangerous to draw conclusions valid for all LDCs because different countries are at different stages of development. These differences (coupled with differences in cultural, political and social environments and traditions) greatly affect the perception of STI problems and needs. For the purpose of this paper three levels of development are distinguished:

1. pre-industrial (agricultural)
2. beginning industrialization, and
3. relatively advanced industrialization

Although we can somewhat better classify the perceptions according to these three levels, further difficulties do arise in the cases of some countries where all three levels of development coexist in different regions or sectors. Thus, not all of the conclusions in this paper are equivalently valid for (or accepted in) different countries. Generalizations are at best limited to a class of countries with some similarities in common.

However, it is also realized that scientific and technical knowledge knows no geographical, cultural, political or economic boundaries. STI may be, in many instances, in need of local adaptation and acceptance, but it still has elements of universality. In this sense, despite many diversities among the world's countries, there are encouraging commonalities when it comes to scien-

tific and technical information and its basic global validity. This helps in making some generalizations about STI in LDCs so much easier to accept.

1.2 Organization

This paper is organized into seven sections:

Section 1: Introduction and scope of the paper. The nature and limitations of evidence used.

Section 2: Recognition of the role of STI in the process of development as reflected by the connections made between STI and development; by actions of UN agencies; by the type of international and national STI systems that have been established in LDCs; and by national STI plans and policies.

Section 3: Availability of STI. The kind of STI that is considered important. The difference in STI requirements with the level of development. Problems of selection from the mass of STI literature. Problems of acquisition (i.e. obtaining documents). Awareness of STI resources in the U.S. and economic considerations.

Section 4: Accessibility of STI. Problems of organization, housing and dissemination of STI. Applications of information technology and information networks.

Section 5: Utilization of STI. Extend of use of STI systems. User education and requirements. Promotion and marketing. Evaluation of STI efforts.

Section 6: Education and training of STI professionals, as a major aspect of STI infrastructure. University education. Training and continuing education.

Section 7: Summary of main points and conclusions.

1.3 Evidence: Nature, Extent, Limitations

The synthesis in this paper is accomplished from a survey of a large number of available literature (listed in the bibliography), including:

- ... reports of UN agencies
- ... specific reports in preparation for UN Conference on Science and Technology for Development (UNCSTD)
- ... plans and reports from various governments and regional organizations
- ... reports from various international professional associations and from conference proceedings
- ... journal articles and monographs (including technical reports) by scientists, technologists or information specialists

The synthesis, particularly in its organization, also utilizes the author's personal, professional, and educational experiences and interviews in over a dozen developing countries in a span of over a decade.

In general, the state of the literature on the subject of STI in LDCs is highly chaotic. The records of perceptions are highly scattered, elusive and fragmented. This imposes evident limitations on the synthesis of such literature.

All of the conclusions derived here come from statements found in the listed literature. The perceptions synthesized here are of two kinds: direct and indirect. Direct perceptions are those that were explicitly stated in the literature -- on what the situation is, recommendations on what should be done etc. Indirect perceptions were derived from actual actions undertaken in relation to STI systems, networks and other national or international activities and the reactions to these activities -- it was taken here that actions and reactions implicitly reflect perceptions.

However, there is a grave problem with factual evidence on the basis of which statements found in the literature were made. There is an appalling lack of valid and reliable facts, data, statistics and similar hard evidence in connection with most of the discussions found in the literature on STI in LDCs. The opinions and recommendations may quite often indeed be a reflection of reality, but nevertheless they are, as a rule, not substantiated. Hundreds of surveys, trip reports and descriptive articles exist on some or other aspect of STI in LDCs and this is not in any way to discount their value. Unfortunately, many of the surveys are shallow, not going further then providing names and short descriptions of some agencies involved with STI, without evaluation of results, without distinguishing between actual and "on paper only" accomplishments; the method of compiling such reports is also quite often suspicious (many are based on few and short interviews, some done even at the airport lounges, or by phone, or on the basis of a two-day trip to a country). This particularly includes the numerous reports done by and for UN agencies, where trip reports are substituted for studies.

As in other areas of human interactions, perceptions on STI are also formed with or without supporting evidence, sometimes even contrary to evidence. In this paper the author had little choice but to record the direct and indirect perceptions as they were -- with or without substantiation. In certain instances the author extracted some statistics from the listed directories to provide some facts about what countries engaged in what STI activities.

The literature listed in the bibliography was roughly distributed according to the following topics:

... Directories, statistics : [items: 8, 24, 26, 27, 33, 49]

... UNCSTD reports and broader preparations: [25, 39, 40, 41, 42, 43, 46, 47, 50]

... International systems: [9, 10, 14, 20, 38, 50, 52, 54]

... International networks: [7, 13, 17, 33, 44, 45, 48]

... Education and training: [11, 24, 55, 56]

... Countries in Africa: [12, 18, 22, 28, 36, 37, 39, 43, 46, 47, 56]

... Countries in Asia: [5, 6, 15, 25, 30, 35, 39, 41, 47, 51, 53]

... Countries in Latin America: [2, 4, 16, 17, 19, 21, 42]

European countries were not considered in this paper. In a number of instances the author also commented about the lack of discussions on certain important topics in the literature on STI in LDCs. Clearly, a lack of perception on some factor shows also a need for action.

2. RECOGNITION OF THE NEEDS FOR SCIENTIFIC AND TECHNICAL INFORMATION IN DEVELOPMENT

2.1 On the Establishment of Connection between Development and Information

The recognition of what array of elements are important in development keeps changing; it is still an evolutionary process. As a result, emphasis on resource allocation keeps changing and broadening. Recognition of importance, of the value of a given element in development, is a prerequisite for support and allocation of resources.

Among the latest element that entered this process of recognition is information in general and scientific and technical information in particular. It is slowly, very slowly being recognized that the organic process of development in addition to the human, economic, technical and physical factors involves information as well. It is perceived in many reports that if there is any one factor to be isolated as a greatest internal and external obstacle to the beneficial use of STI in development, it is the low level or even lack of recognition of its potential role and value, particularly among decision makers and officials of higher rank in LDCs. Even where there is recognition it is often only in lip service form, as measured by the proportion of resources allocated to STI activities.

Although statistics are hard to come by and should be used with caution, it has been found in general that the highly developed countries (such as the U.S.) use some 2-3% of the R & D expenditures for STI activities; this proportion is considerably less in LDCs: in relatively advanced industrialized countries (such as Brazil) it falls to about 1% or less, and in others it gets to be around a few promills [from 8 and an array of country reports].

Since the recognition of the importance of information was perceived as fundamental to the resolution of all the other information problems, there were

great many efforts devoted toward achievement of recognition [e.g. UNESCO reports]. The low level of awareness of the importance and value of information is also the subject of concern in preparation for UNCSTD [e.g. 39, 40]. This is obviously necessary and positive. However, there is another side to these efforts stemming from the problem of methods. Many of these efforts did not move beyond rhetoric. From the literature survey, one gains an impression that it is becoming almost a ritualistic necessity to start any discussion about STI in relation to development with a few pat phrases (which are at times obvious truisms and at other times quasi-political slogans) and no more; phrases such as:

"Information is a resource in development"
"Information is power"
"There are information rich and information poor countries,..."
"Denial of information and lack of development..."
"STI is a basic requirement for development".
"Information resources play a significant role in decision making..."
"The widening gap in STI between developed and developing countries..."

The problem is that the literature reveals little research, little collection of hard data, little substantive support given to these and similar statements; in a more scientific sense these statements are assumptions. The correlation between information and development is quite evident, but it needs much more evidence.

The sparsity of factual evidence about many aspects related to STI in developing countries is the most significant inhibitor in making more powerful arguments on behalf of the recognition of value of STI, in rational decision making on what should be done and the largest obstacle in the evaluating of what was done. The situation would be the same if drilling for water or oil is decided upon and undertaken without prior geological surveys. Thus one of the basic recommendation that is made here is that the U.S. engages in joint fact

finding studies on STI in LDCs, using improved methods of study, developing reliable and comparable indicators; collecting meaningful statistics and correlations etc.

It is not even standardized or clear what type of information should be collected to establish a direct bearing on the situation and to be able to assess the particular information requirements for a particular developmental situation or level. As a result most of the STI efforts in LDC's were directed toward copying what was done in similar efforts in developed countries. It is entirely possible that this is an optimal strategy, but without hard evidence on the situation this is impossible to assess.

However, the large extent of concern with STI can be observed from this: out of 190 consolidated recommendations for UNCSTD, 38 or 20% were recommendations that pertain to some or other aspect of STI [39].

2.2 UNESCO Based Efforts and Perceptions

Of all UN agencies, UNESCO had the strongest involvement with STI. An analysis of UNESCO efforts in many ways characterizes the perception about needs of STI in LDCs on the level of UN and other international non-governmental organizations, (professional, scientific) which are increasingly following the line chartered by UNESCO. In most cases UNESCO efforts resulted from the suggestions or pressures coming from LDCs.

Up until 1977 UNESCO activities in STI were located in two divisions (Div. of Scientific and Technical Information in the Science Sector and Div. of Documentation, Libraries and Archives in the Communication Sector). The first division evolved a program called UNISIST (a non acronym standing for World Science Information System) and the second division a program called NATIS (National Information Systems). On the basis of a resolution of the 19th General Conference of UNESCO the two divisions and programs were in 1977 consolidated into a Division of General Information Program. For the period of 1977-1978 there are four objectives [55]:

1. Promoting the formulation of national policies and plans for STI, including social and economic sciences
2. Promoting the establishment and application of norms and methods suitable for interconnections between STI systems
3. Contributing to the development of information infrastructures and to the application of modern techniques of data collection, processing, transfer and reproduction
4. Promoting the training and education of information specialists and information users

These objectives also represent some of the main concerns in LDCs.

Over the years there were many UNESCO based, sponsored, or inspired guidelines, studies, projects, country reports, consultations, recommendations,

conferences, workshops, training courses, stipends, etc. with a great variation in quality and degree of success. But in general UNESCO is credited by LDCs with many good works. The major success of UNESCO was the creation of international ideas and trends that are predominat today and in raising the consciousness about STI worldwide. A large number of countries have been directly effected in some way by these efforts, particularly through works of UNESCO consultants, who are roaming the globe as a sort of information troubadours.

The major failure of UNESCO (and of other international organizations) was that only a fraction of the endless stream of recommendations have been fruitfully transformed into reality. One of the roles that UNESCO sees for itself is the making of recommendations. But there seems to be a trend toward the manufacturing of recommendations for their own sake and as an end in itself. There were simply too many recommendations, many of which were also unrealistic and were made without a solid base in evidence. Complaints were voiced in LDCs that there were just too many recommendations from too many agencies; many of them were confusing and conflicting. As many UN agencies, in addition to UNESCO, took upon dealing with STI, sending missions, consulting, etc., the situation had a number of undesirable effects [e.g. 43 p. 37]:

> "...Time of the already overburdened policy makers is taken up in servicing various missions.
>
> ...There is no complete follow-up action on any one mission.
>
> ...Individual missions pursue their particular interests to the exclusion of the general goal of strengthening scientific and technical capabilities...thus creating confusion in setting national priorities.
>
> ...Governments find it difficult to identify and evaluate the most appropriate recommendations and sources of assistance."

Suggestions are made that the whole method of making recommendations needs to be re-evaluated.

Here are some other criticisms that emanated from LDCs about UNESCO efforts and UNISIST in particular, as the most visible UNESCO activity in STI:

... A number of information professionals voiced their complaint that the choice for the UNISIST Focal Point[1] in some countries was not appropriate, namely chosen was an institution or ministry department that has little to do with STI activities in a practical sense

... Skepticism was voiced that UNISIST can provide an appropriate framework for standardization (which is one of the major UNISIST goals); there is also an inherent lack of power to do so effectively

... As to the subject emphasis some criticism was voiced that UNISIST is aimed at scientific as opposed to technological information, while the later is much more needed than the former

... It was also voiced that UNISIST is not aiming toward discrimination from the large quantity of available STI which is "chocking rather than helping"; UNISIST is not coming to grips with "information explosion".

... Internal UNESCO conflicts resulted at times in conflicting guidelines, particularly in the area of national planning, which was at times a point of biting remarks.

On an ideological/philosophical plane some critical views of UNISIST and other international efforts were voiced about the relations being supported/created between the developed and developing countries. It was perceived that UNISIST, and most other similar efforts, emphasize links between developed and developing countries rather than promoting developing - developing links, thus reinforcing rather than transforming the dependency relationship. These

[1] By 1978 there were 49 national focal points and 46 national committees for UNISIST.

efforts are being viewed in some circles as having a tendency to avoid promotion of "horizontal cooperation" among developing countries. In more extreme cases a general dissatisfaction is voiced about the dependency for STI on developed countries. Depending on the ideological orientation this dependency is merely resented, or it is considered a form of exploitation or even neo-colonialism. In these views all efforts by developed countries in regard to STI for LDCs cause suspicion. It may be of interest to note that such views were not found in literature by information professionals or scientist/engineers, but only in reports quoting officials.

2.3 International Information Systems: Some Representative Efforts

A large number of UN and other international agencies (particularly ICSU - International Council of Scientific Unions) were also involved in STI activities oriented toward LDCs. Within the aims of this paper, of particular interest are those efforts that resulted in successful operational information systems on an international scale, because their philosophy and design principles were, in a large part, formulated in accordance to perceptions and arguments put forth by LDCs. The direct and growing participation of many LDCs in the operation of these systems is a reflection of their needs, capabilities and of operational feasibilities.

The Directory of UN Information Systems and Services [49] lists in 30 UN agencies some 108 information systems (including libraries) of which about 80 are related to some area of STI. Of course, these information systems and services are for all countries of the world, but to a large extent they are particularly oriented toward the process of development and LDCs. Thus, an analysis of the subjects of their coverage provides a more specific insight on the perception of UN and its members about the particular subjects for which information is needed.

Appendix 1 lists the STI related subjects covered by the UN related or cosponsored information systems and services, together with the number of such services covering the given subject, noticing that many systems cover more then one subject. It can be seen that there is a heavy orientation in areas of agriculture, environment and ecology, communications, health science and in a number of technologies.

The selection for discussion of three widely accepted information systems, as provided below, is an attempt to analyze, in a representative way, the perceptions about the type of systems that are needed.

1. INIS (International Nuclear Information System) was developed and is being operated, since April, 1970, through the International Atomic Energy Agency (IAEA) in Vienna. It is a computer based information retrieval system based on the subject of peaceful applications of nuclear energy. The principle of operation is:

a. decentralized input preparation i.e. an agency in each of the participating countries collects the literature on the subject produced in the country and prepares forms for machine readable input according to mutually agreed standards.

b. centralized processing i.e. all these are collated in Vienna and computer tapes are prepared, together with Atomindex, (a printed abstracting periodical issued semimonthly) and microfiche sets of nonconventional literature.

c. decentralized dissemination i.e. the agency in each of the participating states receives the tapes, and other products, and provides dissemination services as it is capable and as are needed e.g. SDI (selective dissemination of information) services.

The philosophy here is that each participating country is an equal partner in the enterprize contributing according to its own output (and thus use) of literature on the subject (this is sometimes referred to as "territorial formula"). Developed countries, as U.S., found the mode of participation also beneficial (for instance, because of participation in INIS the U.S. stopped publishing its own Nuclear Science Abstracts). The philosophy and design principles of INIS are now championed as models for cooperation between LDCs and developed countries in international information systems. This is particularly deemed suitable by LDCs that are at a level of relatively advanced industrialization, as seen from the list of participating countries (some 50 countries contribute to INIS input).

