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INFORMATICS AS A TOOL FOR INFORMATION MANAGEMENT
IN DEVELOPMENT

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North South Roundtable
on the
Informatics Revolution and Developing Countries

Tokyo, Japan

1 - 3 October 1987



ARCHIV
002-600
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I. INTRODUCTION (1)

Over the past decade, information has been gaining recognition as a key element in the development process. Certainly, researchers know that information is crucial to their work. Good research is based on first collecting and organizing information about the field or problem under study, developing and carrying out the research program in question, and then ensuring that the results of this work are made available to the information pool. Information systems which support research activities, both commercial and public-sector, are designed to facilitate this information flow. The concepts of "knowledge industries" and "knowledge workers" are gaining rapid acceptance in developed countries, where statistics show that an increasing proportion of the population is involved with these activities. Developing countries are recognizing the advantages and necessity of an adequate information base for their development. In fact, some developing countries are hoping, at least in limited sectors, to pass over the industrialization stage and go directly to information-based industries. Informatics is a key ingredient in this process.

Technological developments, especially through the tools which they have engendered, have facilitated and popularized all aspects of the information cycle. These tools are a necessary response to the "information explosion" which has threatened to overwhelm potential information users, at the same time as it has held forth the promise of so many answers to so many questions. In most cases, it is the tool built out of the technology, rather than the inherent technology itself, which is of interest and relevance to information workers and users.

For most purposes, when one talks of "information technologies" one is referring to a particular class of technology-based tools. These are the "electronic", informatics-based tools, which manipulate and communicate digital information. These tools collect, process, store, retrieve, and transmit the bits and bytes which represent information. In fact, these days, "information technology" and "computer technology" are sometimes taken to be synonymous. Data processing systems are now information systems. Communications is telecommunications. When one talks of information technologies one is really talking about

informatics-based tools and systems. And even if one is not directly referring to computers, they are quickly becoming an integral part of the attendant technological systems. For example, although there is still much data collection which is done without computer assistance, much of the research analysis work is done using computers, and the information is converted to digital form at some point in this process. Remote sensing applications can produce analogue media rather than digital, but digital processing and enhancement techniques are those which are becoming most important. The "technologies" which are relevant to information systems are, for the most part, those which interface with computers.

Is this progression to informatics-based tools inevitable? If so, given present limitations of financial resources, skilled manpower, and infrastructure, how can they be most effectively introduced in developing countries? Although the tools are essentially neutral in and of themselves, their application can lead to both positive and negative consequences. Some tools are better than others: how does one select? Developing countries are especially interested in issues such as: who developed the tools; who exercises control over them; can the technologies be transferred; in which sectors can and should they be applied; what are the economics of the introduction of such tools; what are the social consequences?

However, even before such questions are raised and debated, with regard to any particular tool or technology, there is the question which is usually raised first: is the tool or technology in some sense "appropriate" for developing countries? The danger here is that because of circumstances in force at the moment, a particular technology or tool may be prejudged as "inappropriate" and rejected. There is a need for informed choice, based on sufficient research, experimentation, and analysis. This is especially the case since often some sort of implicit pre-selection process is carried out by the developed countries or by agencies involved in the transfer of technology, even if they do not do so deliberately.

If one accepts that informatics-based tools are indeed relevant for many developing-country information needs, this leads one

immediately to a set of broader questions. How important is it to emphasize the need for national planning in the introduction and development of information technologies? Is there really a potential "information industry" in some of the less technologically-developed regions in the near future? Would such an industry include, for example: production of software packages; production of specialized hardware or general purpose microcomputers; adaptation of software or hardware to local needs; commercial database and information services; information access and facilitation services; value-added communications services?

Other important points include to what extent do tools produced in developed countries really need adaptation? Would it be best to emphasize widespread introduction of many types of technologies and tools or limited adaptation of fewer? Is local technology development desirable and feasible? Given the variety of types of technology and possible application areas, which should receive priority? Are there any for which a small investment now is likely to have a more immediate multiplier effect? As can be seen from the above, the list of issues is extensive.

