Programmed for Success

The Story of MINISIS

prepared for the
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of the
International Development
Research Centre
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A special responsibility given the Centre by its statute is that of assisting developing countries in the acquisition, storage and use of scientific materials so that they may keep abreast of the explosive increase in information. As part of that responsibility, the Centre designed and perfected a bibliographic data management system -- software -- which functions on a minicomputer. It is called MINISIS, and is acknowledged as the most powerful system in the world.[01]

Le projet MINISIS a été, pour le groupe des Sciences de l'informatique, un succès dépassant toutes les espérances.[02]

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Introduction -- the problem developed

Opportunity and need in the new IDRC library.

In 1971, the Centre Library was created as an on-going in-house project (now numbered 3-P-YY-7404) of the Information Sciences Division. At its creation, the Library was charged with two principal responsibilities: to facilitate access to information about the social and economic aspects of development, and to serve as a site for experimentation in the information sciences. In discharging its responsibility of facilitating access to development information, the Library gives priority first to Centre staff, and then to Centre projects, the Canadian development community, and (to the extent that resources allow) to others working or interested in the field of development. In serving as an experimental site, the Library participates in the development of technological, methodological, and bibliographical innovations and standards which may have application both in Centre projects and in the international community.[03]

The rôle of computers in the development of the Centre Library was considered in the earliest stages of the Library's formation. First consideration was given to automation of the Library's basic operations. Such automation was understood to be necessary if the Library were to grow large enough to meet the demands for access to development information put to it by its various clients. In 1972 alone, the Library's first full year of operation, staff answered more than 1700 reference questions, filled 2500 requests for books (1400 of which were borrowed from other libraries in Ottawa), subscribed to 1200 periodicals, acquired 2800 books (and had 1000 more on order), and assembled collections of microforms and printed documents from "international organizations, national governments, research centres, local associations, and universities."[04] In order to successfully perform its work, the Centre Library would need to computerize.

Second consideration was given to the gathering of experience relevant to the computerization of libraries, information centres, and documentation centres. Information-collecting, -analyzing and -disseminating organizations in developing countries were expressing the same interest in learning about, and using, newly-developing computer technology as were their counterparts in developed countries. In order to speak knowledgeably and authoritatively about the application of computers to the problems of information management, and in order

to offer practical advice and assistance to developing countries, the Information Sciences Division required first-hand experience with computer technology. In accordance with its mandate, the Centre Library would be the site at which such experience was gained.

Choices and considerations for computerization.

Any system obtained by the Centre Library, to automate its operations and to provide the computer experience which the Information Sciences Division wished to acquire, would need to be international in its orientation. An internationally oriented system would be one which had been adopted by major international agencies, or one whose use was predicated on internationally accepted standards and practices for the exchange of bibliographic data. The choice of an internationally oriented system would enable IDRC to participate in networks which might be established in the future to exchange development-research information.

From a technical standpoint, the Information Sciences Division saw that the structure of such a network must provide four principal elements. The first element is a uniform format for bibliographic data, oriented towards content abstracting and indexing, and compatible with the databases of cooperating United Nations (UN) agencies. The second element is an organization of compatible computer installations, operating in parallel or cooperatively, between which records from development-research information databases could be exchanged. The third element is a set of computer programmes, adequate for the needs of each network participant, to create, maintain, search, and disseminate information collected for such databases. The fourth element is an organization of regional input/output centres in developing countries, which would enable those countries to contribute their own development-research information, and, in addition to accessing information contributed by developed countries, access information contributed by other developing countries.

The prospects for a network to exchange development-research information were bettered, in 1972, with the acceptance by the United Nations Inter-Organisation Board for Information Systems and Related Activities (IOB) of a grant from IDRC for the creation of a single, computer-readable database of the documents processed by the International Labour Organisation (ILO), the Food and Agriculture Organisation (FAO), and the United Nations Industrial Development Organisation (UNIDO)[05]. In addition to

the recognized requirement for an automation system for the Centre Library, then, the Information Sciences Division anticipated that it would soon require a computer facility which could provide Centre staff, Centre projects, and the rest of the Canadian development community with access to this important UN database and to others which would follow.

The nature of IDRC's mission demanded that the system chosen for use by the Centre, besides having an international orientation, be one that easily could be made available to developing countries. This constraint on the choice made the selection of a commercial system unlikely. A more likely choice would be a system within the public domain, or one available at minimal cost.

The experience with ISIS.

The only nonproprietary computer system which was capable of handling normal library operations, and which met the Information Sciences Division's criteria of international orientation and developing-country availability, was the Integrated Set of Information Systems (ISIS) developed by the International Labour Office (ILO) of the International Labour Organisation.

At the time of IDRC's interest in obtaining a computer system for the Centre Library, ISIS was the product of several year's development by the ILO. In one form or another, ISIS was operating with success at the Organisation for Economic Cooperation and Development (OECD); at the Swedish Agency for Administrative Development (SAFAD), on behalf of the Swedish International Development Agency (SIDA), and the Ministry of Foreign Affairs, among others; at the Mexican Ministry of Labour and Social Welfare (STYPS); at the Bucharest Management Development Centre (CEPECA) in Rumania; at the Centro Latinoamericano de Documentación Económica y Social (CLADES) of the United Nations Economic Commission for Latin America (ECLA); at FAO; at UNIDO; and at ILO itself.

In 1972, a consulting firm was engaged by the Information Sciences Division to study the feasibility of implementing ISIS at IDRC[06]. The study's terms of reference called for "a professional assessment of the [ISIS] system, including discussion of the terms of its release by ILO, choice of a suitable host computer facility, diagnosis of problems and procedures for its installation, a cost analysis of the installation, maintenance, operation and development requirements

and the options available."[07]

The conclusion of the study was that the implementation of ISIS at IDRC was both feasible and likely to satisfy the needs of the Centre; and in addition to answering various technical questions, three principal policy recommendations were made:

(1) that IDRC acquire ISIS from ILO;

(2) that ISIS be run at an Ottawa service bureau for an initial period of one year; and

(3) that the Centre "consider further the option of recoding the system for a smaller computer, particularly in the light of the reduced budgets it may offer."[08]

Supported by the results of the feasibility study, the Information Sciences Division sought and received Executive Committee approval to acquire ISIS from ILO, and to implement the system in Ottawa[09]. On 1 June 1973 the Centre signed an agreement with ILO which gave IDRC the right, without charge, to the noncommercial use of ISIS for IDRC's internal administration, to share ISIS on a noncommercial basis with nonprofit governmental and academic institutions, and to use ISIS "for purposes of demonstration and education."[10]

The Centre's use of ISIS at an Ottawa service bureau began in mid-1973, and ended in early 1978. While the use of ISIS met the goals which the Information Sciences Division had set, many difficulties were encountered with the service-bureau operation. The most significant difficulty was cost; the cost of entering a single item into a database, for example, was estimated by the Centre Librarian to be $12.50. Annual costs for the entire ISIS operation were on the order of $180 000.

Other problems with the service-bureau operation were experienced. First, system development was found to be costly, time-consuming and inefficient. Second, scheduling of ISIS operations to provide optimum service to Centre Library clients was difficult. Third, since the version of ISIS which IDRC had chosen to acquire from ILO could run only on the computers of a single Ottawa service bureau, the Centre found itself bound to that bureau. Fourth, as the agency responsible for the nonprofit, noncommerical use of ISIS in Canada, the Centre increasingly was uncomfortable with the need for commerical dealings with a service bureau.

Introduction -- the problem developed

Although the operation of ISIS at a commerical service bureau posed problems for IDRC, overall the use of ISIS was a success. The primary goal of the Information Sciences Division, namely the automation of the Centre's Library, was met. In addition, the Library was able to construct computer-readable records of its holdings, in an format suitable for international database exchange, and was able to search other databases provided on magnetic tape by international organizations such as UNIDO and ILO.

The secondary goal of the Information Sciences Division, that of gaining valuable experience in library and documentation-centre automation, was met also. However, the Division was aware that the experience which it had gained would only be of use to developing-country institutions which had access to medium- or large-scale computers. While it would never be possible for IDRC to provide such computers to developing countries, it was becoming increasingly clear that there was a need to provide in IDRC developing-country projects some system of computerization for regular library operations, information retrieval, and participation in international information-exchange networks.