2. AGRIS - International Information System for the Agricultural Sciences and Technologies, operational since January, 1975, is sponsored by FAO. It is also a decentralized system with FAO acting as the coordinating center responsible for receiving, integrating and processing bibliographic data submitted by national and regional input centers all over the world. Some 87 countries, at all levels of development, (including U.S. and other developed countries) are participating. FAO is assisting in the development of AGRIS centers in a number of countries including staff training and start-up support. AGRIS provides computer tapes and publishes AGRINDEX. An interesting feature of AGRIS design is that it is progressing in levels, roughly corresponding to the perceived needs of the levels of development. The present Level 1 is oriented toward current awareness services. Level 2 is envisioned as a network of specialized centers for given subjects or countries providing customized information to users, up to rural populations.

In some countries where AGRIS centers are becoming operational on a wider scale, specialized information services are being instituted toward rural extention services which have peculiar constraints because of their spread and remoteness. The ideas (i) of levels of system development, (ii) of FAO's active support in establishment of AGRIS centers in LDCs including manpower training and (iii) of services to rural extensions, is striking a particularly responsive cord in LDCs. In many ways AGRIS is actually a creation of LDCs and their perceptions.

A recent evaluation of AGRIS [9] found most illuminating disparities in views about AGRIS in LDCs and in developed countries. The LDCs attitude was summarized as follows:

"(1) We need a single comprehensive data base covering the world's agricultural literature, in conventional and non-conventional form, to replace the multiple data bases now in existence.

(2) We want a participatory program in which we are partners and have equal rights. We do not want to feel completely dependent on a product fully controlled by one of the developed countries.

(3) AGRIS has been a great stimulus to the development of national and regional capabilities for the control of agricultural literature. It has provided a structure within which funds for development of capabilities (e.g., from UNDP and IDRC) have been made available and it has provided excellent training opportunities in the developing countries.

(4) AGRIS is already better than most other sources in its coverage of the agricultural literature of the developing countries.

(5) It would be a serious setback to the development of national information programs in many countries if AGRIS were not allowed to continue."

On the other hand the attitude of developed countries was:

"(1) We are already well provided for by existing services.
(2) Tropical agriculture, a major concern of many of the developing countries, is not our primary interest.
(3) A data base not accessible on-line is of very limited value.
(4) Too much material of low scientific value is accepted into the data base.
(5) We have very little to gain from participation in the program.
(6) Participation on our part would involve giving but not receiving. It would be a form of foreign aid.
(7) Departments of agriculture (insofar as these agencies are responsible for AGRIS in various nations) are not foreign aid agencies."

Among others the study found that: (i) the major achievement of AGRIS, so far, was more in relation to promise than actual performance but that it has a wide support; (ii) the coverage, as yet, is incomplete and the system is not widely known and the products not widely disseminated; (iii) the level of commitment by FAO and other agencies is uneven; (iv) operational standards are not fully adequate; (v) many countries have no resources to participate. The greatest failure of AGRIS coverage is considered to be the inability to secure U.S. input. Namely, U.S. National Agricultural Library (NAL) is in a precarious

[illegible] AGRIS standards for input differ from its own, but NAL has to [illegible] up on input processing; NAL has found only enough resources to make only partial input to AGRIS (in 1977 only about 20% of input is processed).

3. UN Industrial Development Organization (UNIDO), through its Industrial Information Section, is a prime force in the world promoting the [illegible] and use of industrial information in development. Some 130 countries participate in UNIDO information activities with direct input and/or having contact [illegible].

Activities include: seminars, conferences, training courses, [illegible] in establishment of various industrial information centers in many countries, and establishment of centrally run information systems. The systems include:

1. INDIS (Industrial Information System) for managerial, economic and technological aspects of industrial development; incorporates Industrial Inquiry Service for specific inquiries - since 1966 some [illegible] inquiries were answered, half of which are equipment and [illegible] related; the majority of inquiries were related to [illegible], food, [illegible] and light industries, pulp and paper, [illegible] — giving an idea of subject of [illegible] [50].

2. INTIB (Industrial and Technological Information Bank) operational since [illegible], 1978, provides technological information for decision makers in LDCs to assist in selection of appropriate technology at the planning stage of new investments in industrial development.

INTIB, the newly established information bank, was started after [illegible] in [illegible] in 13 developing and 12 developed countries. The surveys uncovered needs for specific and [illegible] ([illegible]) information [illegible] choices in alternate and appropriate technologies. They also [illegible] that the [illegible] needs in different parts of the world [illegible] of information [illegible] technological information".

This is of interest here because it specifically relates to the question of what kind of information is perceived as needed? Here are quotes on the subject from the executive director of UNIDO in the report Establishment of an Industrial and Technological Information Bank [52]:

> "In the case of African countries, for instance, the consultants pointed out that the proposed Bank should lay emphasis on the areas of agriculture, public health and engineering, and that in addition to the collection and storing of information, the Bank should assist its clients to analyze their information needs in order to adequately respond to their specific requirements and development objectives. In the case of Asian countries, on the other hand, technological information was meant to cover the processes of industrial planning, technological choice and transfer as well as industrial operations. It was also felt that the proposed Bank could serve as an appropriate mechanism whereby comparative analysis of relevant data and technological information could be pursued in a systematic manner. In the Latin American countries, the need was stressed for techno-economic information to enhance the bargaining position of recipient countries and in particular, for negotiations of licensing and patents and emphasis was placed on the need to differentiate the various degrees and stages of development of these countries, bearing in mind their own industrial strategies and technological capacity."

INTIB eventually plans to provide, in addition to publications and question/answer services, also computer tapes, and even assessments of specific situations and on-site advice. INTIB's evolution is planned to be heavily dependent on requests from Member States.

The Bank is a response to the increasing perception for a need of appropriate technology and requests for action in this area. UNIDO's perceptions and actions in areas of industrial information and appropriate technology is a direct reflection of perceptions as they are emanating from many LDCs. The very large number of countries participating in these information activities testify to the breadth of this need.

2.4 National Information Systems

An examination of the type of STI systems established in LDCs can provide a further insight into the perceptions about the recognition of information problems and subject areas of needs. Academic libraries were first to emerge, parallel with establishment and evolution of universities; they still remain a very basic and most important, albeit also a very neglected source of information. With the advent of other types of STI systems in developed countries efforts at establishment of similar systems were also undertaken in LDCs. Some of these systems have been in operation for two or more decades, but most of them were established within a decade. Continuous change and evolution is one of the characteristics of these systems; thus the information about factual situations on what exists, under what names, auspices, organizational patterns, subject coverage, processes, services, products etc. is chronically out of date. This is one of the reasons for numerous country surveys by international organizations, remarked about previously, and one of the reasons for preoccupation in these surveys with interviews on the existence and state of STI systems.

As to the subject coverage, four categories or classes of STI systems can be distinguished in LDCs:

1. National STI systems with general coverage
2. Specific subject oriented information systems in an area of science and technology
3. General industrial/technological information systems
4. Sectoral industrial/technological information systems in an area of an industrial product or service

An additional category may be considered - countries that have no specifically organized systems for STI. Some STI activities (in a given subject or for industry) in some of these countries are carried out through a

Ministry or a Chamber of Commerce, but there seems to be no information centers as such. Most of these countries (listed below in footnote 1) are rather small, or are islands, or are isolated. These countries may particularly be considered as outside of the stream of information flow.

1. A large number of LDCs have chosen to establish a national system for scientific and technical information. These include at least the countries listed below in footnote 2.

The STI activities, products and services, and the depth and breadth of involvement of these national STI systems varies widely from country to country. In general, they are more product then service oriented i.e. more toward production of bibliographies, catalogs etc. then toward services directly oriented to users (such as question answering).

There are two major general difficulties that emerge from writings about these national systems:

1. Difficulties in defining the scope of their coverage
2. Difficulties in finding a direct relation and a fitting place in the scheme of development in the given countries

On the positive side these national systems are a focal point for a lot of national STI activities and promotions. Probably their biggest contribution over the years is a creation and support of information professionals in STI as a vital aspect of information infrastructure. Their national and international activities in promotion of STI is sizable; any country that has a

[1] Angola, Bahamas, Bahrain, Barbados, Benin, Botswana, Burma, Burundi, Cape Verde, Chad, Comoros, Congo, Cyprus, Yemen, El Salvador, Ethiopia, Fiji, Gabon, Bambia, Guyana, Haiti, Jamaica, Jordan, Kampuchea, North Korea, Kuwait, Laos, Lesotho, Liberia, Malawi, Mauritania, Mauritius, Montserrat, Mozambique, Niger, Oman, Panama, Papua, Qatar, St. Kitts, St. Lucia, St. Vincent, Samoa, Sao Tome, Seychelles, Sierra Leone, Surinam, Swaziland, Uganda, United Arab Emirates, Upper Volta

[2] Algiers, Argentina, Bangladesh, Bolivia, Brazil, Chile, China, Costa Rica, Cuba, Egypt, Guinea, India, Indonesia, Iran, Lebanon, Mexico, Morocco, Pakistan, Peru, S. Korea, Senegal, Sudan, Thailand, Togo, Turkey, Uruguay, Venezuela, Zaire

national system has more people involved in such promotion than the ones that do not have a national system. The role of national STI systems in provision of products and services may not be as great and significant as in promotion of the recognition of STI in general.

2. Subject oriented STI systems are those that are covering a given subject traditionally recognized as a scientific and/or technical area of activities or research. There are generally four broad such subjects in which systems have been established in a number of LDCs:

1. agriculture and related areas
2. health sciences
3. nuclear energy and other energy forms (e.g. petroleum)
4. environmental sciences

These subject systems have a greatly emphasized international orientation, primarily because they have been instituted with assistance of some international agency dealing with that subject. They are also assuming, as are national systems, a missionary role in relation to their clienteles and government administrations in their areas. They are also a significant source for education and training of information professionals, including usage of information technology.

It may be of interest here to draw a comparison between subject oriented systems in developed countries and LDCs. In developed countries, as a rule, we will find fewer national systems, but more subject oriented systems and in many more subjects. Every area of science and technology will have one (or more) information systems devoted to it (e.g. chemistry, geology, physics, engineering, biology, metallurgy, etc.). In LDCs there are no counterpart systems in most of these subjects. The subject systems in LDCs are limited more or less to the four subjects mentioned. This may be the biggest difference between developed and developing countries in regard to systems for STI.

3. General industrial information systems have been established in some 30-40 LDCs. It is hard to establish the exact number because of great variations in organizational patterns of institutions and ~~universities~~ ministries devoted to industrial development.

The nature of industrial information systems is quite different than the nature of national or subject STI systems, reviewed above -- starting from the type of information collected to the type of services provided. The variation in form, organization, services etc. among industrial information systems in LDCs is much greater than the variation among national or subject STI systems. There is no one general pattern for the industrial systems. One often found variation is where such an information system is located within an industrial development (or research or promotion) institution and it provides information services closely connected with the industrial development services of the parent institution; the most advanced form of this is provision of industrial consulting together with information services. Another variation of such service is to provide answers to planners or industrialists to questions arising in their activities, often only in terms of referral. Many industrial information systems are also found that are "buried" in some ministry or similar high office.

Here are some problems often voiced in relation to such general industrial information services:

... they are attempting as are their parent institutions a broad industrial coverage, but they are ending up supporting only a select number of larger industries

... they are not effective in technology transfer, particularly not in relation to appropriate technology

... they provide too much bibliographic and referral information and too little direct and simple answers to questions or

information in repackaged (scale down, synthesized) form

... their power of assessing the accuracy, value etc. of information is low, including assessment of reliability of industrial contacts.

Although these criticisms are voiced often, there is also a realization that there is relatively little that any industrial information system can do about it. Namely, it seems that the charge or expectation of these systems in LDCs is to provide information that in the U.S. will not be obtained only by querying information systems, but much more by doing market research, laboratory testing, industrial research and the like. In smaller developed countries such as Denmark and Canada, that do not have the capacity to do market, laboratory and industrial research at a scale of U.S., their industrial information systems tried to resolve the problem by having experienced engineers doing the information work, rather than information specialists; they also instituted very close personal contact with industrial personnel and face-to-face communication as an information service. Thus, in a number of LDCs (particularly from Latin America) was voiced the opinion that models and methods of industrial information systems in Denmark, Canada and other smaller countries are much more relevant to their needs than the methods used in the U.S. For instance, the quite successful industrial information centers in Mexico (INFOTEC/CONACYT) and Equador (CENDES) were started and run by engineers -- they became a model for establishment of similar centers in Latin America.

4. Sectoral industrial information systems are devoted only to one class of industrial products or services. Information centers can be found in LDCs related to:

leather; fisheries; metallurgy; paper and pulp; textiles; food and food technology; machine tools; mining; rice; small enterprises; chemical technology and chemistry; and in a host of other areas.

For instance, the Asian Institute of Technology in Thailand operates international information centers on: (i) geotechnical engineering, (ii) renewable energy, (iii) rural sanitation and (iv) ferrocement [53]; the last one is an interesting case because it was established in 1976 on the recommendation of the U.S. NAS Advisory Committee on Technological Information which identified ferrocement as an overlooked labor intensive intermediate technology material with wide potentials, particularly for rural areas.

The advantages often cited of these sectoral systems include the ability to better analyze the users and better concentrate on the satisfaction of their needs. Although they are being strongly promoted in the literature, there is no evidence that the number of such centers is large (in comparison to the number of other systems discussed above) or that they are being established at a high rate. It seems that the need for such centers is there, but the relatively small number of users and uses prevent larger investments.

2.5 National Plans and Policies for STI

One of the ideas and recommendations that is constantly recurring in the literature (particularly in reports to or from international organizations) is about a need to establish national plans and policies for STI activities. Every international agency or organization made and supported recommendations to that effect and many agencies provided assistance and guidelines for such activity. UNISIST in particular was, and still is, active in the area of national policies; there were many consultants sent to different countries on this topic. Even U.S. authors and agencies made such recommendations many times, despite the fact that U.S. itself does not have, nor is it likely that it will have in the foreseeable future, such a policy.

Although the recommendation was made so often and so strongly very few countries made an effort to draft such a plan or policy, fewer to officially adopt it and even those that did so made no effort to enforce it. There is little or no grassroot care for or against such a policy by information scientists, librarians and information users. Practically no mention about national STI policies can be found in the literature stemming from these two constituencies. It is not clear if they consider the issue irrelevant or if the consciousness about national STI policies is very low.

The list of countries that actually have a separately stated national STI plan or policy is low.[1] There was no evidence or discussion published on the effect of these policies where they exist, on the provision of STI services.

However, a number of countries have incorporated some or other aspect of STI in their general developmental plans. It seems that often a confusion exists between policies for: (i) science and technology, (ii) STI, (iii) information in general.

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[1] Bolivia, Brazil, Ghana, India, Indonesia, Mexico, Nigeria, Taiwan, Venezuela.

A need for STI plans and policies is widely perceived; an orderly STI development needs a clear policy, but it seems that many STI activities of a high order are also occurring without specific STI policies. The biggest obstacle to derivation and implementation of STI policies was listed as the absence in many LDCs of adequate functional and integrative relationships between firms, ministries and institutions dealing with STI.