II. SOME DEVELOPING-COUNTRY NEEDS FOR INFORMATICS-BASED INFORMATION TECHNOLOGIES, TOOLS, AND METHODS

1. The need for information concerning information technologies

Information workers, as well as their direct clientele (the producers and consumers of information) have their own requirements for information to enable them to carry out their work. There are, for example, various "tools of the trade" which provide access to other information sources to help meet their clients' information needs; these include directories, union catalogues, and inventories of databases. There is, however, another important area which directly affects the way in which information workers do their jobs, and their effectiveness in doing so: the tools, methods, and technologies used by the information profession. Unfortunately, there is a major lack of appropriate well-organized information about these especially as they relate to informatics-based tools.

There is a wide variety of subjects covered in this area. Tools can include card catalogues, optical coincidence systems, thesauri, and computerized database software; methods and systems approaches include village-level information centres, integrated district-level systems, decentralized and centralized networks, information repackaging and consolidation, agricultural extension, and statistical methodologies and products such as socio-economic indicators; technologies include manual methods, computers, micrographics, telecommunications systems, remote sensing, and so on. However, it is especially in the area of modern information technologies and informatics that the information gap is widest in developing countries.

Information workers require information on: the "state of the art" in information methods and technologies, including trends; technologies adapted for particular circumstances or working conditions; case studies of both successful and unsuccessful information systems and approaches; local availability, cost, and experiences with particular technologies; local policies and regulatory conditions (especially in the area of telecommunications); local sources of technical expertise; and so on. This information is required to permit informed choice in the selection of tools and technologies, to allow for effective sharing of experience and expertise in a region where resources are limited, and to encourage the development of realistic user-oriented applications which solve real-world information problems.

2. The need for training in informatics-based information technologies

An area in which training is especially important for information professionals is that related to information technologies, tools, and methods: the means with which information workers do their jobs. Information workers themselves have a tremendous ongoing need for information in numerous domains, their training should provide them with the basic information set and the means to acquire updating on an ongoing basis (through continuing education, access to relevant information services, etc.). This aspect of updating is especially critical with relation to the rapidly changing new information technologies.

Of course, any specific curriculum needs to be tailored to the level, needs, and likely working environment of the individual in question. Do all information workers need to learn how to use microcomputers? Clearly not, but even some general introductory material to computer literacy (even without "hands-on" training) could be of some value in the future. For advanced-level information professionals (e.g. at the postgraduate level), training in the conception, design, and use of systems involving a variety of information technologies is important. The key element is to teach enough so that information professionals can make informed choices or can effectively use technical expertise in these areas.

In addition, there is the issue of providing technical training to produce the ensemble of technical skills needed to support the information technologies themselves. This is related to the overall question of building up local information/information technology industries and infrastructure. It seems clear that regional and cooperative approaches are needed in many cases.

One area of particular concern is the difficulty in communication between information professions and those involved with the supporting technologies, for example, between documentalists and computer systems analysts and programmers. Just as it is important that information professionals be exposed in their training to computer-based applications, so too should computer professionals be exposed to information applications (including, for example, documentary databases, text-based systems, statistical databanks, etc.).

3. The need for local information and informatics industries

In many developed countries, the "information" sector is already recognized as an important one in the economy, especially if one includes activities which produce or integrate the technologies, tools, and services to support it (including, for example, computers, software, data communications, etc.). However, in some developing regions, this sector is very small and often virtually unrecognized, even as a potential vehicle for economic development. Many factors contribute to this situation:

shortages of skilled personnel, training and research facilities, telecommunications and industrial infrastructure, policies, professional bodies, and so on; furthermore, it would be unrealistic to expect major shifts into this area in the short term. Related to this is the fact that information is not often seen as a commodity of value, one that must be paid for somewhere along the way; this especially inhibits the financing of an information services sector, whether commercial or public sector.

It is evident that the ability to offer information services and to develop information technology skills is enhanced by a local capacity to produce, adapt, and maintain the technologies and tools; conversely, any local industry depends on a market and a supply of skilled personnel.

A key ingredient to the ongoing success of any information project is the availability of local technical expertise. This expertise can be required for training, system analysis and design, implementation, ongoing technical support, maintenance, evaluation, and so on. The advantages are evident: familiarity with local conditions, constraints, cultural factors; local contacts; ability to work in local languages; follow-up and ongoing support and availability to respond to queries; and (usually) a lower cost payable in local currency. However, the local supply of persons with such expertise may be extremely limited and sometimes in great demand; in addition, the depth and breadth of experience and familiarity with the latest advances in technology may be less than those of a "foreign" expert. Note that in the above discussion "local" expertise is taken to mean national or even regional as opposed to that coming from a developed country.