The Information Sciences Division foresaw, also, the need for a computer system, more economical than service-bureau ISIS, which could be used in the Canadian node of future international development-information networks such as the Development Sciences Information System (DEVSIS). As the Division had observed in its original proposal for the acquisition and implementation of ISIS:

> It is certain that a more comprehensive method of collecting and disseminating development information is required; that Canada, as well as the developing countries, must contribute information to a common pool as well as make use of it; and that to do so requires the implementation of an automated information storage and retrieval system. IDRC can play its part by ensuring Canadian input, by encouraging developing country input, and by ensuring that the mechanisms are in place in developing countries to allow them access to the common information store.[11]

Background -- the programme identified

The emerging technology of minicomputers.

As the Information Sciences Division defined its requirement for an economical computer system for use in developing-country projects and at the nodes of international development-information networks, the computer industry was entering a period of significant technological advance. A new type of computer, called a minicomputer, was entering the general-purpose computer market. The purchase and operating costs of these computers were low, in comparison to the costs of older, larger computers called "mainframes", and the ratio of cost to performance for the new minicomputers often was better than that of the old mainframes.

The original market for minicomputers had been industrial and scientific process-control operations. For this market, the computer manufacturers provided minicomputers which were basic, "raw" computing devices, for which factories and research institutions developed their own specialized operating systems and peripheral-device controllers. Over time, however, computer manufacturers were developing generalized operating systems suitable for the users, or potential users, of mainframe computers.

Mainframe computers were in use in nearly all developing-countries, but their principal applications were numerical: accounting, statistics, scientific data-processing, and so on. In addition, these computers usually were located in capital cities. Very few bibliographic applications were run on such mainframe computers, and such rare applications as did exist often were run only on an as-time-allows basis. These conditions militated against the use of developing-country mainframe computers by libraries and documentation-centres. As the Information Sciences Division itself noted: "we have been associated with several attempts to secure part-time use of large computers for bibliographic work; the experience has been a sorry one."[12]

The emerging technology of minicomputers allowed the Information Sciences Division to envisage the establishment of dedicated computer facilities for AGRIS/DEVSIS-type centres[13]. It was imagined that the relatively low operating costs of a minicomputer would allow such a centre to employ the one or two specialists necessary for operation of the facility; and that the relatively low purchase costs would obviate the need to seek

other, likely nonbibliographic uses for the computer in an attempt to justify, or share, the capital expense. The Division anticipated "a major breakthrough in building indigeneous capacities in information science"[14] if a minimum cost minicomputer system, comprising both the computer itself and the appropriate computer programmes, were offered to AGRIS/DEVSIS-type centres in developing-countries as part of a turnkey package.[15]

The Macrothesaurus, and other needs.

The Information Sciences Division was able to derive an understanding of the components necessary for such a turnkey package from the experience in library and documentation-centre automation gained through the use of ISIS. One important component was international acceptance of the ways in which the computer programmes would process information, store information, and prepare information for inter-agency exchange. For example, ISIS already had achieved such acceptance: as an information processor, as an internal file structure, and as a bibliographic record format[16]. A second necessary component for a turnkey package was a suitable indexing tool, commonly called a thesaurus. The Information Sciences Division had long been interested in the development of a multilingual thesaurus[17], and recognized the importance of including such a thesaurus in the turnkey package. In fact, as part of the Division's contribution to the development of ISIS, staff of the Information Sciences Division, in collaboration with a Division consultant[18], had modified ISIS so that it could support a multilingual thesaurus.

In a development-research information network, a multilingual thesaurus is needed to serve (among other rôles) as a translator between the indexing language of any one network participant, and the languages of the others. This translation function enables the retrieval of information without regard to the language in which it was indexed. As originally acquired from ILO, ISIS supported only a monolingual authority file. The carrier language of ISIS was English, and regardless of the language in which an ISIS-stored document was written, it was indexed in English. However, after the Division's modification, ISIS supported multilingual information retrieval. This meant, for example, that a Spanish-language document indexed with the term "desarrollo" could be retrieved by a French-speaker searching for "développement", or an English-speaker searching for "development."[19]

Several other components of the turnkey package were understood to be necessary. One of these was a mechanism for producing specialized bibliographies and directories, such as those which had already been produced by IDRC with ISIS[20]. Another component was a means of providing a current-awareness service, often called "selective dissemination of information" (SDI), which would bring to the attention of the clients of such a service current documents likely to be of particular interest. A third component thought necessary for the turnkey package was a method of producing indexes more sophisticated than those produced by ISIS. In particular, methods were required for the production of a "key words out of context" (KWOC) index; for the sorting of indexes on more than one key; for "see" and "see also" references; and for the efficient production of supplements to indexes printed annually, such as author and title indexes.

Minicomputer development (ISIS).

In order to ascertain the feasibility of constructing the desired minicomputer-based turnkey package, the Information Sciences Division engaged a consultant in 1975 to develop a specification for such a minicomputer system[21]. The consultant did so, producing a report[22] which detailed considerations for the system's file structure, command functions, system requirements, hardware requirements, etc. In addition, the report confirmed the Division's assessment of the system's feasibility, and the timeliness of proceeding with its construction.

The report noted that a minicomputer system dedicated to a bibliographic application would give better service than would a system shared by several applications, as the Division had supposed. The report also observed that recent developments in computer technology meant that the computing power of some minicomputers now exceeded that of some mainframe computers; that appropriate and sufficiently sophisticated operating systems, and system utilities, were now available for use on minicomputers; and that the manufacturers of such computers and operating systems were providing support adequate to the needs of most minicomputer users.

With the confirmation afforded by its consultant's report, the Information Sciences Division in March 1976 proposed to IDRC's Board of Governors a project for the development of a minicomputer version of ISIS[23]. Once completed, and running within the Centre, this minicomputer system was expected to

reduce, by approximately $150 000 per annum, the costs associated with the Centre's computer operations. (As mentioned earlier, the cost of running ISIS at the Ottawa service bureau was on the order of $180 000 per annum.) The project also was expected to result in the definition of "an optimum-cost-benefit [sic] minicomputer installation that could be offered, complete with programs, for AGRIS/DEVSIS/ISIS activities at national centres in developing countries,"[24] an activity which the Division thought might become very important in its future programme of work. In addition, it was anticipated that the project would give the Division the direct experience necessary for it to advise developing countries, to make available the skills required for computer installations, and to train developing-country personnel in computer operations.

As submitted to the Board of Governors, the project proposal listed, in part, the following objectives:

> to design, build, and operate an ISIS-based system ... for information storage and retrieval, and for library management, using minicomputer equipment;
>
> to eliminate the use of service bureaux, thereby achieving substantial cost savings;
>
> to define a low-cost turnkey information storage and retrieval system suitable for installation in developing countries, ... which would enable them to participate in international cooperative networks;
>
> to build within IDRC an expertise in the general area of information systems and data processing, using minicomputers.[25]

On 15 March 1976 the Board of Governors of IDRC approved the proposal of the Information Sciences Division, and granted it an amount of up to $409 457, over a period of up to 24 months, for the development of a minicomputer version of ISIS.

Phase 1 — the technics accomplished

Hardware ABC's: analyses, benchmarks, choice.

The first step along the road to the development of a minicomputer version of ISIS was the acquisition of the minicomputer itself, and its accompanying systems and utilities programmes. The minicomputer recommended for acquisition by the Information Sciences Division, in its project proposal to the IDRC Board of Governors, had been selected through an active programme of analysis and testing. This programme had taken into account three major factors. First, the monetary and staff resources which would need to be committed to the project, both to buy and maintain the necessary computer, ancillary equipment, and related supplies, and for in-house systems development. Second, the extent to which candidate computers were available and supported in developing countries. And third, whether bibliographic applications were to be central to the operation of the computer, or merely "first" among other equally-important applications of various Centre divisions.