3. AVAILABILITY OF STI

3.1 Overview

In order to be eventually utilized information has to be first available and second accessible. This section deals with the perceptions in LDCs about the needs and problems related to availability and the next section deals with accessibility.

This breakdown into availability - accessibility - utilization parallels the main functions of any and all information systems, including libraries. It is important to divide the discussion in this way in order to be able to understand the nature of classes of different problems that require solutions of their own. However, in the literature It is not usual to divide the discussion of problems in this way, nor does any other classification of problems exist. It is usually found that all kinds of problems are all discussed and dumped together and in itself this presents a major problem of sorting out.

Availability is defined here as involving and depending on three factors:

1. Definition of information that is desired and needed as to subject, type, level, language and other characteristics. In a practical sense this should result in criteria for selection from the mass of existing literature, criteria that are needed as the base for input; it may also result in criteria for creation of some specific literature or of repackaging of information
2. Selection of information and/or literature from all that is available. These are the decisions on which specific items, how many items are to be included in a given information system (or in a locality, country, region etc.) in accordance with (i) criteria and (ii) available resources.

3. Acquisition of information and/or literature that has been selected for inclusion, meaning obtaining physical possession of documents and other items where information is recorded.

3.2 Definition of Needed Information

3.2.1 On the Rationale for Definition

What information is needed in relation to development? It is, of course, a key question, because the answer will determine the contents of files and services of information systems. The rationale for the answers found in the literature from LDCs is generally one of experience, common sense and opinion. These are effected by aspirations and concepts of what are the developmental goals and what is development all about. These are also affected by the currency of international drives (for instance, at present the topic of appropriate technology is very much on the agenda, which spurred discussions of appropriate information).

Opinions on the subject, type and other characteristics of information needed were voiced very frequently, over a long period of time and by all the constituencies involved in STI. It is the most often discussed topic in the literature. Many items in the literature had thoughtful and thorough discussions coupled with presentation of some data for the support of conclusions. But it also should be mentioned that many opinions were voiced (particularly as reported in surveys by international consultants) by people who according to their titles have no direct connection with either information processing or use in the subject commented about, and without evidence for their conclusions. At times one gets an impression from looking at the literature that everybody is an expert on this topic.

Another striking aspect that emerges from surveying the literature is the paucity, ~~vague~~ nay absence, of studies (in the scientific sense of the word "study") on the information behavior and needs, and other characteristics of potential information users, which studies were aimed at definition of needed information and/or literature; or studies on the subjects, characteristics and behavior of literature itself that may help such definitions. Thus there is a dire need

for conduct of scientifically based studies that will help define information needs in given developing countries.

One other thing should be underscored. There is little direct connection between the many discussions on the definition of information needs and a follow up in terms of actual implementations in the form of information systems and services for these needs. Rather, the discussions are aimed at creation of a concensus to be used for action.

3.2.2 Categorization of STI

It was widely recognized in the literature that there are a number of different categories of STI and that each of the categories has a different utility in the process of development.

Many perceptions on the division of STI in certain categories according to development needs have been brought forth. Here are some of the more typical and reoccurring breakdown of categories:

1. In terms of levels of information needed for LDCs a distinction was made between:
   - Policy and management information, enabling decision on choices of alternate strategies and an increase in negotiation capabilities
   - Scientific and technical enabling learning and technical decisions
   - Operational information enabling production and services
2. In terms of necessary knowledge a similar distinction as above was made between:
   - Know-why information (more scientifically oriented, generally readily found in the literature and easily transferable);
   - Know-how information (more technically oriented, not so readily found in the literature, may need repackaging, harder to transfer);

- Show-how information (operational training, maintenance etc., not found in the literature, needs creation, repackaging, hardest to transfer)

3. As to STI resources an often made distinction is between:

- Formal information resources: the open literature including report literature and the infrastructure associated with it: libraries, abstracting and indexing services, data bases etc.
- Informal information resources: personal contacts, consultancies, "invisible colleges", meetings, training sessions etc.
- Specialized and negotiable information resources: patents; licences; data on industrial processes and products; operational information; marketing surveys; statistical information; and other information not readily available in formal resources. Great stress is often made on the importance of this type of information for development purposes.

4. Distinction is sometimes made between information for different levels of users, such as STI information for:-

- scientists, engineers
- business managers, industrialists
- administrators, policy makers
- extention workers
- semi-educated persons
- illiterates

These various categorizations are not contradictory, but they do illustrate different concerns and conceptualizations. In order to recount some of the more common themes that are evident from the mass of literature on this topic, and particularly from reports in preparation for UNCSTD, we shall discuss next the perception of information needs in three areas:

1. Scientific information
2. Industrial and technological information
3. Policy and decision making information

3.2.3 Scientific Information

When it comes to discussions of STI in LDCs the "S" is very small and the "T" looms very large. There can be found little discussion about the needs for information and literature strictly scientific, particularly about literature from basic science. In some reports a stance is taken that basic research (at times this means scientific research in general) is not an affordable activity of LDCs, thus literature on these subjects is not of direct interest to information needs.

In the discussions on information needs one can also find biases directly negative or even hostile to scientific literature. At times the literature is viewed as simply "academic" and inappropriate to needs. But at other times the hostility is a consequence of a dissatisfaction with the results of development achievements in some LDCs, where science played a role in the growth of some areas. For instance, the report "Impact of Information Services on National Development" from India [5] discusses the

> "...negative aspects of education in science that...resulted in several distressing aspects like brain-drain, frustration among all sections of technical people, underemployment and unemployment. ...Science as it is now practiced seems to have no influence on the life-style of over 80 percent of the population. This obviously is because of the fact that priorities and policies in science, are laid down by the 20% of the people who are actually in the field of science and even these people are guided by their counterparts in the more advanced countries. [The report then recounts the science based achievements in India in nuclear energy, communication, space research etc]...Amidst such outstanding achievements of science, we see conditions of appalling poverty with millions of people living in conditions which can hardly be called habitable. One frequently asks the question if science, and more particularly technology, has failed in its objective of social utility. ...High sounding theories are aired, more to win recognition in the academic field than to seek solutions to the piling problems of backwardness, squalor and malnutrition...Undoubtedly scientific excellence has been achieved in several areas but there has been no meaningful impact on...the quality of life of common man...on industry [and] industrial research in India [which has] apparently failed to deliver the goods."

This passage is a characteristic reaction to scientific achievements in a number of LDCs. The scientific priorities are questioned and with them the scientific information and literature. The mentioned report provides, in addition, a number of statistics and further analyses of the areas of problems, such as health, agriculture, small industry (in this substantive analysis it is rather uncharacteristic) and then in the recommendations about STI information it unfortunately does not go beyond general suggestions that proper information should be provided to various segments of population from scientists and managers to illiterates (and in this type of general conclusions it is rather characteristic of many other similar reports and articles).

But the perception that all is not well with science, and thus with scientific information as applied in LDCs is coming through very loud from many countries. Unfortunately, the perception of what should be replaced in terms of scientific information is as yet so general, that it is fairly useless for practical action.

When it comes to areas of health sciences and agriculture-related sciences the stance is not as negative or harsh. To the contrary, these are areas of concern, thus ~~it is~~ scientific information in these areas is perceived as very necessary and desirous. However, as for many other subjects, it is being advocated that a relevant proportion of this scientific literature should be scaled down, translated, to the level of understanding of a mass of people. Popularization of science is being called for, primarily in these two subjects (health and agriculture), as well as in a number of other subjects

It is also of interest to note that scientists (especially leading scientists) in LDCs are by and large bypassing STI activities in their own countries and are "plugging" themselves directly into the mainstream of global scientific communication channels. Their best works are published in international scientific journals, they attend international conferences of their peers, belong to "invisible colleges"...and in general behave in relation of

use and communication of scientific information in much the same way as their colleagues in developed countries. The biggest complaint about STI resources emanating from scientists in LDCs is a lack of good library resources, particularly in relation to scientific journals. More direct contacts between scientists from LDCs and those from developed countries are being urged in many items in the literature (trips, fellowships, research exchanges etc.). Programs such as Fulbright are in great favor.

3.2.4 Technological and Industrial Information

This is the area that attracted the most discussions and recommendations from LDCs. It reflects the great concern with industrialization and technology application as the backbone of development. However, the perceptions of what particular information on these subjects should be included vary according to:

... the level or stage of development of a country

... the conception of what should be the direction of technological and industrial development

... detection of flaws in the previous applications of technology and industry in development

The countries that are on the first (pre-industrial) and second (beginning industrialization) level of development perceive their information needs in much more basic terms than in more developed countries. What is understood by technological information is considerably different from what is understood in more developed countries and has almost no relation to the understanding in the U.S. Such basic information is much harder to provide and it requires efforts in mass education, basic technical training, and the like, rather than just provision of printed materials in any form. The perceived needs for technological information and for training and education are inseparable. This

comes through from many reports. Rather then to recount them, here is provided an illustrative example: (from: A Study on the Application of Scientific and Technological Information in Development - Field Study in Tanzania)[18]:

> "This example should be cited here since it illustrates clearly the importance of technical information for the productivity of a unit and the survival of an industrial entreprise. These two factories, [(for sisal and kenaf)] members of the National Textile Corporation (Texco), were installed by an Italian firm. The sisal factory was completed in 1968/69 with an initial cost of 55 to 60 million shillings and the kenaf factory in 1972 with a cost over more than 20 million. Instruction manuals for the operation and maintenance of the machines were furnished in Italian. As a result the local engineers and technicians were unable to read them and could not maintain the machines as required. Moreover they could not even work the machines efficiently or order spare parts when the necessity arose. For the last couple of years, the situation in the sisal factory is dramatic. Some machines are out of order and the others are working below capacity or producing too much waste. The losses are very heavy and Texco has requested the assistance of a foreign expert for a diagnostic study. The consultant visited the factory and noticed a visible lack of management, technical expertise, supervision, maintenance, control and safety measures.
>
> The kenaf factory has encountered fewer problems because the machines are not so old and the processing of kenaf is an easier operation. For maintenance purposes, they have succeeded in finding someone in the region who knows enough Italian to assist them in reading the manuals. According to the manager and his senior technicians, there is little need for information other than that required for maintenance. However, they will be interested to purchase more books and magazines if they are provided with a list of relevant titles. [redacted] appears that no one in the factory knows how to get this information. The chief-engineer, newly appointed, expressed the need for some books and magazines on mechanical engineering and said that he had written to some publishers for bibliographic information.
>
> ...The need for information on research and development activities is more understood by those involved in industrial operations based on evolutive techniques like chemical processes. This is the case, for example, in the tanneries and to a lesser extent, the textile company for dying and finishing operations. One senior technician in the tanneries mentioned that relevant references and abstracts are often found in the few magazines they receive on leather technology and chemistry but, he and his colleagues do not know how to get the original articles with the present restrictions on foreign exchange."

To underscore: three elements that are treated as separate problems in the U.S.: (i) general education, (ii) technical training and (iii) technological information are all perceived as one problem of technological information in many LDCs, particularly in the countries on the first two levels of development.

The countries on the third (relatively advanced industrialization) level of development perceive their needs in technological and industrial information in relation to a number of different concerns:

... creation and extention of technical know-how;

... development of new industries and/or new products; diversification of industrial areas;

... increase in the efficiency of production;

... increase in industrial employment;

... assistance to small industry

One of the failures of a number of developmental efforts in countries that are on the beginning or relatively advanced stage of industrialization relates to the import of advanced technologies and/or ready made and installed ("turnkey") factories. These were proven to be often:

1. beyond the capacity of a country to absorb and integrate in a profitable manner (thus becoming "sick industries")
2. above the level of technical expertise of the available broader work force (thus becoming operable at a low level of production or inoperable) and
3. highly capital intensive and not enough labor intensive (thus draining the resources but not creating desperately needed jobs).

To counter these failures the idea of appropriate technology was developed. Within the past few years this became a pivotal concept in international discussions about science and technology, warmly embraced and promoted by most, if not all, LDCs. In many countries it also became a central thrust for reordering

national priorities in industrialization. It was also seen as a way to provide developing-developing links, and reduce the dependency on highly developed countries.

Alongside the concept of appropriate technology emerged the concept of appropriate technological and industrial information. There is hardly any present day discussion on STI in LDCs that does not have at least some reference to needs for appropriate technology and appropriate information. This is a present day central theme of discussion on STI, a theme that became central only within the last 2-3 years and that is very much present in recommendations for UNCSTD. Being this new, the theme of appropriate information is not yet well conceptualized and it means many things to many people. The range of meanings include:

... on one end of spectrum, the meaning is technology and related information oriented toward the poorest people and the uses of local — resources -- small scale; labor intensive technology designed to meet basic needs and raise productivity [e.g. 9. 5, 15]

... related is the notion of "museum technology" i.e. technology used in developed countries when they were at stages similar to LDCs; suggestions are made for searching of museums and synthesis of finding

... on the other extreme is the view that thus is information related to technologies a country would chose given as wide a range of choices as possible; in this case the task of promoting appropriate technology is that of widening the available spectrum of technologies of all sorts and of information about them [e.g. 54].

One integrating definition suggests that appropriate technology is [23]:

1. In terms of resources, it is technology that is intensive in use of abundant factor, labor, economical in use of scarce factors, capital

and highly trained personnel and intensive in use of domestically produced inputs.

2. In terms of scale: it is technology that is small scale but efficient, readily replicable, operated, maintained and repaired, low cost and accessible to people and enterprises with low income.
3. In terms of compatibility it is technology compatible with local cultural and social environment.

However, the problems and obstacles in obtaining appropriate information are considerable simple because it does not exist, most of the time, in readily available form. Thus discussions encompass needs for:

... Generation of information materials for development problems which are identified but for which scientific solution are not fully available

... Repackaging of information (synthesis, translation to a language and level) to directly relate to technology adaptation and use, particularly on a local level

... Screening and evaluating technological information; provision of technology assessment information

... Reduction of technological dependency*; e.g. provision of maintenance information on the level of maintenance personnel

... Importing information on successful technology applications from other LDCs

... Emphasis of information for small scale industries, together with help in defining their technological needs/opportunities; stress

*A Brazilian definition of technological dependency is when an assembly line which has been in operation for some time breaks down and a "little old man from Preoria" has to come and fix it.

on small scale technologies and connections with small scale industries in developed countries (a connection which does not exist, as a rule, the usual connections are with large industrial enterprises).

... Emphasis on provision of "information and answers" vs. "documents and references"

... In relation to rural needs, the emphasis to be on information suited for segments of the population, as yet largely unserved, particularly extention workers, semiliterates and illiterates*

... Use of unconvential channels for distribution of information -- radio programs, films, picture books, illustrated manuals etc.

The evident theme here is a desire to increase the absorptive capacity in a number of potential users by gearing information in direct relation to their levels, needs, tolerances; to make non-users into information users; and to try new avenues of approach, as shortcuts to development.

It is realized (but in very few reports) that the greatest obstacle to the implementation of ideas on appropriate information is that it is not readily available in the scientific and technical literature. It has to be created, and in itself, this is a monumental task. This idea does not include only distribution of what exists, it incorporates creation.