In some of the more technologically-advanced countries, the "information sector" is being viewed as one client of a potential "informatics" industry -- one involving computer hardware, software, and applications for a variety of uses including public and private administration, resource management, planning, and, of course, information. It appears that to be successful, regional strategies and cooperation will be required (to support the training, capital, and market needs), and that the emphasis should be on software and other non-capital-intensive (but information-intensive) industries. The entry point for effective

immediate action in many developing countries appears to be applications involving the microcomputer.

While information programs require adequate infrastructure, including local information and information technology industries, there are other related areas in which assistance can be provided: sensitization of policymakers to the importance of information as a tool for development; promotion of national policies in information and information technologies; support for the development and use of appropriate information technologies in information projects in the region; training; studies on specific needs for information sciences and informatics technologies (e.g. the types of software required in priority development disciplines); and so on. Finally, improved information services on the relevant technologies can promote greater awareness of existing gaps, and hence opportunities for the development of products and services.

4. The need for local experimentation with and adaptation of information technologies

Even when specific information technologies are known in developing countries (for example, through reading of the literature, especially literature from developed countries), there is often a lack of local experience with the technologies. This lack of experience is often tied to other lacks: training, local expertise, maintenance, etc.; in many ways, it is a vicious circle.

Experience with a tool or technology can be gained in essentially two situations: when the object of the exercise is experimentation/testing/adaptation of the tool or technology, or when the tool or technology is simply being used to carry out some function within an information system or service. It should be noted that, in the former case, the testing should still be linked to a "real-world", user-driven application, although certain experimental constraints or conditions can be imposed; in the latter case, some attention can still be placed on evaluating the "appropriateness" and success of the tool or technology in question. In both cases, user feedback and evaluation are crucial.

Adaptation refers to making changes to the tool or technology itself or to the way it is used in order to make it more "appropriate" to the user or application at hand. Thus, changes to hardware, software, language, character set, documentation, interfaces, application for which used, or even environment in which used, can all be considered adaptations. To the extent that such work can involve major changes, novel approaches, innovative uses of the technique or development of new technologies and tools, this adaptation process can be considered applied research.

The reality of the situation in developing countries today, especially with regard to the newer information technologies, is that these are imported from the developed world. Without going into a debate on the desirability of this approach in the long term or the likelihood of a local information/information tools industry, it appears that working with imported technologies is here to stay in many developing countries for quite some time and has the potential to greatly assist with information delivery and development processes.

5. The need for "appropriate" information tools and technologies

In establishing and operating information systems and services, information workers make use of a variety of information tools, technologies, and methods -- both manual and automated. The selection of these tools and technologies, especially at the design stage of an information system or service, usually has a major impact on the requirements for funding, personnel, infrastructure, and connections to other systems, and on the overall effectiveness of the activity. However, the choice of an appropriate tool or technology is often a difficult one, depending on: local infrastructure; available information; experience with and availability of adapted, documented, and useable tools or technologies; local expertise; and standards.

But what is an "appropriate" tool or technology? Is it to be appropriate with reference to: training and skills of the personnel who will use it (present or potential), clientele for whom it will ultimately be used, institutional environment, local infrastructure, physical requirements, local support and

maintenance, financial resources, functional requirements, volume and type of information to be handled, regulatory constraints, current practices of other related information services, standards, changing circumstances and conditions, etc.? Ideally all of the above conditions apply, as well as others. Each case must be studied carefully and individually before a choice is made.

III. ONE DONOR'S RESPONSE: INFORMATICS AT IDRC

A wide variety of requests for assistance in meeting needs such as have been described above are communicated each year by developing countries to the International Development Research Centre (IDRC), a public corporation established by the Parliament of Canada in 1970 to stimulate and support scientific and technical research by developing countries for their own benefit. IDRC is somewhat unique among development aid agencies because it has stressed information sciences from the outset, in addition to its support for programs in agriculture, food and nutrition sciences; health sciences; and social sciences.(2) Within the Information Sciences Division at IDRC, programs provide support for: information systems and services within various sectors of importance to development, including socio-economic information and scientific and technical information; development and distribution of a database management software package (MINISIS) and other computer-based tools; operation of the Centre Library; and research and experimentation with different information technologies, tools, and methods for managing, storing, and retrieving this information and delivering it to its end users.