Early in its consideration of the issues associated with the selection of a particular minicomputer, the Information Sciences Division had decided that computer operations should be confined to a single site within the Centre's headquarters building, and that it should be possible for the staff of the Division to manage wholly their bibliographic applications themselves. Further, it should be possible for developing countries to use the computer programmes of which minicomputer-ISIS would be composed without difficulty on computer installations smaller than that which the Centre would choose for itself; and it should be possible to operate such smaller installations as easily as the Centre's.

After much discussion within the Centre about the possible uses of the minicomputer by other IDRC divisions, it was decided that while consideration would be given to these possibilities, they would not be given priority in the Division's deliberations. To this end, it was decided that the selected computer hardware (the computer itself, and ancillary equipment) and software (the computer programmes; in this case, the systems and utilities programmes) were to be the minimum necessary for the successful development of minicomputer-ISIS.

With these factors and decisions in mind, the staff of the Information Sciences Division asked major manufacturers of minicomputers, and those Canadian system houses which sold turnkey minicomputer systems, to demonstrate their products. When examination of the available turnkey products revealed that the goals of the Centre's minicomputer project could best be met by a system developed in-house, Division staff invited ten manufacturers to submit proposals for the provision of computer hardware and software on which minicomputer-ISIS development could be based.

The requests for proposals made of the minicomputer manufacturers stressed three important criteria: the power of the minicomputer's operating system, the reliability and availability of the systems and utilities software, and the minicomputer's ability to handle a varied mixture of jobs. Also included in the request for manufacturers' proposals was a requirement that all proposed products be tested against a benchmark devised by Division staff. This benchmark was an extension of one developed in 1974, by the United Nations' Educational, Scientific, and Cultural Organisation (UNESCO), for an evaluation of the proposals of mainframe-computer manufacturers. The Centre's benchmark extension included components which simulated the functional demands which minicomputer-ISIS likely would make of a computer and its operating system, and thereby increased the rigour of the benchmark.

Of the ten manufacturers invited to submit proposals, three replied; and of these three, two replied with proposals for the use of mini-, as opposed to mainframe, computers. Of the proposals submitted by these two manufacturers -- Hewlett-Packard (HP) and Digital Equipment Corporation (DEC) -- the one from HP was judged to be superior.

The minicomputer proposed by Hewlett-Packard, the HP 3000, clearly outperformed its rival, the PDP 11/70, on the benchmark test. Hewlett-Packard offered a range of minicomputers, from rather small to rather large, which all were based on the same central-processor and which all used the same operating system. Further, it was widely agreed that the support offered by HP was better than that offered by DEC. In addition, the staff of the Division judged as above average Hewlett-Packard's understanding of IDRC's requirements and their approach to a joint effort with IDRC, and judged the calibre of their software specialists as excellent. Also, HP provided support for the 3000 in Asia and South America, and had plans for extension of support to South Africa, Japan, Taiwan, New Zealand, and the Philippines.

After careful consideration of the Centre's requirements for a minicomputer, extensive research into the available options, and an exhaustive analysis of their findings, the staff of the Information Sciences Division were able to state that "for the hardware and the basic software we fully recommend [the] Hewlett-Packard 3000CX minicomputer for the needs of IDRC."[26]

System design and the relational model.

Once the selection of a minicomputer had been made, and their project approved by the IDRC Board of Governors, the staff of the Information Sciences Division were able to turn their attention to considerations of the design of the minicomputer version of ISIS. At the time of the project's approval, in early 1976, three models of database design were popular among computer scientists. These were the network model, the hierarchical model, and the relational model.

Although the relational model was then relatively new to the field of database design, it was decided to adopt this model for the design of minicomputer-ISIS. Through adherence to the relational model, the system developed by Division staff was given a coherence and integrity which otherwise would have been difficult to achieve.

The relational model of databases is based on the mathematical theory of relations[27]. As applied to databases, a relation can be thought of as a collection of unique database records, called "tuples". Each tuple, in turn, can be thought of as a collection of elementary data fields called "domains."[28] Taking these concepts further, a relation can thought of as a table made up of rows and columns, such as one might encounter in financial or scientific publications. As determined by the mathematics of relations, such a table has several important characteristics:

(1) no two rows in the table are identical;

(2) in the cells at the intersections of rows and columns, only single values are found; that is, no <u>sets</u> of values, or repeating groups, are allowed; and

(3) the contents of columns in the table are homogeneous.

Relational mathematics provides an algebra for the manipulation of relations conceived as having the table structure described above. This relational algebra provides a set of relational operators for the manipulation of the table as a whole. (The term "operators" is used in the sense that multiplication, division, addition, and subtraction are "operators" of conventional algebra.) Moving backwards from the metaphor of a relation as a table, it then can be said that relational algebra provides for the manipulation of a collection of database records, or more simply still, for the manipulation of a database.

The relational algebra provides a set of three basic relational operators: JOIN, PROJECT, and STORE. The operation of JOIN is the joining together of two or more relations using a common domain as a bond. Using the table metaphor, the action of joining databases is equivalent to expansion of a table by the addition of the columns of one or more others. For example, if two tables each have an identical column, joining the second to the first is equivalent to expanding the first by adding to it all of the columns of the second, except for the identical column.

Continuing with the table metaphor, the operation of PROJECT can be said to be the creation of a new table (i.e., a new relation) composed of one or more columns from an original table. The operation of STORE can be said to be the insertion or deletion of one or more rows into/from a table (i.e., the insertion or deletion of one or more records into/from a database).

In the same way that it provides an algebra for the manipulation of relations conceived as having the table structure described above, relational mathematics provides an algebra for the manipulation of domains conceived as being part of the same table structure. This domain algebra provides a set of domain operators for the manipulation of the individual cells found at the intersection of the rows and columns of the table. Moving away from the metaphor of a relation as a table, it can be said that the domain algebra provides for the manipulation of elementary data fields.

The domain algebra allows the application to domains of the operators commonly employed in database systems. These include conventional arithmetic operators (+, -, /, *, etc.), logical operators (AND, OR, NOT, XOR, etc.), and string operators (truncate, concatenate, extract, etc.). These operators may be

applied horizontally, that is, on one or more domains, a tuple at a time; or vertically, on one domain across all tuples. In terms of the table metaphor, horizontal operators are applied on one or more columns, a row at a time; and vertical operators are applied on one column, across all rows.

Within the relational model of databases, relations are considered the principal entities which contain data. This consideration leads to the conception of customized views of the data contained within the relations. These customized views, provided by so-called "data submodels," in effect redefine data to meet the needs of database users.

The virtual redefinition of data afforded by data submodels is accomplished by the specification of operations to be performed on a relation, or a set of relations. While other models of database design allow some redefinition of data, only the relational model adopted by the staff of the Information Sciences Division permitted a uniform approach to data at all levels within the model. As Division staff themselves noted:

> The concept of data definitions is an integral part of the system software, and it is this which gives the [minicomputer-ISIS] system its flexibility -- the system can, in fact, process any data that can be broken down into sets of defined elements.[29]

FERRIS: the technical feat.

The minicomputer-ISIS system was developed by the staff of the Information Sciences Division after 45 person-months' labour. This work was performed by a team of two for 12 months, and a team of three for an additional 7 months. Throughout its development, the minicomputer-ISIS system was known by the working-name "FERRIS." This name, an acronym for "Faye's Extraordinary, Reliable, Relational Information System", was chosen to honour its project manager and principal designer, Faye A Daneliuk. While the working-name was chosen light-heartedly, it was no misnomer. Faye's (and Terry A G Gavin's, and Richard Lee's[30]) relational information system <u>was</u> extraordinary: in its conformity to the relational model on which it was based, in its adherence to the design principles established for it, and in the elegance of its execution.

Phase 1 -- the technics accomplished

The general design principles for the minicomputer-ISIS system were established, before any development work began, by the staff of the Information Sciences Division and members of the MINISIS Design Review Committee. This committee was struck by the Division to advise the minicomputer-ISIS team on its system design work, and the committee both made recommendations and proposed solutions to this effect. The terms of reference of the committee were threefold: to consider the progress of the work of system design, to consider particular design features, and to consider the issues of compatibility with other systems.[31]

Within the constraints of the relational model of database design, the principles established by the Design Review Committee guided the development of FERRIS. The most important of these principles were as follows:

(1) the system was to be general-purpose, to the largest possible extent;

(2) the system was to be constructed entirely of modular components, so that it could be maintained and extended easily;

(3) applications functions, such as querying the database and printing database records, were to be independent of database management functions, such as defining database structures and inverting database fields;

(4) the system was to provide a wide variety of outputs;

(5) the system was to accept, as input, output from other information systems;

(6) the system was to be easy to understand and to operate;

(7) operation of the system was to be possible within a small organization; and

(8) the system was to be compatible with international systems such as ISIS and AGRIS.