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*This includes emphasis of information in areas such as: soil preparation; conservation; fertilizers; pesticides; traction power, including plows; improved seeds; use of agricultural waste; water managements; tools, implements; animal husbandry; forestry; wildlife; fishery; beekeeping; handicrafts; housing; sanitation; health; transportation, etc. [5].

A criticism of the concept of appropriate technology is that this means inferior technology - one that will keep LDCs locked permanently in a low stage of development and permanently dependent.

In a way, quest for appropriate technology and information is also a rejection of the previously popular models for development stressing building of heavy industry as a base of development and achieving development in large quantum jumps.

There are also views that developed countries are not willing to provide appropriate technology and information because it is in their interest to continue to provide expensive large scale technologies and finished products and to prolong the dependency of LDCs.

3.2.5 Policy and Decision Making Information

As the discussions of STI for LDCs began some 15-20 years ago, it was conceived initially that the main thrust is toward bibliographic information in sciences and engineering proper. This was expanded some 10 years ago to include the social sciences and the numerical data from sciences and engineering. Then it came to another expansion of the concept to include technological data, industrial data, etc. as discussed in the previous section. Most recently another expansion occured to include data, information, documents that are of direct aid to making policy decisions, from decisions on general strategies, to decisions on specific purchases among alternatives, to decisions on marketing of products/services, to choices for specific designs. This is for use for a wide range of decision-makers: from politicians and ministry officials to managers in banks, business and industry, to industrial designers, to plant engineers.

The range of the type of information that is mentioned as required for this area is very, very wide, for instance it includes information related to:

1. Business and management information: financial and commercial data; names, addresses, volumes, reliability of firms in given sectors; productivity, inventories, resource distribution etc.
2. Marketing information: markets, products, forecasts, costs and pricing.
3. Negotiable information: licenses, patents, consultancy assessments.
4. Design information: standards, specifications, blueprints, industrial catalogs, regulations.
5. Operational information: maintenance and repair manuals; replacements; process specifications and guides.
6. Laws and regulations: international and in various nations.

Often mentioned are desires to provide:

... Analysis of such information and particularly to assess its value and appropriateness

... Reviews on various topics (e.g. of existing technological processes and associated hardware) with a clear and quick presentation of relevant elements to permit informed choice of the more appropriate technological alternatives

... Assessments of future primary and secondary impacts of technologies before its application to improve present decision making

... Information aimed at increasing negotiating capabilities including information from other LDCs to their negotiations, prices achieved etc. (stressed very strongly by Latin American countries).

One view gaining in popularity is that arbitrary limitation of information to its bibliographic form or to information in predetermined fields of human endeavour have "lost meaning" and that to plan STI systems at the national level solely for the transfer of bibliographic information has "become anachronistic"[34].

In terms of the U.S. practices and divisions, this means inclusion of management information systems, business systems, patent and licensed registry systems, financial information systems, market research and marketing systems, and the like, into the universe of STI.

Again it should be stressed that such information is not readily available, in any literature, but this point is very rarely mentioned. Such information requires extraction[1] and even generation, which while clearly possible will require commitment of resources and expertise on a much higher level than it is presently commited to STI activities anyplace.

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[1] In the U.S. such information is often extracted, synthesized and provided by various business information services (such as Predicast Inc.) and is accessible for on-line searching via vendors such as Lockheed. Many aspects of STI information explained here would classify as business information in the U.S.

3.3 Selection Problems

The discussions of the problems of selection and of acquisition emanated almost solely from information scientists and librarians -- people concerned directly with the practical issues in running information systems. These are operational problems and already relate to building of information infrastructure. It was widely recognized that selection and acquisition present severe obstacles to successful operations of libraries and other information systems in LDCs.

The modern worldwide problem of selection of materials for scientific and technical information systems stems from the very large amount of scientific and technical literature available in the world. And as the amount is growing at a high rate (the phenomenon refered to as "information explosion"), the selection problem became acute and it is getting worse. The reason is that the rate of growth of ST literature is much higher than the rate of growth of resources of libraries and other STI systems. The crunch is felt not only in LDCs, but also in U.S. and other developed countries, where many efforts (resource sharing, automation, networking, research on utilization for decision making etc.) have been initiated to counter the situation. Similar efforts cannot be as yet found to any larger extent in LDCs, although librarians and information scientists from many LDCs showed in their writing an awareness of the need for similar resource sharing efforts [e.g. 32].

The scientific and technical literature is growing at some 7% a year, thus doubling every 14-15 years. The major contributors to this literature, up to about a decade ago, were the developed countries (U.S. and USSR in particular). However, more recently the percentage of contribution from developed countries is falling off, but the contribution of literature from developing countries is rising, [evident from a number of studies by D. J. de S. Price and E. Garfield]. The growth is still 7%, but the contributors are divided differently; here we

can clearly observe one of the rising effects or indicators of development. However, if impact of literature is measured with the relative amount of citations that an article or journal receives, then it can be seen that the highly recognized journals from developed countries still have the highest rate of impact.

The increase in mere quantities of publications does not have a direct relation to quality or impact of such publications. But it does make for even more difficulty in finding and selecting the qualitative items in all that mass of quantity. Discrimination is ever harder, and ever more necessary, because there simply is no money for indiscriminate selection. Some information scientists and librarians in LDCs are displaying a high degree of awareness of this problem as seen in their discussions, but others are not (as seen by the lack of discussion on this problem). The recognition of this quantity/quality problem is not universal.

The discussion of the problems of selection of appropriate STI also centers at times on the problem of translation and even creation of such information (as remarked previously). Namely, it is being noted that users in much of the available literature cannot be used because it is not in the language and/or on the level of the potential users. To cope with problems of different languages many countries and information systems instituted translation efforts, but because of the very high costs in relation to relatively low use, the translation efforts are not wide spread. Thus translation is very often listed as one of the major problems for which no satisfactory solution has been found as yet. As more countries are producing their own literature, the language and translation problem is increasing rather then decreasing. This factor is also seen as an obstacle to furthering developing - developing links.

As to creation of appropriate literature the difficulties are even greater, much greater. Some libraries and information centers in LDCs found themselves

in position of writers, rewriters, synthesizers, popularizers and publishers of literature -- a role for which they are not well suited. Calls were made for organization of special departments in information systems or even special institutions that will deal with creation and publishing of appropriate literature, while the information systems then will organize and disseminate it, as is their traditional function. The relations between information systems and publishers in LDCs are not close, which pose still another problem. It should be noted that there are no calls in U.S. or other developed countries for libraries and information systems to assume a role of a rewriter and publisher ~~role~~ in the above sense.

A further problem in selection often voiced pertains to the inaccessibility and lack of tools from which selection can be made; tools such as book and journal lists and reviews, publisher catalogs, union lists, announcements, indexes of technical reports, etc.

An often mentioned approach to selection problems is cooperative selection, or distributive selection; the idea is that a number of libraries or information systems in a country or a region should cooperate in parcelling the selection, making sure to minimize the unnecessary duplication and spread more widely the coverage. Unfortunately, such ideas have rarely been put to effect. It is often lamented that the situation is often just the opposite and that the degree of cooperation among information systems and libraries, even in a given city, is very low. This lack of cooperation is found in relation to many other functions, not only to selection.

But above all the problems related to selection, loom the complaints about great disparity between the available resources allocated for selection and the available mass of literature from which to select.

3.4 Acquisition Problems

Acquisition pertains to ordering and obtaining the physical copy of a document; this is often referred to as "document delivery," "document procurement" etc. Being so tangible, the problem received a great deal of discussion. Excerpts from a paper on the problems of acquisition of biomedical literature in Nigerian libraries is quite illustrative of the problem in general [12]:

> "Tight budgetary and administrative controls give them [libraries] little elbow room in the acquisition of the materials they need. The journals more then books present the greatest amount of problems.
>
> ...Delay in transportation, [cause] delay in receipt of the journals from publishers. . .Orders take four to six months to be serviced...because of surface mail, as air freight would raise the total cost of the subscription far out of proportion to the library's budget for journals. Journals are lost in transit... poor postal service.
>
> ...Delay causes inability to claim missing issues of journals... because publishers demand that claims be made within sixty to ninety days. . .Overpaying for the missing copies when reordering [i.e. they are paying twice].
>
> ...[Because of such losses] gaps frequently occur in the collection.
>
> ...It takes as long as four to six weeks to get a photocopy [from a U.S. or British library]...minimum of eight weeks from continental Europe or Eastern Europe.
>
> ...Lack of competent book dealers in the country.
>
> ...A few biomedical periodicals published in Nigeria...are even more difficult to obtain from publishers than journals from abroad."

Beside the chronic lack of resources the problems of acquisition are miriad and generally out of the realm of influence of information systems themselves; problems such as this are listed:

... Currency restrictions in many LDCs, that gave low priority for foreign exchange funds for STI materials.

... Inadequate postal services as one of the general problems of infrastructure.

... Inadequate telecommunication services, domestically and internationally for direct contacts.

... Inadequate attention to special problems of acquisition in LDCs by publishers, book and journal dealers and other agencies providing physical copies of documents in developed countries

... Copyright restrictions related to copying of materials (including problems of fair copy use vs. pirating)

... Photocopying equipment and services within LDCs and obtaining photocopy services from developed countries

... Administrative obstacles in ordering and purchasing; an excess of bureacracy in procedures

... Ever increasing costs of publications, which are growing at a particularly high and prohibitive rate

... Very low degree of success in plans for exchange of publications

... All the problems cumulatively causing considerable scarcity of current publications

Many international efforts to ease these problems have been launched, but with rather limited success. Many calls are made for more effective schemes in solving the acquisition problems; considerable assistance from developed countries is expected.

At times some of the acquisition problems are viewed as restrictions imposed on LDCs and as a form of exploitation (this is done without consideration that these are general restrictions, and that many of the problems are internal to given LDCs).

At a different level the problem of acquisition is being intensified with the introduction of bibliographic and other data bases, with on-line or batch access to such data bases and with general wider accessibility to indexing and abstracting journals. In relation to specific questions by users search of such data bases or indexing journals provides the users with citations of documents which at times seem exactly what is wanted. But where to get the actual document? The

"hardcopy" delivery causes considerable user frustration. In countries that have some backup in library services the problem is eased, but in others where there are no adequate library collections in STI the problem is intolerable e.g. in Equador the Industrial Development Center (CENDES) offering information services to industry (among others a current awareness bulletin) has to "send abroad 100 percent of its requests for copies of articles from primary journals, patents, specifications etc. . .[because the] corresponding library facilities in Equador are totally inadequate" [4]. The introduction of modern and computerized information approaches in LDCs brought home very vividly the necessity for adequate and corresponding STI library resources. Introduction of computer services without library backup is seen by some as counterproductive in that it raises users' appetite and with it the frustration in not satisfying the appetite, thus turning users away from information services.

As mentioned, the amount of STI materials published in LDCs is increasing at a high rate. It may be of interest and somewhat surprising to note that in many instances the information scientists and librarians in LDCs are reporting that they have considerable difficulties in obtaining their own native STI materials; sometimes the difficulties are greater than in obtaining the materials from abroad.

3.5 Awareness of Available STI Resources in the U.S. and Economic Considerations

It is widely recognized in LDCs that the U.S. is the principal country in the world in terms of STI resources. The export of journals, books, indexes, data base services etc. from U.S. to LDCs is sizable, particularly to countries on the level of relatively higher industrialization. E.g. the number of international subscriptions to U.S. journals rose from 7.1 mil. in 1960 to 17.2 mil. in 1977 [8]; a good proportion of this rise was in LDCs. According to every citation study, the U.S. journals receive the highest number of citations, worldwide, indicating their use. There is no major scientific/technical library in LDCs, without a sizable proportion of its collection being U.S. materials. In general, there are many indications showing a relatively high rate of acquisition of U.S. materials in LDCs.

Realizing the need for awareness of STI resources in general, UN agencies commissioned studies that resulted in directories or handbooks of STI resources and approaches [e.g. 1, 13, 27].

A number of other international directories, handbooks, bibliographies of bibliographic guides (e.g. UNIDO series on industrial information) and similar listings appeared over the years, all proven to be very popular. Most STI resources listed in these come from the U.S. Recommendations were made to have more directories published and in more specific subjects. A number of particular recommendations were for making an easier access to: (i) names and addresses of individuals, enterprises and agencies in the U.S. to whom can be written about specific requests for STI resources, documents or answers to questions and (ii) photocopying services for specific journal articles, technical reports and other STI materials. Photocopying in particular is a sore point with many information systems.

However, not many specific discussions of STI resources in the U.S. can be found in the literature of LDCs or (besides the mentioned directories) in the reports/recommendations of UN and other international agencies. There is no discussion on how widespread and how specific is the awareness of U.S. resources. From personal observation and discussions, I can conclude that the awareness in LDCs that U.S. is the major supplier of STI in the world is very high, but the awareness of the specific resources (e.g. names of specific journals, indexes, statistics, business information sources, patent listings etc.) is very low in general. It is not even very high among librarians and information scientists. The lack of specific knowledge of the existence and names of specific STI resources is one of the ~~great~~ higher obstacles in utilization of U.S. STI resources.

Marketing of U.S. STI resources in LDCs by U.S. firms and agencies is at a very low level and very sporadic. For instance, only recently did NTIS (National Technical Information Servic) started organizing outposts in Latin America and providing promotion material in Spanish. Some data base services (NLM, Lockheed, SDC) showed some interests toward LDCs, but in no way as much as toward developed countries (e.g. National Library of Medicine (NLM) has bilateral agreement for MEDLINE services with 10 countries -- two of them LDCs -- and with Pan American Health Organization (PAHO) for Latin America). Publishers showed also relatively little interest toward marketing in LDCs. More marketing, more marketing materials in local languages are urged.

High costs and lack of foreign exchange are cited most often as a barrier for higher use of U.S. STI resources in LDCs. These costs are often considered as exploitative. Suggestions were often made that STI should be shared with LDCs free, or at greatly reduced costs -- this is also urged in UNCSTD reports. There is no particular discussion of the economics of information, nor is there any good understanding

about what elements enter into economic considerations, such as costs, price, value etc. (It should be mentioned that there is no consensus on these matters in the U.S. either, despite many discussions). In the U.S. there are many cost/benefit discussions related to STI services, such discussions cannot be found in the LDCs literature. In some papers there are mention of information as a reusable commodity and of information systems as utilities [e.g. 34]. In the recent suggestions and calls for appropriate information, repackaged information, business information etc. there are no economic considerations present; there seems to be no awareness at all of the associated economic aspects (costs and cost/benefits in particular). In general, there seems to be a surprise at the relatively high costs for STI resources and for STI systems and services, and even a resentment at these costs.

In general, in supply of technology U.S. has many competitors, but in supply of STI resources and in supply of tools and procedures for handling STI (as discussed in the following sections) U.S. outdistanced its competitors by far. It is in knowledge, expertise and information for science and technology that U.S. excells, not necessarily in technology alone, in which many countries have an excellent production. LDCs show an awareness of this. This may be a factor in considering U.S. policies in relation to STI for LDCs.

4. ACCESSIBILITY OF STI: A BASIC ASPECT OF INFORMATION INFRASTRUCTURE

4.1 Overview

In order to be eventually utilized, information has to be not only available at some place or other, but it has to be physically accessible to users. To provide such accessibility information systems intellectually organize materials in some fashion, house it some place and provide dissemination services. In more recent times information technology has been utilized for these functions. Also, various information networks have been built to increase both availability and accessibility; at their base these networks have a concept of resource sharing.