The latter Information Sciences Division program, known as Information Tools and Methods (ITM), provides support for research and experimentation covering a variety of technologies and disciplines, including informatics, telematics, cartography and remote sensing, micrographics and other storage technologies, and statistical systems and methods. Activities supported include: information systems, networks, and services on specific technologies and methods; technology assessment, selection, evaluation, and testing; feasibility studies and technology demonstrations; pilot projects and experiments; technology introduction and transfer; technology adaptation and development;

education and training; and documentation and exchange of experience.

IDRC's Informatics program, located within ITM, concentrates on tools to assist with the management of information for research and development planning in general, rather than those supporting strictly administrative applications. Furthermore, it supports the development, adaptation, and testing of information tools which are in some sense "new", and hence add to existing knowledge, and which thus may be unfamiliar to many current users in developing countries. These are, however, often general-purpose tools, useful in different sectors and applications, and the Informatics program encourages their application in different domains. Because the need for relevant software has been expressed so often, a great deal of attention has been given to the development of software packages to help solve some of the pressing problems of developing countries. The improvement of the supply of professional information to informatics workers has also been the focus of several activities funded by the program; building up informatics skills is an important component of nearly every project undertaken by the Informatics program. Some of the projects of the Informatics program are described below (3).

Informatics can provide useful tools for a variety of development applications, even (or, in some cases, especially) using low-cost microcomputer equipment. For example, several years ago it was recognized that the increase in external debt in many developing countries had led to a need for better methods of recording, managing, and analyzing information related to a country's overall borrowings. The Commonwealth Secretariat had studied the debt situation in several developing countries and had concluded that a computerized system using readily-available microcomputer technology could solve many of the information problems related to debt management. In a series of projects, IDRC has supported the development and initial testing of the necessary computer software comprising such a system (called CS-DRMS), and the preparation of appropriate training materials. The system is now operating in a pilot project in Sri Lanka with IDRC support, and in several other countries as well.

Statistical agencies are frequently asked for census data for small geographic areas which can be used in planning new facilities. For the most part, the agencies are not able to meet these requests because the work required to retrieve and subsequently process the necessary data is excessive, and staff resources are limited. To help solve this problem, IDRC is supporting work at the Latin American Demographic Centre (CELADE) in Santiago, Chile, to develop a microcomputer-based software package for the creation, storage, and retrieval of small area census information. Project participants are producing computer program documentation and user manuals in both Spanish and English, and testing the software package in centres in St. Lucia and Chile.

The creation of ways to manage and consult the increasing quantity of scientific and technical information is imperative for developing countries such as Cuba. However, there are various possible approaches which can be taken. In a technology investigation and demonstration project, the feasibility and appropriateness of decentralized microcomputer-based systems using Local Area Network technology for information management within Cuba's National Scientific and Technical Information System is being examined. This is being done by implementing pilot systems, including automating periodicals management at the national and sectoral levels, and by integrating these systems into an overall system. The results will improve services to users of scientific and technical information in ministries, research institutions and universities.

Microcomputers can also assist with training of researchers. In one project, the International Rice Research Institute (IRRI) in the Philippines is developing an information retrieval system for training objectives, and microcomputer-based instructional systems that will document and store the technical content of IRRI production courses in a modular format adaptable for dissemination in print, slide/tape, or computer-aided instruction format. These teaching media can be used interactively and individually by students, enhancing their learning and retention of the material. As well, this courseware can be replicated and/or customized for use by national rice research institutes.

Sometimes simple guidance and advice is needed for organizations about to undertake automation. In India, the Centre for Development of Instructional Technology (CENDIT) is developing a manual to provide structured, impartial guidance to research institutions and library and documentation centres on how to select and implement minicomputer and microcomputer systems. This manual will contain case studies of small- to medium-sized institutions that have gone through, or are about to go through, the process of automating their bibliographic, cataloguing, word processing, data analysis, and other user and data management services. The manual will be distributed to libraries and small research institutions in India, and interested institutions in the region and elsewhere.

In other cases, information on techniques is what is required. For example, most work in development-policy modelling is conducted at centres in the developed world, and detailed information about current findings and advances in methodology is not readily available to workers in developing regions. IDRC has supported the establishment of the Information Centre on Development-Policy Modelling at the Systems Research Institute (SRI) in Pune, India. The Centre is collecting, processing, and disseminating information on development-policy modelling; adapting models which can be run on SRI's minicomputer; selecting some of these models and creating transportable versions of them to run on a microcomputer; preparing user manuals for these computer applications; holding workshops to make information and training available on modelling techniques; and demonstrating the use of these techniques on a minicomputer and microcomputer.