In addition to establishing these design principles, Division staff decided that FERRIS would be more than a simple reprogramming of ISIS for operation on a Hewlett-Packard minicomputer. Rather, the decision was taken to design an entirely new system which, while still compatible with ISIS, would extend and improve upon its functions, and meet the requests of the Centre Library

for new features.

This decision to design a new system allowed the staff of the Information Sciences Division to take advantage of the capabilities and sophistication of both the advanced architecture of the HP 3000, and of its operating system. FERRIS was designed to make use of the systems software provided by Hewlett-Packard (such as the file system, the text-editor, and the utilities for sorting and merging files), but no modifications were made to this software. In this way, Division staff guarded against the need to revise FERRIS whenever Hewlett-Packard revised its systems software.

As the first implementation-ready version of FERRIS neared completion, there were several discussions within the Information Sciences Division as to an appropriate, formal name for the new system. In the end, the name "MINISIS" -- meaning "MINIcomputer-ISIS" -- was chosen so as to reinforce the idea of the system's membership in the international family of ISIS-derived database management systems.

As the following observations demonstrate, MINISIS, in its original and subsequent versions, meets virtually all of the requirements which had been set for it during its conception and development.

- The Information Sciences Division operates MINISIS at a single site within IDRC's headquarters building, and the staff of the Division are able to manage wholly the Division's bibliographic (and other) applications.

- Developing countries are able to operate MINISIS on computer installations smaller than the Centre's, and such operations are run without technical difficulties.

- MINISIS provides for standard library management functions, such as reference, acquisitions, cataloguing of monographic literature, and processing of serials, as well as for more advanced functions such as the production of specialized bibliographies and indexes, and current-awareness or SDI.

- MINISIS supports the use of alternate character sets.

- MINISIS is a highly-interactive system. In addition, MINISIS allows users the choice of executing most functions in batch mode.

Phase 1 -- the technics accomplished

- MINISIS is an effective, practical implementation of a relational database management system, with true variable-length fields.

- MINISIS is, to a large extent, general-purpose.

- MINISIS is totally modular.

- MINISIS applications functions are totally independent of the intrinsic functions of database management, the so-called "database primitives."

- MINISIS is relatively easy to understand and operate.

- MINISIS is a compatible member of the ISIS family of information systems, and supports the exchange of data in internationally-recognized formats. As well, MINISIS can support the activities of AGRIS/DEVSIS-type centres.

- Although not supported by the staff of the Information Sciences Division, there also exist MINISIS applications programmes which provide library circulation functions, and which offer more sophisticated help-functions for users.

Phase 2 -- the solution presented

The establishment of distribution policies.

Before the completion of the first version of MINISIS, word of the development at IDRC of a minicomputer-based information system had spread quietly throughout the international community. Inquiries regarding the new system's use and availability had arrived at the Centre all through the period of MINISIS development; and while the response of the Information Sciences Division was positive, its answers reflected the Division's inclination to play down the activities of its minicomputer-ISIS project until the new system was actually up and running.

In January of 1978 the new system was up and running. The Centre Library had just begun its full-time use of MINISIS, and was preparing to end its service-bureau use of ISIS. While not all of the required MINISIS applications functions were immediately available (notably absent was an integrated QUERY processor), all functions necessary to the Library were in place within a few months' time.

Pleased with the remarkable progress of MINISIS development, and the growing success of MINISIS operations within the Centre, the Information Sciences Division decided that the time was ripe to announce to the international community the arrival of the newest member of the ISIS family. The forum chosen for this announcement was a NATO AGARD[32] conference, held early in 1978 in Turkey and the Netherlands, on the application of inexpensive minicomputers to information work. At the conference a paper was presented on the design and implementation of MINISIS at IDRC, offering the first-ever public description of the Centre's minicomputer-ISIS project.

This description of MINISIS was well received, and before long several requests for MINISIS had landed at IDRC. The first such requests actually to result in the acquisition of MINISIS were those from the National Sports and Recreation Centre (NSRC) in Ottawa, the Library of the Wageningen Agricultural University (AGRALIN) in the Netherlands, and the Centre national de Documentation agricole (CNDA) in Tunisia.

For its Sports Information Resource Centre, NSRC had been sharing with IDRC the use of ISIS at the Ottawa service bureau. Having been informed before-the-fact of the Centre's plan to discontinue its service-bureau operations, NSRC at the time of

the public announcement of MINISIS was ready and eager to adopt the new system. Also ready for a new system, at the time of the MINISIS public début, was the Agricultural Library in Wageningen. In collaboration with the Netherlands Directorate of Agricultural Research, AGRALIN was in the process of "examining the feasibility of implementing an on-line, integrated library-documentation system to serve the agricultural information services complex."[33] Having heard the paper presented at the AGARD conference, AGRALIN was interested in evaluating the suitability of MINISIS for its libraries, AGRIS, and other documentation applications.

At the same time, the Tunisian government and the United Nations Development Programme were negotiating the purchase of an HP 3000 minicomputer to assist CNDA in: the automation of its existing database of current agricultural research (CARIST), the production of a union list of agricultural periodicals in Tunisia, the implementation of AGRIS SDI, and, perhaps, the management of the libraries of the Ministry of Agriculture. CNDA was interested in using MINISIS for all of these applications.

With requests for MINISIS in hand, the Information Sciences Division and Centre management were required to address the issues of MINISIS distribution policy. Earlier policy decisions taken at IDRC had concerned the design and development of MINISIS as a system; but the policies required now concerned the terms and conditions of MINISIS acquisition and operation, and the protection and promotion of MINISIS as a common, integrated system.

In making distribution policy decisions, the Division was able to draw on the world-wide experience with ISIS. When ISIS was distributed to institutions, first by ILO, then by IDRC, these institutions received ISIS software in two forms. The first, called "source code", was the form in which the ISIS computer programmes were written originally, and was amenable to change by ISIS users to suit their local requirements. The second, called "object code", was a derived form of the source code and could be executed directly by a computer, but was virtually impossible to change. With the ISIS source code in hand institutions could, and did, modify the ISIS computer programmes in ways which led to the existence of several incompatible versions -- a state of affairs which had prompted ISIS users to begin consideration of ways to regain a common ISIS system.

Aware of this state of affairs, the Information Sciences Division sought a method of distributing MINISIS which would prevent incompatible versions from arising. To this end, it was decided that MINISIS would be distributed only as object code This practice would ensure the integrity of MINISIS as a common system.

The decision to distribute MINISIS only as object code was not absolute. Instead, a distinction was made between the basic components of MINISIS software, called the "intrinsics", and other components often called the "applications programmes." It was decided that, as source code, the intrinsics would never be distributed or released at all; in fact, the intrinsics would be regarded by the Centre as a proprietary product, to be protected as a trade secret. However, the applications programmes would be distributed as source code in rare instances when a recipient institution could demonstrate a need to develop a special version of an application programme, and IDRC did not plan to undertake such a development itself. In any event, only that portion of the source code necessary for such a development, and no more, would be released.

A natural extension of the first distribution policy decision restricting the distribution of MINISIS to its object code was that IDRC would maintain the common MINISIS system, and a second policy decision to this effect was made. In this way, the Centre made itself responsible for the future development and growth of MINISIS; and as an added benefit, relieved each MINISIS recipient of the requirement of employing a highly trained analyst to support the system at its site, a requirement often difficult to meet in developing-country institutions.

The third distribution policy decision was that IDRC would be responsible for MINISIS distribution. This responsibility included the evaluation of requests, the establishment of terms and conditions of distribution, the actual installation of MINISIS, and the training of personnel in its use. To assist in the discharge of this responsibility, the Information Sciences Division struck the MINISIS Policy Committee. This committee handled the month-to-month supervision of MINISIS distribution, and recommended policies to be adopted by Division and Centre management.