These aspects have been of great concern to librarians and information scientists in LDCs, quite naturally because it is the backbone of their professional activities. The importance of the activities related to accessibility lies in the fact that they are a basic aspect of information infrastructure -- without them there would be no utilization. Selecting and acquiring information is just the first step in the chain of information transfer -- however, this is often not fully realized either by policy makers or even users. For this reason there is much more discussion by the officials of what type of information is needed then of what type of systems are needed that will make this information accessible once it is acquired. A similar problem is with availability and accessibility of goods: it doesn't do any good if they are available in the warehouse, but not accessible to the populace in stores at their localities.

One thing that comes out clearly from the literature is that information scientists and librarians in LDCs are in a general battle for recognition of the aspects related to accessibility of STI. Almost all of the perceptions presented here come from this constituency.

4.2 Intellectual Organization of STI

Organization refers here to indexing, classification, coding, cataloging and/or creation of other intellectual forms of representation or bibliographic controls. It also refers to creation of union lists (e.g. list of holdings of journals or other materials among several information systems), and similar tools necessary for resource sharing.

In order to provide for intellectual organization, it is necessary to establish a priori scheme or procedure on the basis of which such an organization can be done. And as in the U.S., there were many discussions and perceptions about such schemes in LDCs. Tools for vocabulary control particularly thesauri, are mentioned most often as lacking and needed. Multilingual thesauri in various subjects are promoted as one of the solutions to vocabulary control problems. UN and other agencies published a few such thesauri, but there could be found no discussion on their specific applications. Subject heading lists, as another form of vocabulary control, also received considerable discussion particularly from library concerns. There were many calls for development and/or adaptation of thesauri and other vocabulary control tools that are suitable for specific situations in a given LDC. Classification schemes, the traditional library tools, have not received nearly as much attention in discussions as the vocabulary controls. This is probably a reflection of the similar U.S. trend in intellectual organization of STI, where classification is not widely employed in modern data bases.

Procedures for analysis and indexing of STI literature also received considerable attention. In response to these needs UNESCO (and other agencies) published manuals for indexing, abstracting, analysis etc. More procedure guides are requested.

Another often broached topic is standardization of schemes and procedures for handling STI. Standardization and harmonization is seen as a prerequisite for cooperation among systems. Most standardization that was achieved was simply by wide adaption of some specific practices, rather then by acceptance of international standards. However, some of the international standards (for instance for international book numbers) proved clearly to be beneficial, and more work on standards is called upon. The impression is left that the whole issue of standards, as important as it is, was approached haphazardly, rather then systematically.

Creation of tools such as union lists of holdings, is another aspect of organization that is necessary for resource sharing and cooperation among libraries and information systems. Such tools are common in the U.S., but greatly lacking in the LDCs; this is one of the reasons why each library and information system in a LDCs is usually an island onto itself. In some LDCs in a cooperative effort, union lists of journal holdings for a set of libraries were produced (usually as a prolonged and painful effort with little resources assigned to it); but the big problem proved to be updating and maintaining of such lists. Little assistance from developed countries is ever given for such efforts. Need for such tools is constantly expressed [e.g. 6].

The way things are done in the U.S. in regard to intellectual organization had great world wide impact. Many LDCs are using or adapting many U.S. approaches. For instance, U.S. produced thesauri are routinely used in many institutions in LDCs; the subject heading lists of National Library of Medicine and of the Library of Congress are used or even translated in libraries in many LDCs; procedures for coordinate indexing developed in the U.S. are now used world wide, East and West. Thus U.S. is looked upon not only as a prime source of STI materials, but also as a prime source for procedures and schemes for organization of such materials.

4.3 Housing of STI

Housing refers to the physical location and arrangement of documents and other information sources or artifacts. Characteristically, in most LDCs the physical facilities from buildings to computers for housing STI are inadequate. Although a great building doesn't make a great library, a large computer doesn't make for a good information system by itself, physical facilities are of obvious importance. The lack of adequate facilities is often cited as a great obstacle to users and to provision of a variety of information services.

Another characteristic is that in most LDCs the pattern of geographic and size distribution of libraries and information systems is very biased. There are a few larger libraries and information systems and this is it. There are no small ones. These larger systems are usually centrally located in the largest city or within some large institution, university, etc. Smaller collections of STI do exist, but they are hardly substantial, or they can hardly qualify as libraries or information systems. As a rule there is some geographic distance between the potential users and these larger systems. This distance is acting as a very effective barrier to utilization, especially in view of transportation and communication problems. These difficulties are often discussed in literature and many recommendations for dispersion or branching of information systems were made. Bringing information to where the potential users are -- is a goal of such recommendations. However, most LDCs registered very few accomplishments in this area. One of the recommended approaches to decentralization is to provide centralized organization and housing, but decentralized dissemination. For instance, one of the more successful efforts along this philosophy is the East African Literature Service in Kenya [Munn, 1973]; they acquire and process centrally a large set of journals on agriculture and related areas and first provide extention stations and

other institutions first with copies of journals' content pages and then upon request with photocopies of articles in these journals. Many recommendations were made for institution of similar efforts.

4.4 Dissemination of STI

Dissemination of STI from libraries and information systems involves a number of products and services in addition to traditional products, such as bibliographies and traditional services, such as circulation. For instance, selective dissemination of information (SDI), retrospective searches, assistance in question formulation, on-demand bibliographies, information analysis and synthesis, reference (question/answering) services, referral, photocopying, citation tracing, bibliometric analyses, etc. The effectiveness and quality of each information system depends clearly on the number and quality of its dissemination services, particularly if they are diversified to meet diversified user needs. E.g. an information system that just produces generalized bibliographies or a library that only circulates its materials provides only a fraction of possible dissemination services. Unfortunately, this is exactly the range of many information systems and libraries in LDCs -- they do little more than make general bibliographies or circulate materials (and some have very restrictive circulation policies). This is often mentioned in the literature [e.g. 5,15,25,43]

An examination of various country reports or surveys on STI systems for or by UN agencies provides a picture of these systems being much more product then service oriented [25,41,46,47]. Especially in many national information systems the resources are channeled in production of bibliographies, keyword indexes, newsletters and the like, and not into direct information services to groups or individuals on request. The value of these products to scientists and engineers is open to question; i.e. although many subject bibliographies have a value as a national record of production of national STI literature, they have little value in answering specific questions in that subject. The product vs. service orientation is at times a subject of considerable debates in STI systems and the situation seems to

be slowly changing in favor of service orientation. But the whole concept of STI systems being search oriented, which is quite prevalent in the U.S., is not prevalent in LDCs. The resources are not allocated in that direction. This, of course, is another barrier to effective utilization of STI for development.

One reason for low service orientation is a lack of proper information resources. To illustrate from an Nigerian article [12]

> "There are not very many indexes and abstracts in the libraries either, and the absence of these makes literature searches very difficult. . ."

4.5 Applications of Information Technology

Examples of utilization of computers and other technology for processing and dissemination of STI in the U.S. and other developed countries had a great impact on the aspirations of information scientists and librarians in LDCs at all levels of development (e.g. UNCSTD recommendations [39]). Computer seems to be in many writings a magic word, the expectations somewhat naive and unrealistic. In a number of LDCs (primarily at higher levels of development) computers have been applied by various national or industrial STI systems and by some libraries. In general, they did not have their own computers, but had access to a computer. The applications range from production to simple indexes, and union lists, to printing of bibliographies and catalogs, to information retrieval applications, and in at least a few instances to building of on-line systems. Thus the range of applications is the same as in the U.S., and in most instances the applications were copies of what was done in the U.S. with little consideration of local applicability.

Most applications were simple e.g. KWIC, (Key-word-in-context), indexes, which are very popular, but there was also a good number of more sophisticated current awareness services, particularly as related to INIS and AGRIS systems that provide files on which searches can be done. More information retrieval operations are hampered by the lack of files (data bases) on which to perform them. Many considerations and even negotiations were made with various data base producers for buying or leasing of their files by LDCs but very few resulted in operational systems. Getting of data bases from the U.S. and other developed countries is wrought with many obstacles and then making them work with even more obstacles. This is a matter of great disappointment and great debates. Canada had a program for LDCs to transplant their very successful national information retrieval systems (CAN-SDI and CAN-OLE), and their efforts seems to be warmly accepted; nevertheless they weren't too successful in this either [38]. The only moderate success in the data base

application areas was scored by the INIS and AGRIS efforts. Still there are great many calls for data bases and technological applications related to them. Also there are many calls for production of local, national or regional data bases.

The big problem listed all the time was software. Here the need was expressed for programing guidelines and packaged programs for all kinds of STI operations. It is in this, the software area, where the U.S. is looked upon for assistance. The computer capacities available for STI are usually greatly underutilized, primarily because of the lack of suitable software. Where the multinational companies (such as IBM) were involved in the transfer of information technology, hardware and software, these were generally more successful than any other efforts at transfer.

There were many mistakes committed in the applications of information technology in LDCs, the same ones as in the U.S. But since the professionals in LDCs have pretty much left this work to themselves with relatively little assistance, these efforts were powerful learning experiences. They may not have been successful as hoped operationally, but they were certainly successful in terms of education and experience. As a result it is quite evident that in many LDCs, a cadre of computer-experienced information ptofessionals exists ready for further developments in this area.

The apetites for applications of information technology for STI problems are very large and growing. However, a few remarks were made that in some STI areas indiscriminate application of information technologies may not be appropriate and may even be counterproductive. There was some debate on the issue of gradual evolution vs. quantum jumps in applications of information technologies, with a general inclination toward quantum jumps. Unfortunately, too often a computer is considered a panacea, which in itself is a problem.

4.6 Information Networks

Information networks are one of the tools aimed at increase of availability, accessibility and thus utilization of information. Many such networks exist in the U.S. (for instance, library networks for interlibrary loans, for cataloging and for resource sharing in general; data-bases services networks; document-delivery networks etc.). Great many calls are made in the literature by all constituencies (officials, information professionals, information users) to institute similar networks in LDCs. There is practically no set of recommendations that does not place information networks high on the list; particular stress of this is made in UNCSTD reports.

As mentioned, many international efforts were directed toward information networks [list in Sect 1.3]. In some LDCs various types of networks emerged aimed at libraries and at information retrieval. However, network development in many instances is hampered by many tangible factors, such as inadequate telecommunications and many intangible factors, such as lack of willingness to cooperate among information scientists and librarians in LDCs. The low level of cooperation or of knowledge of each others activities is cited quite often as a major problem. The talk about internal country networks is considerable, the motivation for their realization seems low. No suggestions can be found on how to increase this motivation and willingness for cooperation.

Of the networks that were realized most successful were the mentioned INIS and AGRIS efforts. In some LDCs also were realized union lists of holdings among libraries as a cooperative network effort; but the interlibrary loan networks that were to follow were not that successful.

The most often mentioned desired networks were for on-line data base services (such as offered by NLM, SDC, Lockheed, Euronet in the future etc.). A number of institutions in LDCs already are accessing some of these data

base services, particularly the U.S. ones, through telex (which is slow and expensive) or through a mode of TYMNET or similar telecommunication network. Many demonstrations of these data base services were made in LDCs, which considerably increased the apetites for access. The level of use of these data base services in LDCs is low, but it is growing steadily. Some national STI systems such as IBICT in Brazil initiated regular services for users at a fee to search SDC and Lockheed files via telex. A number of companies in Latin America (particularly national petroleum companies) made direct contracts for accessing these services. The problem of course is high fees that restrict the usage of these services only to users from the richest companies or institutions.

There are a great many expectations by LDCs that the U.S. will provide an easier access and at lower fees to data base services. There seems to be little understanding of the private (or not for profit) nature of many of these data base producers and services in the U.S. and of the ensuing economic structure of the U.S. information industry. It is not well comprehended that such a major national activity as the information industry and information networks, are by and large outside of direct government involvement in the U.S. Thus many of the expectations are directed at the U.S. government which is not always the proper party at all. Private enterprises were much more successful in establishing contacts and modes for information networks in LDCs than the efforts by U.S. government agencies.

One type of networks receiving considerable attention in LDC's are so called SDI (Selective Dissemination of Information) services [e.g. 14, 38]; these involve periodic computerized searching of given data bases (e.g. as they are updated) for answers to user questions deposited with the system. The problems involve: (i) software for computer manipulations of data bases and for searching and dissemination and (ii) obtaining or building the data base itself. AGRIS and INIS are typically established to enable SDI. UNESCO contracted with the Canada Institute for Scientific and Technical Information (CISTI) for three pilot projects in the period 1974-1976 for transfer of CAN/SDI services on internationally available data bases to Argentina, India and Mexico. An evaluation of the pilot projects showed a good deal of acceptance. The countries are continuing these projects on their own and a new pilot project was initiated in Nigeria. The encouraging results have led to measures to make the SDI packages available on a wider basis involving ~~continuation~~ merging of Canadian software and approaches with the UNESCO/ILO package called CDS/INIS. The main problems involve personnel, training, data base procurements, documentation scheduling and follow-up; of all these personnel is problem number one. The U.S. was involved in these efforts by at-cost or free provision of data bases and with little else. Since this is perceived as a highly desirable service in LDCs, it may be of great interest if the U.S. will further get involved in SDI networks in LDCs. In comparison to on-line searching services as offered by Medline, Lockheed etc. the SDI is an older development primarily started and based as a batch-mode computer operation. Little exploration was done on the relation between these two types of services in LDCs. The question is quite open: should the promotion of SDI services be continued as done in UNESCO pilot projects, or should on-line information retrieval services be incorporated or even replaced by the SDI services as they were instituted

originally? The question also involves the alternative of mounting data bases in the country and not relying on a telecommunication network or relying on data bases, software and hardware available elsewhere and on international telecommunications. It is a sensitive issue that has not been addressed, at any depth, but it certainly will come to a head clash. As mentioned, many demonstrations of on-line STI services have been made, and a degree of familiarization with these services has been achieved [e.g. 2, 7, 13]. An impression is left that it is so much easier to hook-up onto existing on-line services, than for SDI to build its own capabilities.

Considerations of networks for STI also included many aspects of hardware, software and telecommunications (generally labeled in the international parlance as "informatics" and "information technology" in the U.S.) in addition to consideration of information alone. It is quite evident that at times there is great confusion (or potential for confusion) in discussions of international networks because of this. Recently held Intergovernmental Conference on Strategies and Policies for Informatics (SPIN, Aug. 28-Sept. 6, 1978) was attended by 76 Member States of UNESCO, and demonstrated both, a great interest in establishment of networks and a wide range of interpretations on the meaning of network, and in consideration to what is involved in networking. Expectations as reflected in recommendations cover also a wide range of topics, including desired action in the areas of [e.g. 8]:

... National strategies and policies for informatics

... Education and training in informatics

... International cooperation in informatics

... Transborder data flows

... Telecommunications

... Information industry

... Maintenance of information services

... Standardization

... Transfer of STI in area of informatics

A number of specific proposals (in addition to the SPIN conferences) were made to institute or strengthen international (global or regional) networks that involve the informatics technology (computers, telecommunications). The following types of networks are mentioned[e.g. 7 and UNCSTD reports]:

... International time sharing networks

... Networks for scientific computing (e.g. ARPANET)

... Information retrieval networks (e.g. Lockheed, SDC, BRS, Medline, RECON, etc.)