One challenge in North African countries has been the introduction in computer systems of Arab characters alongside Latin ones. IDRC is supporting a project to promote interconnection of electronic messaging systems within a multilingual context. The Centre National de l'Informatique (CNI) will set up a bilingual (French and Arabic) message system in Tunisia using the telex network and conforming to international standards. This will lead to an exchange of information between countries in the region and will reduce constraints researchers now face.

Different languages often introduce complexity in computer processing as well. In another informatics project, IDRC is

assisting the Institute of Scientific and Technical Information of China (ISTIC) to prepare a union catalogue of Chinese scientific and technical periodicals held within the institutions belonging to the ISTIC system in China -- in Chinese. To accomplish this, ISTIC is writing the required computer software and procedures and is acquiring appropriate equipment for processing Chinese character information. The resulting database will lay the groundwork for Chinese participation in the International Serials Data System (ISDS).

Of course, new technologies continue to develop and require testing in circumstances appropriate to the needs of developing countries. For example, one set of developments involves the use of optical-disk technologies to store bibliographic references, pictures, and even full text in a computer-accessible format. One such technology, CD-ROM (Compact Disk - Read Only Memory), is actively being developed and tested around the world, especially in conjunction with microcomputers. IDRC is supporting the testing and evaluation of CD-ROM technology for the delivery of bibliographic references within six IDRC projects and the Centre Library. An analysis is being carried out on CD-ROM's potential impact on the information sciences field, particularly as applied within developing countries.

In a related project, IDRC is assisting the Consultative Group on International Agricultural Research (CGIAR) to investigate alternative methods of permanently preserving its publications, as well as of increasing international awareness and availability of these publications, particularly in developing countries. Project participants are collecting CGIAR scientific and technical literature; cataloguing and indexing this literature; physically preparing the materials for conversion to either microfiche or optical-disk storage; and analyzing the technological feasibility and market acceptability of using optical-disk technology versus micrographics technology for preserving and disseminating the publications.

Finally, through the Information Sciences Division's Computer Systems Group, IDRC itself has also been involved in software development, mainly involving its MINISIS program, with results that have proven useful for many developing countries. MINISIS is

a generalized information storage and retrieval system developed, disseminated, and supported by IDRC. The computer software operates on the Hewlett Packard 3000 family of minicomputers. The MINISIS package provides for the design of relational database structures; data entry and modification; information retrieval using phrases, keywords and Boolean operators; SDI profile execution; multi-level sorting; flexible formatting for printed output; arithmetic calculations; and the exchange of information in the ISO 2709 format. Since MINISIS became operational in 1978, it has been installed in over 190 organizations, including more than 115 in developing countries. Although MINISIS was originally developed to manage bibliographic data, it is general enough to support a large variety of textual applications. Some examples include: project information systems, mailing lists, registries of correspondence, directories of consultants, inventory systems, historical and museum artifact data banks, meteorological information services, and chemical toxicology databases.

The MINISIS software operates in a variety of languages and permits users to manage information stored in different character sets. Through the use of discrete dialogue files, it is possible to operate MINISIS and process data stored in a combination of Roman-based languages, as well as Arabic, Greek, Thai, Korean, and Chinese. In addition, the multilingual thesaurus capabilities of MINISIS make it possible for searchers to find information indexed not only in the languages of the search but also in other language equivalents. MINISIS is an important part of the Information Sciences Division's program to transfer information technology to developing countries. It is a tool which provides developing countries with the capabilities to manage their own information more effectively and to easily exchange information with others.

IV. CONCLUSIONS

As can be seen from the examples discussed above, informatics-based technologies can play an important role in a wide variety of development-related information applications. New technologies and tools bring with them an immensely complex range of issues -- social and economic, as well as technical. Developing countries are demanding relevant information upon which to base their

decisions. The need for experimentation, open discussion, and information dissemination has never been greater.

The international community has an important role to play in keeping the dialogue open and active between developed and developing countries, as well as among developing countries themselves. However, it is through the work carried out by developing countries themselves -- at times in partnership with others in both the developing and developed world -- that significant, long-term progress will be made in harnessing informatics for development.

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