As a practical approach to the problem of distributing MINISIS widely, and still retaining the Centre's proprietary rights (in order to protect and promote the common system), it was decided that the use of MINISIS would be licensed. In

support of this decision, it was determined that two types of fees would be levied on MINISIS licensees: an initial licensing fee, entitling each licensee to the unlimited use of MINISIS on its own computer, and an annual software-support fee, to be used to help IDRC defray the ongoing costs of MINISIS maintenance and development.

The fee levels for MINISIS licenses were established by the MINISIS Policy Committee, in close consultation with the relevant Officers of the Centre. The initial licensing fee was set at one level for nonprofit organizations, and at a higher level for others; and in consideration of the investment which the taxpayers of Canada had made in the development of MINISIS, the licensing fee for Canadian nonprofit institutions was waived, or set at a very low level. Likewise, the fee for developing-country institutions was often reduced or waived.

The fifth principal MINISIS distribution policy arose from the interest of third parties in promoting the sale of MINISIS licenses, on behalf of IDRC, in developed countries. The advantages to IDRC of agreeing to such a third-party arrangement were twofold. First, motivated by profit to widely distribute MINISIS throughout the developed countries, such third-party agents would help broaden the user base of MINISIS; this broader base would support the long-run viability of MINISIS, and by extension make MINISIS more attractive to developing countries. Second, these third-party agents could serve as liaison between IDRC and developed-country users of MINISIS, freeing the Centre to concentrate its efforts on its main objective: assisting the developing countries.

Seeking to benefit from these advantages, it was agreed that IDRC would permit third-party distribution of MINISIS, and the Centre established agreements to this effect with various firms. These agreements licensed the distributors to use MINISIS and granted them the right to distribute MINISIS to their clients in turn, in consideration of which right the distributors undertook to support their clients' use of MINISIS, and share with IDRC the MINISIS licensing fee which they collected from their so-called "sublicensees." In establishing these distributorship agreements, IDRC reserved the right to collect from distributors a share of the software-support fee due with each sublicense, aware of the long-term value such regular revenue would offer the Centre.

Since the inception of the five principal MINISIS distribution policies, no fundamental policy changes have been made, although there have been refinements to fee structures, the wording of agreements, the rights and responsibilities of distributors, and so on. One example of a recent change to policy concerns the proprietary rights to software written by MINISIS licensees or sublicensees. The new policy in this regard allows the authors of software which directly or indirectly uses MINISIS intrinsics to retain their proprietary rights to such software, and grants IDRC a nonexclusive right to distribute this software to direct licensees for their royalty-free use.

Reaching out and looking forward.

Starting with the first installation at the IDRC Library, and continuing with the installations at NSRC, AGRALIN, and CNDA, the growth in the number of MINISIS sites around the world has been nothing if not remarkable. From a total of 10 installations in 1979, of which 2 were in developing countries, MINISIS has spread to every continent. As of the end of the first quarter of 1985, there were 124 MINISIS installations outside of the Centre's own, including 63 installations in developing countries[34]. MINISIS is an unqualified success.

In order to manage the on-going affairs of its MINISIS programme, the Information Sciences Division established three groups of staff specialists which each make specific contributions to the success of the Division's work with MINISIS. These staff constitute an Outreach section, with the primary responsibility for distributing MINISIS world-wide, and for training new users; a Future Systems section, with the primary responsibility for maintaining and developing MINISIS software, and for providing technical advice to MINISIS users; and a Computer Operations section, with the primary responsibility for operation of the Division's computer and ancillary equipment, and for maintaining a library of user-contributed MINISIS software.

The work of the Division's Outreach section revolves around the provision of support to developing-country users of MINISIS. This support includes: the actual installation of MINISIS at the computer sites of developing-country institutions[35]; the training of developing-country personnel in the effective operation and application of MINISIS; the preparation and maintenance of MINISIS documentation and training materials, and the production of the MINISIS Newsletter; the promotion of the exchange of information and experience among MINISIS users; the

conducting of MINISIS demonstrations; the provision of advice and technical support to developing-country institutions; and liaison between MINISIS licensees and distributors on the one hand, and the Future Systems section on the other.

The Outreach section provides knowledgeable and responsive support to institutions in developing countries. Next to the intrinsic value of MINISIS as an information tool, it is perhaps the nature of this support which most distinguishes the MINISIS programme of the Information Sciences Division.

The work of maintaining the value of MINISIS as an information tool is the responsibility of the Future Systems section. Future Systems plots the course for improvements and enhancements which MINISIS system development will follow. The section is well advanced in the fulfillment of its current plan to stabilize MINISIS intrinsics, and to optimize their functioning, so that the effects of future MINISIS programme changes on present users will be minimal. These future changes will likely include improvements to the multilingual operations of MINISIS, more effective support of numerical and statistical data, and features to aid in the development of thesauri.

As part of its efforts to reach out to developing-country users of MINISIS, and build towards their common future, the Information Sciences Division supports the MINISIS Users' Group (MUG) and its activities. The Users' Group provides a forum in which developing-country users of MINISIS meet developed-country users as equals, share their experiences, and learn from one another. Membership in MUG is extended to all MINISIS direct licensees and distributors, and participation in the group provides opportunities for the transfer of technical skills and the benefits of cooperative action. The principal annual activity of MUG is the convening of an international meeting at which new MINISIS users are introduced, the recent activities and accomplishments of other users are described, and so on. Of special importance is the opportunity which the annual meeting presents for the staff of the MINISIS programme to report on its progress in the past year and its plans for the coming year, and for MINISIS users to respond to these plans and recommend changes and new directions for MINISIS.

In addition, the Information Sciences Division supports the development of a library of MINISIS programmes written by users. This library includes programmes such as those for the handling of alternate character sets, and the management of library circulation activities. In its support of this so-called "user-

contributed library," the Division makes tangible its interest in operating MINISIS as a common system in which users are also contributors, and in which the development process does not proceed only from the Centre outward.

MINISIS: fulfilling its rôle in development.

A principal goal of the minicomputer-ISIS project of the Information Sciences Division was to create a tool whose use would enable developing countries to participate in international cooperative networks of data exchange, whether such networks were organized according to a decentralized or a centralized model of operation.

Networks organized according to a centralized model call for each participating country or region in the network to contribute, to a coordinating agency, the data which it has collected and developed. The coordinating agency then combines these data with those of other participants, and distributes the resulting database to all members of the network. AGRIS provides an example of a centralized network.

In contrast, the decentralized model of network organization calls for the exchange among network participants of self-contained databases which can be installed for searching on the individual computers of each network participant. No combined database is created, but access to the data of all participants is made possible. Networks operating according to this decentralized model include those of UNESCO and ILO.

Regardless of the model of network organization, the most salient feature is that members of the network are participants in a process of sharing information. It is in this feature of cooperative networks that the interest of the Information Sciences Division lies; the Division is, in the words of the International Development Research Centre Act, interested in fostering "cooperation in research on development problems between the developed and developing regions for their mutual benefit."[36] The primary interest of the Information Sciences Division is not in MINISIS installations which stand alone (nor was it in ISIS installations which stood alone), though it recognizes that developing-country institutions can be self-sufficient in their operations, since the Division believes that no institution -- and by extension, no developing country -- can be self-sufficient in information.

The development of MINISIS, then, was integral to the Information Sciences Division's programme of work. MINISIS provides developed and developing countries with a comprehensive method of collecting, managing, and disseminating information about development; and in important ways, MINISIS contributes to the development of international cooperative information networks.

First of all, MINISIS meets one of the principal goals set in 1976 for the Division's minicomputer-ISIS project: "to define a low-cost information storage and retrieval system, suitable for installation in developing countries, which would enable them to participate in international cooperative networks."[37]

Second, MINISIS is multilingual, in that it can support the use of descriptors in many languages. At last count, MINISIS was being used in at least eleven: Arabic, Chinese, Dutch, English, French, German, Greek, Malay, Russian, Spanish, and Thai[38].