... Human communication networks (e.g. TECHNOTEC, computer conferencing such as CONFER)

... Bibliographic - library networks (e.g. OCLC, BALLOTS, AMIGOS, and many others)

U.S. experiences and/or involvement in institution and operation of such networks are considered as indispensable. This is considered a most desirable area for much greater U.S. involvement and probably offering the greatest potential in benefits.

The barriers which are most often mentioned that impede network development, of types mentioned above, include [ ] :

... Regulatory problems

... Interconnection problems

... Technical problems

... Legal and political problems

... Privacy of personal data

... Privacy and security in broader aspects

... Intellectual property rights

... Economic problems; pricing

Still another type of network being debated at present are networks for information on appropriate technology. Numerous proposals exists for international mechanisms for promoting appropriate technology including:

... UN Inter-Agency Task Force proposal for an interagency network for the exchange of technological information; this was endorsed by UN General Assembly in 1977 [45]

... UNIDO Industrial and Technological Information Bank (INTIB), described previously, with the pilot project completing in 1978 [20,52]

... World Bank proposal in 1978 for a Technology Referral Service (TRS) [54]

... ILO proposal in 1976 for establishment of a Consultative Group on Appropriate Technology; other organizations made proposals for Consultative Groups in a number of areas [23]

... International Rice Research Institute proposal for an International Center for Appropriate Technology [23]

... US/ AID proposal for a program in appropriate technology in 1976 involving information and communication and organization of Appropriate Technology Institute to administer the progress

... and a number of other proposals from individuals and institutions

It shows quite clearly that the notion of appropriate technology includes also the idea of necessity for networks for appropriate information. As is the nature of appropriate technology subject to different interpretations, so is the nature of associated information networks. Up to now the US shows relatively little involvement in these debates. More involvement is clearly desirable; if it is desirable that the issue not be settled without the U.S.

5 UTILIZATION OF STI

5.1 Overview

Institution and operation of information system is quite naturally a prerequisite for obtaining information, but that does not automatically mean that indeed the systems will be used and that information will be utilized. The proverb "Build a better mousetrap and the world will beat a path to your door" is not necessarily valid for information systems, particularly not in LDCs. This is often remarked in the literature, about information systems in LDCs. However, there is little solid data on the extent of use of the information systems that exist in LDCs, and on the utilization of STI that is provided and/or readily available. A few general conclusions can be derived from various remarks in the literature [e.g. 4,9,11,12,15,]:

1. The use of information systems in LDCs are not very high; they are underutilized.
2. The utilization of STI is not widespread even when readily available; a large proportion of potential users are nonusers.

Lack of use of STI systems and STI in general in LDCs has many a cause, but among the major ones are the people toward which information is aimed and that could benefit directly from such information. The tradition of utilization of STI systems is not well developed and the skills and knowledge of users in utilizing information itself are low. Thus the problems are not only in the areas of availability and accessibility of STI and in STI systems and networks, but the problems are also in the users themselves.

The 'user problems' are perceived as existing in the areas of:

1. User education
2. User requirements
3. Promotion and marketing and
4. Evaluation and feedback

particularly in UNCSTD reports.

In recognition of user problems many recommendations have been made and many sporadic efforts have been attempted but few actual sustained efforts have been recorded. It is perceived that this is an area in dire need of attention. U.S. methods applied to user education, promotion, marketing, study of user needs and requirements, etc. have attracted attention, thus being another area for further interaction with LDCs.

5.2 User Education

Two levels of user education problems are recognized involving users and potential users that have some exposure to academic education in an STI subject:

1. During their formal schooling
2. During their professional practice, after the formal schooling

It is recognized that in many instances the formal academic programs do not include emphasis on the use of information sources beyond textbooks, and on the utilization of information beyond rote learning. Thus the user problems start from the outset with students' formal education; STI in its broader aspects is just not a significant part of their education and the utilization of information for problem solving is not an educational objective. Inclusion of STI in the educational process would require a fundamental reorientation of many curricula and educational practices in great many academic institutions. This in turn requires a faculty willing and knowledgeable to do so; which in itself is another problem.

Considering that the U.S. academic institutions have an ever increasing number of students from LDCs[1] a number of interesting suggestions have been made, e.g:

1. Providing LDC students in U.S. when appropriate, with supplemental education on availability, accessibility and utilization of STI with training on operations of information systems

[1] According to Chronicle of Higher Education (Dec. 11, 1978) in 1978 there are some 235,000 foreign students in the U.S., a good number from LDCs. (In mid 1940's there were about 26,000 foreign students). The count is expected to be a million in ten years. Presently foreign students are 2% of all post-secondary education in the U.S. The percent in graduate schools is even higher: 27% of all engineering doctorates are earned by foreign students and 45% of all engineering degrees go to foreign students. A good percentage of institutions enrolling foreign students report that they have substantially altered their graduate programs because of the influx of persons from abroad.

2. Sensitizing the U.S. faculty involved with students from LDCs to the special information problems the students will be facing upon return

3. Supporting curricular studies and changes that emphasize use of information within studies for various STI subjects and programs attended by students from LDCs.

Many efforts in user education have been promoted that were aimed toward already practicing professionals. These efforts included seminars, short courses, presentations manuals etc.; considerably more of such activities are being urged. Suggestions were made for providing short training courses on STI for engineers, scientists and policy makers; these could be in "packaged form" including audio visual techniques. A U.S. involvement in such courses was also deemed desirable, particularly in relation to explanation of U.S. STI resources and on modes of their utilization in the U.S. Also interest was shown in transplanting and adapting U.S. user education practices for use in LDCs.

A further aspect here relates to opportunities for direct exchanges and meetings between scientists and engineers in LDCs and those in developed countries. A much expanded number of contacts is urged, including attempts to deliberately establish or strengthen "invisible colleges".

5.3 User Requirements

Two problem areas are included here:

1. Methods for determination of user needs in STI in general
2. Assistance to users in expressing and formulating their specific information requirements and questions.

While the studies of user information needs have a long history in the U.S. and other developed countries such studies are not conducted as a rule in LDCs. User needs are surmized rather then studied. However, many calls were made for study of user needs, for definition of these needs in terms of particular developmental goals and local conditions, for application of more appropriate methods in study of these needs and for 'inventories' of potential users and their characteristics. It is not clear to what extent are the methods for study of user needs as developed in the U.S. applicable to LDCs -- this is an area for possible cooperation.

In a number of instances it was pointed out that information users in LDCs, particularly in small industries and enterprises have great difficulties in expressing their information requirements; some estimates even say up to 95% of inquiries on industrial information are incorrectly formed or are wrong questions (the figures were not supported) [50]. Help in formulation of correct inquiries is perceived as a needed activity in provision of STI. The difficulty is becoming ever greater with the introduction of computerized information retrieval systems, where the method of question handling, question analysis and formulation of search strategies is essential to success. As in other user problem areas U.S. experiences are looked upon as potential solutions.

5.4 Promotion and Marketing

The success of a number of efforts in marketing of information systems, products and services in the U.S. did not escape the attention of information scientists in LDCs. In particular, the success of products such as Citation Indexes and Current Contents, and the increase in use of numerous data bases and data base services is in no little measure due to judicial and comprehensive marketing. This includes market research, mass mailing, conference reports and exhibits, direct contacts, user education seminars, demonstrations, mass production and destribution of promotional and educational material, continuous advertising campaigns, integration of training and marketing efforts, etc. Such planned efforts are perceived as needed in LDCs, as well. It is quite evident that often the fundamental ideas about promotion of information systems and services are lacking, although considerable discussion about the need for recognition of their value is present. The connection between the two is not made.

5.5 Evaluation

A number of recommendations have been made for a need to evaluate the various national and international STI systems that have been implemented, the various STI activities and promotions of UN and other international agencies, and the effects of assistance to the LDCs in relation to STI. Many evaluative opinions have been voiced and many evaluative observations have been recorded in trip reports. However, very few actual evaluative studies have been conducted. A few rare examples include studies commissioned by UNESCO on assessing the benefits and promise of AGRIS [9]

and on the evaluation of CDS/ISIS and CAN/SDL pilot projects in three countries [14].

Because of scarsity of factual studies it seems that the effects of evaluation efforts (which were largely opinion gathering) were rather marginal, even though the need for evaluation is widely recognized. Calls are made for new approaches to STI project planning and execution that will involve evaluation as a mandatory and integral part. The U.S. involvement in STI efforts for LDCs was never evaluated in any comprehensive sense. Even good historical accounts do not exist, beyond some histories of U.S. assistance in libraries and librarianship to developing countries [e.g. 3]

Evaluation and assessment is clearly an area which is inviting a greater U.S. involvement.

6 EDUCATION AND TRAINING: ANOTHER ASPECT OF INFRASTRUCTURE

6.1 General Concerns

The number of discussions on the needs for well educated and trained information professionals for STI services in LDCs has increased considerably within this decade. Concern for education/training in information science, librarianship and computing in LDCs is reflected in a great number of recommendations in country reports, international conferences, and articles [e.g. 5, 11, 16, 19, 22, 24, 29, 39, 55, 56] in the literature in general. Furthermore, various reports (particularly emanating from UNESCO conferences) have emphasized the dangers of involving LDCs in the new sophisticated information systems and technologies where there is an absence of skilled professionals to operate these systems. Examples of concerns can be illustrated with a few quotes:

From article "Problems Involved in Setting up and Operating Information Networks" [16]:

> "The problems which cause the greatest trouble in setting up and operating information networks are of a human order. . . On the one hand, although there are at present in the developing countries high-level specialists in practically all the areas with which we are concerned (librarians, documentalists, systems engineers, programmers, communication and telecommunications specialists), there are generally too few of them. Efforts to provide the accelerated training may turn out to be in vain, unless the young specialist is offered a number of economic and professional incentives which encourage him to continue his career within the network instead of being tempted by openings in other sectors.
>
> On the other hand, it is fairly common to meet professional people who, having acquired a little experience in a given area, overestimate their own abilities and tend to think that theirs is the only workable solution."

From a "Seminar on Industrial Information in Latin America" [21]:

> "The education/training for industrial information professional development in Latin America stands out as the primary area in which information infrastructure development should take place. . . .Much more is included under this heading than just academic education oriented toward a degree in library or information science."

6.2 Activities of International Organizations

UNESCO and other UN agencies have been deeply involved, primarily because of insistent requests by LDCs, in many education/training activities, including courses, workshops, establishment of schools and programs, provision of teachers and consultants, drafting of guidelines etc. The depth of concern in this area is further underscored by the fact that one of the four major objectives of UNESCO's General Information Program within the UNESCO medium range plan (1977-82) pertains to training and education of professionals and users of information, more particularly [55]:

> ... to help LDCs build up facilities for systematic, formal training of needed information manpower
>
> ... and in the meantime to provide support for international training of managers and advanced specialists for national information systems, and of teachers to staff national training programs

UNIDO, UNITAR, WHO, FAO and a host of other agencies were also involved in similar activities, so were regional organizations such as Organization of American States and nongovernmental organization such as International Federation for Documentation (FID).

All this is mentioned here, because most of these educational/training activities were initiated on suggestions and demands from LDCs and show their perception that education of professionals for STI activities is inseparable from provision of STI and building of STI systems. Nevertheless, one of the most often voiced criticisms of initiation of STI activities in LDCs, be that on the planning or implementation level is that too often inadequate attention was paid to education/training of appropriate professionals.

6.3 University Education

For a long time there was a debate in LDCs (as in developed countries) as to whether the necessary education for STI activities should be achieved through formal university-level channels or just through short training courses offering technical details to 'specialists' (people who already have some level of education in a subject). The debate also involved the issue of the level of education: graduate, undergraduate, or less e.g. certificates for courses from a few months to two years. In many LDCs, at the first and second level of development, the question was also raised if any higher level of education for any information activities is at all appropriate to their needs; the notion of "barefoot librarians and/or information officers" was advanced as being an appropriate response. As these questions were not settled either in the developed countries or in LDCs we have, as a result, around the world educational settings for STI activities in every shape, form and length. This can be clearly seen from the "World Guide to Library Schools and Training Courses in Documentation [26] which lists some 203 schools or programs from 59 countries; of which 89 schools/programs are in 31 LDCs[1] (no European country was counted here as LDC). The Guide (published in 1972) is now out of date; since then a considerable number of schools and courses in librarianship and information science were added in LDCs; but still this gives an idea of spread.

The trend in STI education in LDCs is definitely toward university level education. Most efforts are within the subject of librarianship and

[1] Argentina, Brazil, Chile, Columbia, Costa Rica, Cuba, Egypt, Ethiopia, Ghana, India, Iran, Iraq, Jamaica, Jordan, Korea(s), Mexico, Nigeria, Pakistan, Paraquay, Peru, Phillipines, Saudi Arabia, Senegal, Thailand, Tunisia, Turkey, Uganda, Uruguay, Venezuela, Zambia.

information science, very few in computer science or other subjects. Thus most of this education is centered in library schools and in some instances in independent information science schools or departments. However, there is an increase in information science courses and programs, within or without library schools, that are most directly related to STI activities. For instance [24] : In Latin America and Caribbean there are at present 66 schools in librarianship and information science; about half a dozen of these are also on the graduate (masters) level -- all of the graduate programs were instituted within the last few years; there is a marked trend toward inclusion in the curricula of information science courses (including computer related courses) and toward more graduate (masters) education.

The problems listed most often in relation to university level education in library and information science are:

1. Lack of qualified faculty; this is a universal situation listed most often as in need of great attention and assistance. Import of temporary faculty has great limitations, thus requirements are made for teaching of indigenous teachers.
2. Determination of relevant curriculum and subjects to be taught. Criticisms are leveled that in some countries educational programs in library and information science as instituted have little relationships to STI national plans or systems or international interconnections made in STI services. Often mentioned is the issue in teaching of computer aspects and advanced STI methods and their relevance/irrelevance to domestic situations.
3. Orientation of programs to satisfy a whole range of needs for professionals for different situations that are encountered; included as most problematic are orientations toward information

managers.

4. Career development and professional status of graduates of these programs is often problematic (e.g. their civil service classification is in many countries lower than for other professionals). This does not work well for attracting students with higher qualifications and stronger subject backgrounds.
5. Lack of adequate instructional resources and facilities seriously hampers education. This includes lack of textbooks in the language of students, lack of laboratories, inadequate library and course materials, problematic access to computers in computer or automation courses etc.

A large number of students in information science from LDCs are being educated in developed countries, including in the U.S. A number of U.S. library and information science schools have specific programs or orientations for students from LDCs, but others do not even though they accept many LDC students. An often heard criticism from LDCs is that students educated abroad have been 'overeducated' or educated without socially relevant competencies that are specific to the environment of the country; furthermore people educated in different countries come back with different philosophies and techniques, making them hard to work together [e.g. 43]. Two suggestions are often made toward the U.S.: (i) to increase the opportunities for education in subjects related to STI for students from LDCs, and particularly for future faculty so that similar schools in LDCs can become selfsufficient and (ii) to increase the orientation of programs attended by LDC students toward problems and solutions as relevant to LDCs.

There were few examples of U.S. schools establishing direct and long term cooperation with similar schools in LDCs in teaching, curriculum and faculty development, course materials development etc. A number of favorable

results of such cooperation prompted suggestion that more direct cooperation between schools is highly desirable. However, the resources for such cooperation are very sporadic, which in effect kills such efforts.