Third, MINISIS accomodates the most useful international standards for the exchange of data. These include ISO 2709, UNISIST, and UNIMARC[39]. This last standard is of particular value to small-library cataloguing operations, in that it facilitates both the efficient transfer of cataloguing data from national libraries (thereby allowing significant reductions in cataloguing overhead), and the production of a national union catalogue.

Fourth, MINISIS is compatible with ISIS at a level above that of the simple exchange of data formatted according to ISO 2709. MINISIS and ISIS are compatible in function: operations which can be performed with one system can be accomplished in natural and straight-forward ways with the other. This allows MINISIS and ISIS to be used compatibly at different nodes in a single network.[40]

MINISIS, as a system, is now reaching a mature stage in its evolution. This maturity will allow the Information Sciences Division to exploit further the rôle which MINISIS plays in international development. Hence MINISIS, as a programme, is now coming into its own, and the world can expect to profit increasingly from its contribution in the years ahead.

Summary and Conclusion -- the success confirmed

In order to speak knowledgeably and authoritatively about the application of computers to the problems of information management, and in order to offer practical advice and assistance to developing countries, the Information Sciences Division required first-hand experience with computer technology. In 1973, the Division acquired the Integrated Set of Information Systems (ISIS) developed by the International Labour Office (ILO). The Information Sciences Division foresaw, however, the need for a computer system, more economical than ISIS, which could be used in future international development-information networks such as the Development Sciences Information System (DEVSIS).

As the Information Sciences Division defined its requirement for such a computer system, the emerging technology of minicomputers allowed the Division to envisage the establishment of dedicated computer facilities for AGRIS/DEVSIS-type centres. On 15 March 1976, the Board of Governors of IDRC approved a proposal from the Information Sciences Division for the development of a minicomputer version of ISIS. This minicomputer version was expected to reduce the Centre's computer-operations costs; to result in the definition of a "minicomputer installation that could be offered, complete with programs, for AGRIS/DEVSIS/ISIS activities at national centres in developing countries;" and to give the Division the direct experience necessary for it to advise developing countries.

The three major phases of development of the minicomputer version of ISIS were acquisition of the minicomputer itself, planning the new system's design, and actual implementation of the system. After careful research and analysis, the staff of the Information Sciences Division recommended acquisition of an HP 3000 minicomputer, and decided to develop the new minicomputer ISIS system according to the relational model of database design. The planning and implementation of the new system involved 45 person-months, and produced a system called MINISIS. In its original and subsequent versions, MINISIS meets virtually all of the requirements which had been set for it during its conception and development.

When MINISIS was ready for international distribution, the Information Sciences Division established five principal policies concerning the terms and conditions of MINISIS acquisition and operation, and the protection and promotion of MINISIS as a common, integrated system. These were: (1) that MINISIS would

be distributed only as object code; (2) that IDRC would maintain the common MINISIS system; (3) that IDRC would be responsible for MINISIS distribution; (4) that the use of MINISIS would be licensed; and (5) that IDRC would permit third-party distribution of MINISIS.

Starting with the first installation at the IDRC Library, the growth in the number of MINISIS sites around the world has been remarkable. The total number of MINISIS installations has grown from 10 in 1979 to 124 as of the end of the first quarter of 1985. In order to manage the on-going affairs of its MINISIS programme, the Information Sciences Division established three groups of staff specialists which each make specific contributions to the success of the Division's work with MINISIS. These staff constitute an Outreach section, with the primary responsibility for distributing MINISIS world-wide, and for training new users; a Future Systems section, with the primary responsibility for maintaining and developing MINISIS software, and for providing technical advice to MINISIS users; and a Computer Operations section, with the primary responsibility for operation of the Division's computer and ancillary equipment, and for maintaining a library of MINISIS software.

The development of MINISIS was integral to the Information Sciences Division's programme of work. MINISIS provides developed and developing countries with a comprehensive method of collecting, managing, and disseminating information about development; and in important ways, MINISIS contributes to the development of international cooperative information networks. First, MINISIS meets one of the principal goals set in 1976 for the Division's minicomputer-ISIS project: "to define a low-cost information storage and retrieval system, suitable for installation in developing countries, which would enable them to participate in international cooperative networks." Second, MINISIS is multilingual, in that it can support the use of descriptors in many languages. Third, MINISIS accommodates the most useful international standards for the exchange of data. Fourth, MINISIS is compatible in function with ISIS.

In sum, MINISIS met the objectives set for it when the Information Sciences Division proposed its minicomputer-ISIS project. The minicomputer system was actually built. MINISIS is capable of being installed in developing countries, is installed at many developing-country sites, and is desired for many more. Several important IDRC computer applications are run in-house with MINISIS, notably the Centre Library's operations, and IDRIS, the Interagency Development Research Information System. Sub-

stantial savings over the cost of service-bureau operations have been realized. Further, the Division now advises developing countries on computer-related matters, now makes available to developing countries the skills required for computer installations, and now trains developing-country personnel in computer operations. MINISIS as a programme is coming into its own, and the world can expect to profit increasingly from its contribution to international development in the years ahead.

Notes

01. From a statement by Ivan L Head, President, IDRC, to the Standing Committee on External Affairs and National Defence of the Parliament of Canada, 28 May 1985.

02. Du Résumé de projet pour le projet 3-P-78-0094: "MINISIS: pays francophone d'Afrique," 6 février 1979, p. 4.

03. Adapted from Library Services, March 1981, an information brochure distributed by the Centre Library.

04. From the Project Summary for project 3-73-004: "Centre Library (Fiscal 1973-1974)," 22 February 1973, p. 4.

05. Project 3-72-049: "COMPASS: creating multi-agency data base," approved by Executive Committee 24 June 1972.

06. Project 3-A-72-4049: "Consultancy services, August-November 1972, to define how we could best implement the 'Integrated Scientific Information System' (ISIS) in Ottawa," approved by President 28 July 1972.

07. From p. 5 of: O'Reilly, B.E. (1972). ISIS implementation at IDRC: a feasibility study. Ottawa: Digital Methods Limited. [IDRC-doc-058-I; RESARC 002 D5]

08. From p. 110 of O'Reilly, 1972.

09. Project 3-73-006: "Computer information system (ISIS) (Fiscal 1973-74)," approved by Executive Committee 18 March 1973.

10. From an Agreement between IDRC and ILO signed in Ottawa on 1 June 1973, p. 2.

11. From the Project Summary for project 3-73-006: "Computer information system (ISIS) (Fiscal 1973-74)," 22 February 1973, p. 6.

12. From the Project Summary for project 3-P-75-0105: "Mini-computer development (ISIS)," 3 March 1976, p. 7.

13. AGRIS: International Information System for Agricultural Sciences and Technology.

14. From the Project Summary for project 3-P-75-0105: "Minicomputer development (ISIS)," 3 March 1976, p. 8.

15. A turnkey package is one which can be operated without extensive or specialized training. The metaphor implies that operation of the package is as easy as turning a key in a lock.

16. The ISIS format was that of the International Organization for Standardization: "Documentation: format for bibliographic information interchange on magnetic tape" (ISO 2709). The three aspects of ISIS's acceptance are from O'Reilly, 1972.

17. Project 3-03-16, "Improvement of the Aligned Descriptor List," approved by Executive Committee 28 February 1971, resulted in the production of the Macrothesaurus: a basic list of economic and social development terms.

18. Consultancy of Associate Professor William Kurmey, Faculty of Library Science, University of Toronto, cited in Letter to the Governors, January 1974, 4(1), p. 6.

19. Example taken from Letter to the Governors, September 1975, 5(6), p. 9.

20. For example, Low-cost rural health care and manpower training (IDRC-042), and Directory of food science and technology in southeast Asia (IDRC-023).

21. Consulting contract: "Dr Gordon Somerfield: Development of a specification for a mini-computer version of the Integrated Set of Information Systems (ISIS)," 14 March 1975, funded from project 3-N-74-7407.

22. Somerfield, G.A. (1975). A systems specification for bibliographic information processing implemented on a midi-computer system. Ottawa: author. [RESARC 681.3 S65]

23. Project 3-P-73-0105: "Minicomputer development (ISIS)".

24. From the Project Summary for project 3-P-75-0105: "Minicomputer development (ISIS)," 3 March 1976, p. 2.

25. From the Project Summary for project 3-P-75-0105: "Minicomputer development (ISIS)," 3 March 1976, p. 8.

26. From the memorandum of 17 February 1976 from S Kassum to JE Woolston, entitled "Choice of a minicomputer for IDRC -- finally an open-and-shut case," p. 5. [File 3-P-75-0105]

27. This discussion of the relational model is based on: Daneliuk, F.A. (1978). The IDRC's Bibliographic Information System. In The application of inexpensive minicomputers to information work, AGARD Lecture Series No 92. Neuilly-sur-Seine: North Atlantic Treaty Organization.

28. No limit on the number of domains within a tuple is imposed by the theory of relations.

29. From Daneliuk, 1978.

30. Ms Daneliuk and Mr Gavin, the original members of the minicomputer-ISIS team, were joined by Mr Lee part-way through FERRIS development.

31. From the provisional agenda for the first meeting of the Design Review Committee, dated 2 June 1976. The first meeting was held on 8 July 1976.

32. NATO: North American Treaty Organization. AGARD: Advisory Group for Aerospace Research and Development.

33. From the letter of 21 April 1978 to the Information Sciences Division from the Agricultural University Library, concerning the possible acquisition of MINISIS. [File 3-N-83-7411 -- A(04) volume 1, closed.]

34. A more complete analysis of MINISIS installations appears in Appendix C.

35. Incorporating the work of project 3-P-78-0094: "MINISIS: pays francophone d'Afrique."

36. International Development Research Centre Act, proclaimed 13 May 1970, article 4(1)(d).

37. From the Project Summary for project 3-P-75-0105: "Minicomputer development (ISIS)," 3 March 1976, p. 8.

38. From the memorandum of 9 May 1985 from CA Godfrey to IL Head, entitled "Recent examples of IS project impact," p. 2. [File 3-N-84-7411 -- A(00)]

39. ISO 2709: Standard format for bibliographic information interchange on magnetic tape, promulgated by the International Organization for Standardization. UNISIST: Reference manual for machine-readable bibliographic descriptions, prepared by the UNISIST/ICSU-AB Working Group on Bibliographic Descriptions, 1974. UNIMARC: Universal Machine-Readable Catalogue, developed by the International Federation of Library Associations.

40. For further details, refer to: Valantin, R.L. (1981). CDS/ISIS and MINISIS: a functional analysis and comparison. Ottawa: IDRC. [IDRC-TS37e]

Appendix A: Financial analyses

Original appropriation for project 3-P-75-0105: Minicomputer development (ISIS)

item	breakdown	amount	% of total[a]
hardware total		250,734	67
hardware	232,734		
maintenance[b]	18,000		
software total		34,500	09
software[c]	30,000		
maintenance[b]	4,500		
software development salaries		67,000	18
travel,courses		10,000	03
software for other applications[d]		10,000	03
subtotal appropriation		372,234	100
10% contingency		37,223	
total appropriation		409,457	
actual payments		391,068	

Notes

[a]Percentage of subtotal appropriation, before contingency.
[b]For the period ending 1 October 1977.
[c]Systems and utilities software necessary for computer operations and MINISIS development.
[d]Applications of other Centre divisions. Included in budget of this project for reasons of economy.

Actual budgets, for the three most recent years[a] of the Information Sciences Division Computer Systems group

fiscal year	actual budget	% growth yr-to-yr	support[b] revenue	support revenue as % of budget
81-82	727,277		143,337	20
82-83	800,774	10	130,313	16
83-84	761,635	-05	224,400	29

Notes

[a]For which complete figures are available for Computer Systems as a separate group.
[b]Received by Computer Systems group from IDRC MINISIS revenue.

Total MINISIS revenue[a] as at 11 July 1985, of International Development Research Centre

fiscal year	license revenue	support fees	total[b]	% growth yr-to-yr	total[b] as % of actual CS budget
78-81	113,795	44,700	158,495		
81-82	134,450	49,210	183,660	16	25
82-83	131,326	94,377	225,703	23	28
83-84	125,965	125,983	251,948	12	33
84-85	22,586	124,894	147,480	-41	
85-86[c]		32,500	32,500		
other[d]	225,000		225,000		
totals	753,122	471,664	1,224,786		

Notes

[a]Including outstanding invoices of $190,214.
[b]License revenue plus support fees.
[c]Year-to-date only.
[d]Distributor payments under alternate licensing scheme.

Appendix B: Documentation

Principal files.

3-P-75-0105 (fiche). Minicomputer development (ISIS).
3-N-yy-7411 -- A (multipart). MINISIS Outreach.
3-N-yy-7411 -- B (multipart). MINISIS Future Systems.
3-N-yy-7411 -- C (multipart). Minicomputer service.

Principal documents.

O'Reilly, B.E. (1972). ISIS implementation at IDRC: a feasibility study. Ottawa: Digital Methods Limited. [IDRC-doc-058-I; RESARC 002 D5]

[Agreement between IDRC and ILO]. (1 June 1973). Ottawa.

Somerfield, G.A. (1975). A systems specification for bibliographic information processing implemented on a midi-computer system. Ottawa: author. [RESARC 681.3 S65]

Daneliuk, F.A. (1978). Information retrieval and library management: an interactive minicomputer system. Ottawa: IDRC. [IDRC-TS14e]

Valantin, R.L. (1981). CDS/ISIS and MINISIS: a functional analysis and comparison. Ottawa: IDRC. [IDRC-TS37e]

Training materials. Approximately 400 pages of these materials are produced and maintained by staff of the Computer Systems group of the Information Sciences Division.

Principal publications.

MINISIS manuals. These exist in three volumes:
(1) database manager's guide;
(2) user's guide;
(3) application programmer's guide.

MINISIS Newsletter. 1980- , vol. 1- .

Proceedings of the annual meeting of the MINISIS Users' Group. 1982- .

Appendix B: Documentation

A database of publications related to MINISIS and its use is maintained by the Computer Systems group of the Information Sciences Division. In addition, the titles of those publications most relevant to the needs of MINISIS users appear in the MINISIS Newsletter.