This area also encompasses many recommendations for a greater and easier direct direct exchanges between STI professionals from LDCs and developed countries e.g. through meetings, conferences, trainings trips etc. that are aimed at transfer of information.

6.4 Training and Continuing Education

Need for practical training of STI personnel is an often mentioned problem. A closely related problem is a need to provide already practicing professionals with opportunities to update their knowledge and skills. This is particularly acute in light of rapid changes in information technologies and in STI systems based in these technologies. It was noted, in particular, that many international efforts have been launched without adequate training provisions, which doomed them from the outset.

No adequate solution to these problems have been found, despite a number of training courses offered worldwide by various national and international organizations. They were just not enough and often not too good either. The same type of problems are listed as above for university education: lectures, content, orientation, professional status, resources, facilities. One problem is also that the formal education programs in universities paid little or no attention to continuing education, despite needs for continuing education their involvement is minimal.

The U.S. did not participate to any great extent in an organized way in continuing education programs in LDCs. However, many lecturers and some institutions from the U.S. gave courses or participated otherwise in continuing education on their own. This is another area where an organized U.S. effort may be of considerable impact. One suggestion often made is to assist in preparing 'educational packages' (including course and demonstration materials, audio-visuals, particularly videotapes and films etc) that could be used for continuing education.

7. CONCLUSIONS - SUMMARY

7.1 AIMS

The aim of this paper is to survey and analyze the literature emanating from less developed countries (LDCs) and international agencies and dealing with their perception of the needs of LDCs for scientific and technical information (STI) in relation to social and economic development. The literature surveyed comes from three different constituencies: (i) scientists, engineers, technologists as users of information, (ii) information specialists as purveyors of information and (iii) officials, planners as policy makers in allocation of limited resources. Thus the perceptions surveyed come from different vantage points. Some of the perceptions are explicitly stated, others are derived from activities in STI that were either undertaken or are being promoted -- in these cases the actions or proposals implicitly reflect perceptions. All of the conclusions in this paper are based on statements in the literature listed in the bibliography. However, a great problem exists that the statements, conclusions and recommendations found in the literature were made without support in hard evidence. Particular attention was made in this paper to the various UNSCTD reports and recommendations. Out of the 190 consolidated recommendations for UNCSTD, 38 or 20% pertain to some or other aspects of STI.

7.2 RECOGNITION OF STI: INTERNATIONAL AND NATIONAL

A. Recognition of the needs for STI in development in general

A Considerable number of effors were extended in this direction particularly by UNESCO. Nevertheless, a number of problems and obstacles were mentioned:

1. Still a low level of recognition, particularly by officials and decision makers of higher rank
2. Percentage of R&D budgets allocated for STI activities much lower than in developed countries; often only lip service paid to STI
3. Very few facts and solid studies in extence on the relation between STI and development; no standardization established on even what facts to collect
4. Existing studies of questionable value because of questionable methods applied

B. Involvement of UN and other international agencies in promotion of STI activities. Their involvement is widely spread and very well received. Considerable achievements have been acknowledged. Many calls are made for further and greater involvement.

Problems/Obstacles:

1. So many international agencies got involved with STI that in itself this presents a problem. Lack of coordination and of communication and cooperation between agencies
2. Too many recommendations are made; some contradictory. Individual agencies and missions pursue their particular interests to the exclusion of general goals of a country. Confusion is created in setting national priorities
3. Too little follow-up on recommendations. Recommendations are difficult to evaluate
4. Focal points for international STI activities as selected in some countries are inappropriate. They have little or no connection with STI activities in a practical sense
5. Activities are not aimed toward discrimination from the large quantity of STI materials available; problems of "information explosion" are attacked but not of "information pollution"
6. Some voiced that international activities as instituted tend to reinforce rather then transform the dependency relation between developed countries and LDCs; they do not promote developing - developing links

C. International Information Systems

Application of the "territorial formula" in operations of international systems such as INIS, AGRIS is very popular and deemed appropriate. Calls are made for many more such systems. Their value is recognized not only in

relation to information provided, but also as a stimulus for development of national and regional systems, as an excellent provider for training and as a vehicle for reduction of dependency on STI products/services controlled by any one developed country.

Problems/Obstacles:

1. Considerably more proposals and plans were made than actual systems instituted
2. Those systems that are instituted are still not spread widely in LDCs. The systems and their products are not widely promoted. They are new and thus infamiliar
3. Standardization and harmonization between various international systems and national systems is low
4. Differences in input formats, software, and other aspects prevent participation of many countries. It is particularly noted that because of this the U.S. National Library of Agriculture is inputing only 20% of what it is processing to AGRIS, thus depriving AGRIS of a major source of agricultural information
5. Quality of operations vary between countries. Internal quality and appropriatness of indexing and vocabulary controls is questionable
6. Transfer of software from one country or system to another is most difficult
7. Lack of qualified personnel
8. Uncertain commitment of resources for these systems makes for uncertainty in further develbpment to a full potential and even for a likelihood of suspension of operations. This is viewed as possibly significantly impeding the LDCs' access to information of practical nature which could be of immediate utility to them

(particularly in relation to AGRIS)

9. Lack of credibility, particularly in developed countries. They view these systems differently than LDCs. (E.g. -developed countries see that they already have these services; the systems have too much material of low scientific value; emphasis is on topics not of direct interest; little to gain in participation; participation is a form of foreign aid, rather then of STI value)

D. National STI Systems

Some 28 LDCs instituted a national STI system in some form or another. Their strength is not only in their products/services provided but also in contributing in development of information professionals.

Problems/Obstacles:

1. Difficulties in defining the scope of their coverage, because science and technology covers such a broad range of activities and subjects
2. Difficulties in finding their place and most effective role in the scheme of national development
3. Marginal resources with negative results on operations
4. Often a questionable relation between products/services provided and the actual information needs

A number of countries have instituted an information system devoted to a given scientific or technical subject. The big difference between LDCs and developed countries is that they later have fewer national STI systems and more subject systems, The subject systems in LDCs are so far limited to just a few subjects: health, agriculture, energy and environment. The problems are similar as above, although they have considerably less problems with definition.

E. Industrial Information Systems

Many LDCs instituted systems that are generally oriented toward problems of industrial information. There were also systems that are oriented toward one industrial sector.

Problems/Obstacles:

1. They are attempting broad industrial coverage but end up supporting only a select number of larger industries
2. Low effectiveness in problems of technology transfer and in recognition/creation of appropriate technology
3. Providing too much bibliographic information and referrals vs. direct and simple answers; low power of synthesizing information
4. Low power in assessing the accuracy and value of information

F. National Plans and Policies

These are perceived as a very necessary element. Recommendations to institute national plans and policies for STI are constantly made at every international forum.

Problems/Obstacles:

1. Despite numerous recommendations very few countries made an effort to actually draft plans and policies specifically for STI. In many cases these are incorporated in broader national plans.
2. It is not clear why the area of STI warrants plans and policies separate from general policies. Should every area of national life have a separate plan and policy?
3. In the few cases where separate STI policies were adapted, there was no evidence of their enforcement and thus of effects.
4. The process of drafting separate STI policies is cumbersome; in part this is because of the confusion between subjects of policies (i) for science and technology, (ii) for STI and (iii) general information policies.

7.3 AVAILABILITY OF STI

A. Categorization of STI

Many perceptions exists on the division of STI that is needed into certain categories. The range of what is meant by STI is very wide. Among the more frequently mentioned are:

In terms of neeessary knowledge:

- know - why information (more scientific, readily available)
- know - how information (more technical, harder to get)
- show - how information (operational, hardest to get and transfer.

As to STI resources:

- formal resources (open literature)
- informal resources (conferences, contacts)
- special and negotiable resources (patents, licenses)

As to information for different types of users:

- scientists, engineering
- business managers, industrialist
- administrators, policy makers
- extention workers
- semi-educated persons
- illiterates

Problems/Obstacles

1. Wide differences in perceptions of what constitutes STI.
2. Wide range of STI requirements in terms of levels of users
3. For some categories the type and level of STI is not readily available.
4. For some categories (such as special and negotiable information - patents, licenses, operating manuals, commercial and economic information etc.) in many cases, it is perceived that developed

countries pose exploitative restrictions.

B. Scientific Information

There is relatively little demand for and discussion of strictly scientific information. But there are some strongly held views and perceptions of the particular type of science (and thus scientific information) of benefit to LDCs.

Perceptions and related obstacles:

1. In some countries (as India) where science played a role in development of some areas, there are calls for a fundamental rearrangement of scientific priorities and applications, i.e. toward the needs of majority of populace in curing social deficiencies (malnutrition, housing, public health, transportation etc); in this respect needs for different subjects of scientific information are perceived and on a different level of population (e.g. mass of people, rural population). There is a scarity of such information, or it even does not exist in the desirable form.
2. In some instances it is perceived that much of scientific information from developed countries is superfluous; research in relation to needs of LDCs is not carried out to any extend in developed countries (e.g. in tropical diseases).
3. Scientific research (and thus information) is viewed in some instances as not affordable by LDCs; it should be carried out in most cases by developed countries anyhow (e.g. in pollution, because they caused it).

C. Technological and Industrial Information

This is the major area of concern by all LDCs. However, marked differences exist in perception of what type of information is needed according to the

level of development. The perceptions are markedly different than those in the U.S. What is meant by technological and industrial information in the U.S. is much narrower than what is meant in LDCs.

Perceptions according to level of development:

1. In countries on first (preindustrial) and second (begining industrialization) level of development information needs are perceived in much more basic terms; in particular the needs for (i) technological information, (ii) technical training and (iii) general education are treated as inseparable (these are dealt as separate problems in the U.S.).
2. In African countries the stress is on areas of agriculture, public health and engineering; requirements are also for assistance in analysis of information needs for specific requirements and objectives of development.
3. In Asian countries the stress is on industrial planning, technological choices, technology transfer, and industrial operations.
4. In Latin American countries the stress is also on technical and economic information that strengthens positions in bargaining and particularly in negotiating for licenses and patents.
5. In general in countries at the third (relatively advanced industrialization) level of development the concern is with information for: creation and extention of technical know-how; development of new industries/products and diversification; increase in efficiency of production; increase in industrial employment.
6. Assistance to small industry is considered in all countries as a particularly neglected area. It is noted that there is no connection with small industries in the U.S. and that smaller developed countries (e.g. Denmark) may be more suitable for help

with smaller industries.

One of the notions receiving considerable attention in LDCs is appropriate technology. It is perceived that the cure for many developmental failures (e.g. import of "turn-key" factories that become sick or inoperable industries; or of high capital intensive and low labor intensive technologies) is development and application of appropriate technologies. Closely associated and even inseparable with it is the notion of appropriate information. Discussions of appropriate technology (and with it of appropriate information) is to be expected to be a major theme of international discussions. In a way the notion of appropriate technology is also a refutation of some models of development, stressing development of heavy industries and quantum jumps and acceptance of more moderate models but which will affect a much broader populace.

However, one of the major problems is that the notion means different things to different people, countries and contexts. The range of meanings include:

1. "Museum technology" - i.e. technology that was used in developed countries when they were at similar level of development as LDCs; suggestions are made for searching of museums and synthesis of fundings.
2. Technology that is labor-intensive, small-scale designed to meet the basic needs and raise productivity of the poorest people and that uses local resources.
3. On the other extreme is the view that this is the technology a country would chose given as wide a range of choices as possible; in this case the task of promoting appropriate technology is that of widening the available spectrum of technologies of all sorts.

it is

4. In terms of resources, technology that is intensive in use of abundant factor, labor, economical in use of scarce factors, capital and highly trained personnel and intensive in use of domestically produced inputs.
5. In terms of scale: it is technology that is small scale but efficient, readily replicable, operated, maintained and repaired, low cost and accessible to people and enterprises with low income.
6. In terms of compatibility it is technology compatible with local cultural and social environment.

The problems/obstacles in obtaining the related appropriate information are considerable because it is simply not readily available; it is perceived that there is a need for:

1. Generation (creation) of relevant information materials which are not fully available
2. Repackaging of information from many sources
3. Screening and evaluating information, providing assessment of technological information
4. Importing of information about successful applications of technology from other LDCs
5. Emphasizing developing - developing information links

In general, it is perceived that appropriate technology and information will require entirely new information systems and communication links, but the proposals in that respect are still rather nebulous. One thing is clear, a much higher amount of resources will be needed for such systems.

In a number of cases it is perceived that:

1. Developed countries are not willing to provide appropriate technology and information because it is in their interest to continue to provide expensive large scale technologies and

finished products.

2. Appropriate technology will reduce technological dependency.
3. Inadequate action on appropriate technology prolongs exploitation of LDCs; such technology is necessary for a new economic order.
4. In an opposition view to appropriate technology it is seen that such technology is also an attempt to sell LDCs inferior technology, one that will keep them permanently underdeveloped.

D. Policy and Decision Making Information

This is an area most recently added to the perception of needed STI. The range of information requirements in this area is very wide because it is meant for use by a wide audience in making decisions, including:

1. Government officials, politicians, planners
2. Managers in banks, business and industry
3. Industrial designers
4. Plant engineers, operational personnel

The type of information needed for decisions includes:

1. Business and management information; financial and commercial data; names, addresses, volumes, reliability of firms in given sectors; productivity, inventories, resource distribution etc.
2. Marketing information: markets, products, forecasts, costs and pricing.
3. Negotiable information: licenses, patents, consultancy assessments.
4. Design information: standards, specifications, blueprints, industrial catalogs, regulations.
5. Operational information: maintenance and repair manuals; replacements; process specifications and guides.
6. Laws and regulations: international and in various nations.

Often mentioned desires are to provide

1. Analysis of such information, particularly with assessment of value.
2. Reviews of various topics; extraction and synthesis from many sources into one or few accessible files.
3. Assessment of future impacts of alternate decisions.
4. Information that will increase negotiating capabilities; similar experiences from other LDCs.

It is also realized that such information is not readily available and that new systems will be needed. There are views that developed countries are not amicable to provision of such information, that too many restrictions are imposed, particularly on proprietary information. It is perceived that such proprietary information in particular and decision-making information in general is of great value to LDCs and for this reason it is highly desirable, but also highly obtainable. Because of this, considerable hostility is evident in discussion of decision-making information.

E. Selection of STI Literature by Information Systems:

Problems/Obstacles:

1. STI literature is growing at a much higher rate than the resources of information systems, leaving less and less money for selection of more and more literature.
2. STI literature from LDCs is also growing at a high rate, making for more dispersion and harder selection.
3. Criteria for selection of the type of desired information are not well stated, if they are stated at all.
4. Resource sharing efforts for cooperative selection between information systems in LDCs are generally ineffective.

5. Problem of translation is growing rather than receeding.
6. Much literature that is desired, does not exist in a form or at a level appropriate for given users, thus creation of such literature is necessary.
7. The problem of selecting qualitative items in the literature from all that quantity is becoming more acute.
8. There is a lack of tools from which to do selection.

F. Acquisition of Literature (documents) by Information System:

Problems/Obstacles:

1. Currency restrictions in many LDCs; low priority for foreign exchange funds for STI material.
2. Inadequate postal and telecommunication services; very slow oversees deliveries; high rate of lost materials in transit.
3. Inadequate attention of publishers in developed countries to special problems in LDCs.
4. Copyright restrictions.
5. Lack of photocopying services for and in LDCs.
6. Low degree of success of plans for exchange or free provision of books, reports, journals etc.
7. Intensified problems in getting hard copy of documents for which citations were retrieved from data base or indexes.
8. Lack of adequate library collections to fall back for delivery of documents from data base searches.