Appendix C: MINISIS installations

Types of MINISIS applications

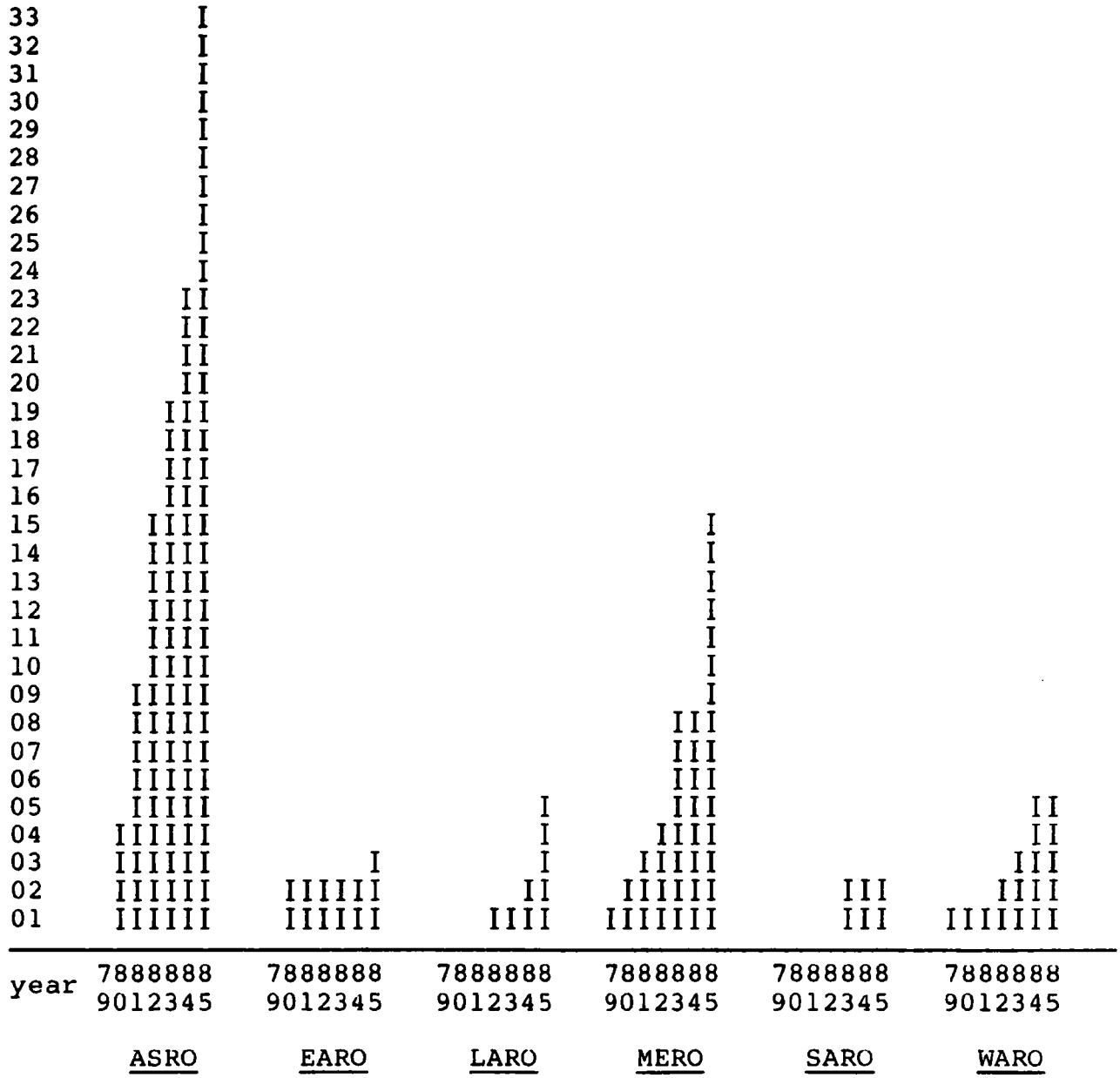
Two types of institutions are typical MINISIS users. The first is an institution at which MINISIS is used to manage the institution's own information collection. Such MINISIS users include the libraries of governments, universities, and technical institutes. The second is an institution at which MINISIS is used to manage information collected for dissemination on a national, regional, or international basis. Examples of this type of user include research and development centres, documentation centres, and members of international data exchange networks.

While most users employ MINISIS to manage bibliographic data, there are several who manage collections of widely different types. This includes still- and motion-picture collections, museum and art collections, descriptions of on-going projects and activities, and archival collections of various kinds.

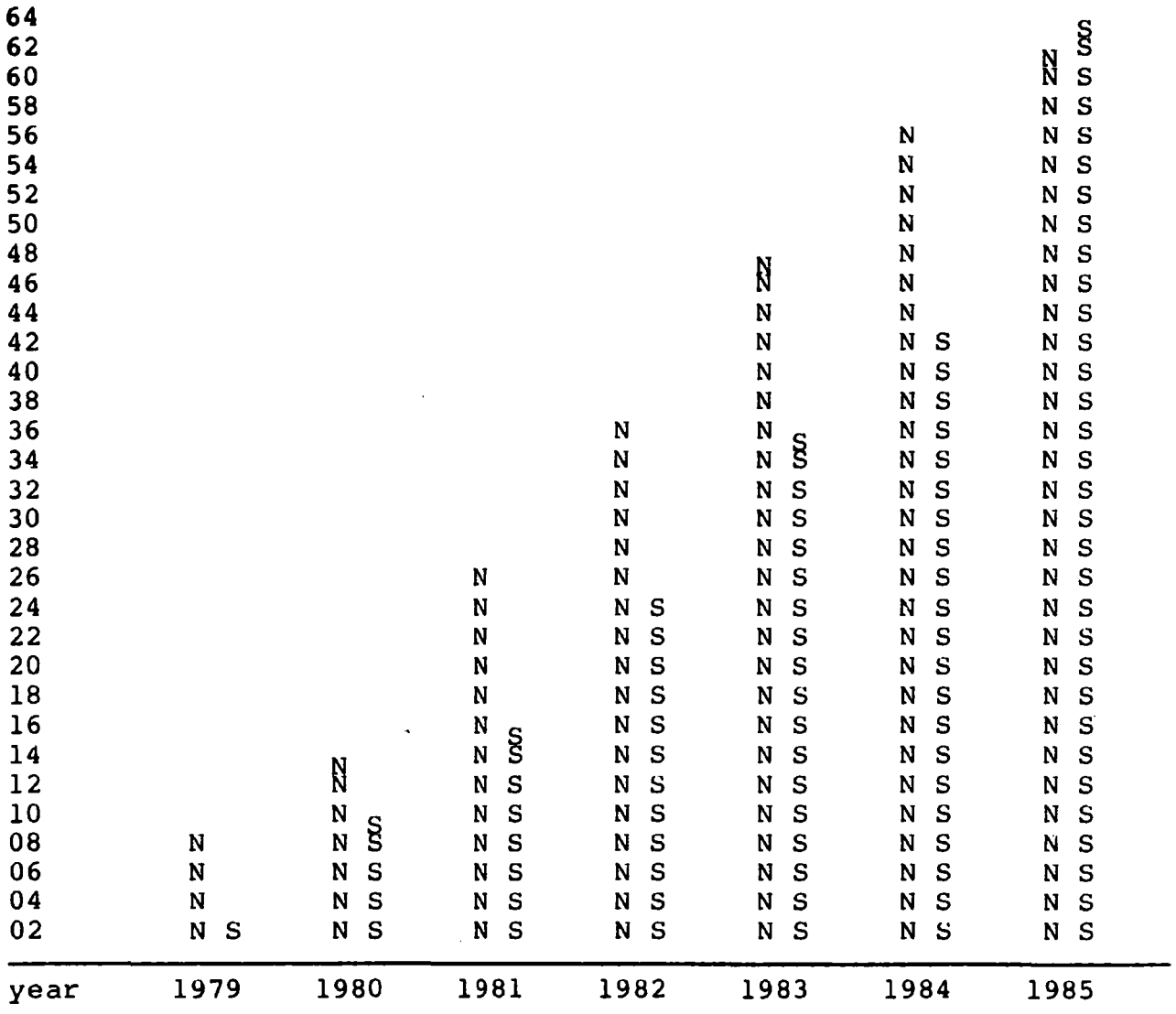
In order to indicate the diversity of applications currently operated by MINISIS users, the following examples are offered.

- a national educational research institute, at **Centre for Development of Instructional Technology**, India
- a national library, at **National Library of Malaysia**
- a regional health sciences information centre, at **Centro Latinoamericano de Información en Ciencias de la Salud**, Brazil
- a national documentation centre, at **Centre national de documentation**, Morocco
- a national information centre, at **National Energy Information Centre**, Thailand

Cumulative growth in MINISIS installations, by regional office, as at 01 May 1985



Cumulative growth in MINISIS installations, by country development, as at 01 May 1985



Legend: N = developed countries
S = developing countries

Number of MINISIS licensees, excluding distributors, as at 31 July 1985

Algeria	1	
Australia	2	(including 2 sublicensees)
Brazil	1	
Canada	21	(including 16 sublicensees; excluding IDRC users)
China	6	
Columbia	1	
Congo	1	
Ethiopia	3	(including 1 United Nations agency)
Finland	1	(including 1 sublicensee)
France	5	(including 4 sublicensees)
Greece	1	
Hong Kong	1	
India	3	
Indonesia	2	
Iraq	3	
Italy	1	(including 1 sublicensee)
Korea	3	
Malaysia	5	
Mali	1	
Mexico	2	
Morocco	4	
Netherlands	3	(including 2 sublicensees)
Philippines	7	
Romania	1	
Saudi Arabia	2	
Senegal	1	
Singapore	3	(including 1 sublicensee)
Sudan	1	
Switzerland	3	(including 2 sublicensees)
Taiwan	2	(including 1 sublicensee)
Thailand	4	
Trinidad	1	
Tunisia	5	
USA	15	(including 14 sublicensees, and 3 UN agencies)
Venezuela	1	
Zaire	2	
total	118	