G. Awareness of STI resources in the U.S. and Economic Considerations

It is generally perceived in LDCs that many other developed countries are suppliers of technology, but that the U.S. is the prime supplier of STI because of its large information resources and services.

Problems/Obstacles:

1. Despite the above general perception, there is a low awareness in LDCs about specific information resources in the U.S. (existence, names, addresses, contents, area of usefullness, services provided, mode of access, etc.).
2. A number of directories that were published did not perceptively alleviate this situation.
3. The awareness is especially low of sources that do not cover traditional STI areas and literature (e.g. numerical data bases, statistics, business information, patents etc.) which in turn is perceived as highly desirable in LDCs.
4. Marketing of U.S. information sources and services in LDCs by U.S. firms and agencies is low.
5. Interest of U.S. public and private organizations dealing with data bases in establishing modes in and links with LDCs is minimal. The example of NTIS is not followed.
6. Economics of information industry, in the U.S., particularly the private sector, are not understood in LDCs. This causes many false impressions and charges of exploitation or deliberate creation of barriers to STI.
7. Costs and cost/benefits of information systems and services are generally not studied, debated or understood. When the costs are revealed they are perceived as very high.

7.4

ACCESSIBILITY OF STI

A. Intellectual Organization of STI

U.S. schemes and procedures have a world wide impact; many LDCs are adapting or even indiscriminately using them. International standards are perceived very desirable, particularly because of interconnection.

Problems/Obstacles:

1. Deriving specific schemes and procedures reflecting specific environments and requirements in given LDCs.
2. Adapting schemes from abroad; translating available schemes.
3. Obtaining or constructing tools for vocabulary controls, thesauri, in particular, for specific subjects; adapting multilingual thesauri.
4. Specifying indexing, cataloging and similar procedures; quality control of these processes once specified.
5. [illegible]l a low degree of standardization.
6. Low number of tools necessary for resource sharing and cooperation (e.g. union lists); great intellectual and technical difficulties in creating them.
7. Low understanding and interest in the U.S. about these issues, particularly in view that U.S. schemes, tools and procedures are widely used.

B. Housing of STI

Problems/Obstacles -

1. Inadequate physical facilities from buildings (libraries, information centers) to computers.
2. Biased size distribution: in many countries there are few larger STI facilities and no smaller ones, particularly in smaller enterprises, schools etc.

3. Biased geographical distribution: STI facilities tend to be in a few larger national centers, often far away from potential users; distance serves as a very effective barrier to use.

4. Few attempts to combine centralized facilities with decentralized services or branches.

C. Dissemination of STI

Problems/Obstacles:

1. In many LDCs limited range of dissemination services offered by libraries and information centers; tend to stick with traditional services (e.g. circulation) and products (e.g. bibliographies).

2. Information centers are more product than service oriented; STI search orientation often lacking.

3. Relative absence of modern services (e.g. SDI, retrospective searching, photocopying, assistance in question formulation and analysis, etc.).

4. STI searching is hampered by the lack of indexes and ~~abstracts~~ abstracts; low degree of skills by librarians and information scientists in using such sources where existing.

D. Application of Information Technology

Examples of usage of computers and other information technologies in developed countries had a great impact on the aspirations of librarians, information scientists and officials in LDCs; this impact is so great that often the expectations are dangerously high and naive, because it is not realized what is entailed and how complex the applications of information technologies are. However, many computer applications for some or other aspect of STI activities are recorded in LDCs. In many LDCs a nucleus of computer experienced information specialists exists. Next to appropriate

technology and information, further applications of information technology and related networks for STI is a major topic of perceived needs.

Problems/Obstacles:

1. Lack of access to computers by STI facilities; consequently still a low degree of experience.
2. Lack of adequate software; low in-house or in-country capacity to adapt or produce needed software; too few attempts to transfer software beyond mere provision. When and where attempted, methods used for transfer did not produce high successes. Inability to evaluate ready-made software.
3. Lack of trained manpower -- usually listed as the number one obstacle in applications of information technology.
4. For information retrieval applications: lack of files (data bases) on which to perform them; no (or very small) production of local or regional data bases which are deemed as highly desirable.
5. Great difficulties in acquiring and adapting for domestic use data bases that are commercially available from U.S. and other developed countries. Often it is perceived that undue barriers are put up for doing do. Little interest by data base producers in U.S. toward utilization of data bases in LDCs.
6. Same mistakes committed in applications of information technologies as were in U.S. and other developed countries; little learning from others mistakes.

In a number of instances it is perceived that a number of trading barriers exist for all kinds of aspects related to information technology, (software, hardware, network interconnection, data base purchase, data base access etc.). This is a most sensitive issue and the U.S. is often painted as the villian because it has the most developed information tech-

nology, networks and information industry. Often these criticisms are coached in a strong ideological framework. The criticism also involves transnational companies.

E. Information Networks

As mentioned, information networks (national, regional and international) primarily based on information technology are perceived as a major necessity and solution to problems of tapping the world STI resources. It is a major point of expectations from the U.S. and a major point of impatience, particularly because many demonstrations of on-line data base services were made in LDCs and they whetted the appetites.

Problems/Obstacles:

1. Lack of adequate national and international telecommunication facilities and networks on which to base STI networks.
2. For national networks within LDCs: a chronic lack of willingness to cooperate among librarians and information scientists; territorial fears and lack of explanations and thus understanding of network activities and benefits; low motivation for realization of networks.
3. Difficulties in arranging for access of U.S. on-line data base services (such as SDC, Lockheed etc.), low degree of interest on the part of these services toward LDCs.
4. Administrative demands and rules put up by U.S. government on-line services (such as NLM) -- these are often deemed as unrealistic and prohibitive; low assistance in establishing links with such U.S. services.
5. Difficulties in setting up SDI networks for batch processing of requests (as opposed to on-line searching).

6. Lack of clarification on the connection between domestic SDI services and international on-line data base services.

7. Confusion between the issues related to informatics and STI services; informatics involving all sorts of computation and data transmissions.

8. Legal and regulatory issues in international STI networks; privacy of personnal and societal nature; security; intellectual property rights.

9. Interconnection and technical difficulties; standardization.

10. Economic constraints; high costs for realization of networks. Often the prices for access of STI networks are considered as being set-up too high and prohibitive for LDCs; this is resented and a cause for hostility.

In general, U.S. participated little up until now in the growing debate on international STI networks, while there are many, many accounts by LDC authors of such networks in the U.S.. Numerous requests were made that the U.S. and other developed countries provide access to STI networks at reduced prices and some requests were made that such access be free.

7.5 UTILIZATION OF STI

A. Use of STI systems

Problems/Obstacles:

1. General underutilization of STI systems and resources where they exist; use of such systems is simply not high at all.
2. Utilization of STI, not widespread even when readily available; large proportion of potential users are non-users.
3. Tradition of using STI systems are not well developed.

B. User Education

Problems/Obstacles:

1. Low skills and knowledge of users in utilizing information itself; the problem thus is not only in availability and accessibility of STI and in STI systems and networks but in users themselves.
2. Formal academic programs do not condition potential users toward use of information; emphasis on textbooks and ~~rate of~~ rote learning; broader aspects of STI is not a significant part of education; faculty and curricula simply not oriented toward STI.
3. Sporadic efforts (seminars, courses etc.) in user education (those working already as professionals) by STI systems.
4. Institution of curriculum and materials for short user training courses; making users willing to attend such courses.

The U.S. has considerable number of students from LDCs; in particular graduate schools in many universities are teeming with LDC students. Suggestions were made: (i) to supplement the education of LDC students in STI disciplines with special education in availability, accessibility and utilization of STI and with training on operations of STI systems, (ii) to have the U.S. faculty become more involved with LDC students and more sensitive

about STI problems in LDCs, (iii) to support curricular changes that emphasize use of information within various STI programs attended by LDC students.

C. User requirements

Problems/Obstacles:

1. Relative absence of studies of user information needs; lack of methodologies and ready made procedures appropriate for such studies.
2. Difficulties by users in formulating and expressing their information requirements and questions; these are increasing with introduction of computerized STI systems.
3. Low degree of assistance by STI systems to users in formulation of their requirements and questions.

D. Promotion and Marketing

Problems/Obstacles:

1. Low degree of recognition of the need for promotion and marketing of STI products and services.
2. Lack of promotion and marketing efforts, techniques and methods; absence of market research.
3. Lack of connection being made between the marketing and promotion efforts and the recognition of the value of STI in development in general.
4. Inadequate attention paid in U.S. and other developed countries for development of marketing efforts and market research of specific use for STI in LDCs.

E. Evaluation

Problems/Obstacles:

1. Too few evaluation efforts -- despite numerous recommendations made for evaluation of national and international STI efforts.
2. Misdirected and inadequate efforts and mistakes tontinued for lack of evaluations; resources squanderd.
3. Lack of valid and reliable methodologies for evaluations; trip reports and brief interviews are too shallow and even misleading as evaluation methods.
4. Low degree of U.S. involvement in evaluation of STI efforts, even where the U.S. was directly involved.

7.6 EDUCATION AND TRAINING OF STI PROFESSIONALS

This is another major area of concern. It is perceived that it is impossible to build STI systems and services, (particularly in relation to utilization of modern information technology and international networks) without properly educated/trained professionals and that the major obstacle to all STI activities is the lack of such personnel.

A. Activities of International Organizations

On insistent requests by LDCs, international organizations are deeply involved in education and training efforts. Requests are for (i) assistance in building facilities for formal, systematic education of STI professionals and (ii) international support in training of managers and advanced specialists for national STI systems and for education of future educators.

Problems/Obstacles:

1. Sporadic nature of these efforts; lack of long term financial resources to sustain these efforts.
2. Involvement of too many UN and international agencies without considerations of each others efforts; lack of coordination.
3. Lack of international educational planning.
4. Questionable quality of many educational training efforts.
5. Collapse of many efforts after international support was stopped.

B. University Education

Problem/Obstacles:

1. Issue of whether preparation of STI professionals should be university (academically) based or should it involve short training of specialist which already has a degree in other subjects still not fully settled; particularly not for industrial information systems.

2. Lack of qualified faculty in programs relevant to STI activities: librarianship, information science, computing.
3. Determination of level of university education.
4. Difficulties in determination of relevant curriculum to be taught.
5. Low degree of relationship between curricula as instituted and existing national STI systems plans and policies.
6. Teaching advanced methods of STI handling (e.g. computerization, on-line services) in relation to their relevance or irrelevance to domestic situation.
7. Orientation of programs to satisfy a whole range of information needs from most elementary to most sophisticated.
8. Lack of adequate educational resources and facilities, including textbooks in native languages, laboratories, library and course materials, access to computers etc.
9. Lack of positive career development opportunities and professional status of graduates of these programs in many LDCs; this does not work well for attracting best prospective students.

A large number of students from LDCs are being educated in subjects relevant to STI activities in the U.S. and other developed countries. Criticisms are voiced that often such students are 'overeducated' and without competencies needed for the country's environment and that students coming from different institutions or countries bring different philosophies and solutions, creating difficulties for working together. It is often perceived that the U.S. should provide more attention toward:

1. Increasing of the opportunities for LDC students to study STI subjects in the U.S. and particularly for future faculty members.

2. Increasing of the orientation of programs in the U.S. where LDC students attend toward problems of LDCs.

3. Initiating and sustaining of direct and long term cooperation between similar schools in the U.S. and LDCs to develop faculty, curriculum, courses and to help in teaching.

C. Training and Continuing Education

Problems/Obstacles:

1. Not enough opportunities, facilities and resources for practical training of future STI professionals during their academic training, particularly in relation to information technology.

2. Lack of opportunities for continuing education of already practicing professionals.

3. Sporadic nature of the efforts for continuing education. Great diversity in quality of such training courses.

The U.S. did not participate to any great extent in continuing education/training efforts; calls were made for intensification of such participation; also for creation of "educational packages" suitable for continuing education.

7.7 Major Themes and Expectations

The strongest and most often made recommendations made by LDCs pertain to:

1. Need for appropriate technology and related appropriate information
2. Need for policy-making and business information
3. Requests for more development of international STI systems and networks
4. Need for building necessary information infrastructure, particularly assistance in education/training of STI professionals
5. Strengthening of regional approaches to STI and developing-developing links

The major expectations of LDCs from the U.S. are surmized from general expectations from developed countries:

1. Easier access to U.S. based STI systems; more consideration by these systems of LDCs needs.
2. Greater involvement in and contribution to of U.S. STI systems and networks in international systems and networks (such as AGRIS)
3. Easier access to information technology and telecommunication networks and assistance in their deployment in LDCs,, particularly in relation to software and training
4. More opportunities for direct exchanges between scientists, engineers and STI professionals in LDCs and those in the U.S.
5. Assistance with costs of acquisition of ST literature and STI in general
6. Easier access to hard-to-get information, particularly to policy making, business and negotiable information.
7. Assistance in building of national STI systems, particularly in education/training of necessary STI professionals.

Appendix 1: S & T SUBJECTS COVERED BY THE UN RELATED OR COSPONSORED INFORMATION SYSTEMS AND SERVICES

(Numbers in parenthesis indicate the number of system covering the subject; many information systems cover more than one subject)

Agricultural economics and policy (9 information systems)

Agricultural technology (4)

Agriculture, farming (14)

Air transport (4)

Animal biology and physiology (8)

Animal husbandry (8)

Anthropology (4)

Applied chemistry (3)

Area Studies (11)

Atmospheric sciences, meteorology (4)

Biology (3)

Biomedical engineering (1)

Biophysics and biochemistry (3)

Chemical technology and engineering (8)

Chemistry, general (1)

Communication Sciences and Techniques (18)

Computer science (2)

Construction technology (6)

Ecology (26)

Environment and natural resources (15)

Environmental technology, pollution control (7)

Experimental medicine (1)

Food and nutrition (10)

Food, drinks and stimulants technology (3)

Forestry (8)

General engineering and technology (3)

Geodesy and geophysics (4)

Geography (4)

Geology (5)

Human health and hygiene (5)

Hydrology (6)

Industry and business (11)

Information science and documentation (11)

Inorganic compounds (3)

Linguistics (5)

Marine technology (1)

Mathematics and Statistics (4)

Medicine (7)

Metallurgy (2)

Microbiology, virology, immunology (2)

Nuclear engineering and technology (2)

Nuclear physics and chemistry (5)

Oceanography (8)

Organic Chemistry (3)

Parasitology (2)

Patents (2)

Petroleum technology and products (3)

Pharmaceuticals (1)

Pharmacology (2)

Physics - theoretical (2)

Plant biology and physiology (5)

Plant crops, agronomy, horticulture (8)

Preventive medicine (6)

Public health (5)

Psychiatry and psychopathology (3)

Psychology (6)

Safety engineering (2)

Science and technology - general (11)

Science Policy (1)

Social medicine and health services (7)

Social sciences (9)

Sociology (8)

Toxicology (6)

Transport technology and services (2)

Veterinary science (1)

Water transport (3)

Wildlife exploitation, fishing, hunting (13)

Wood, pulp and paper technology (2)

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