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A UNIVERSITY'S MULTIPURPOSE INFORMATION CENTER AS A RESPONSE TO MODERN TECHNOLOGY IN A DEVELOPING COUNTRY

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The Information Center for Sciences and Humanities of the National Autonomous University of México acts as a database producer, as publisher of current awareness services, as input center for an internationally supported literature abstracting system, as information center and reference library, as computerized subscription agency, as node of an international electronic mailing and computer conferencing system, as computer center and as training unit of human resources in information science and services. This multipurpose character reflects a type of response of developing countries to modern and mainly foreign technologies.

INTRODUCTION

The application of computers and computer science to indexing and abstracting of scientific and technical literature and to its massive storage and retrieval during the sixties, to library automation and publishing routines together with the development of on-line and teleprocessing operations during the seventies and the almost daily increase in capacity and reduction in size and price of computers that has brought them to the domestic environment during the eighties, are possibly the most dramatic effects of modern technology on information, documentation and library science that have given rise, in some developed countries, to current information technology.

To dynamize and improve the processes for the publishing, storing, retrieving and accessing of scientific and technical literature in the context of its exponential growth does not only save a substantial amount of scientist's, technologist's and other type of user's precious time in gathering the proper information they need for their decision making, but also increases the amount and quality of information they look for. Consequently, it catalyzes and speeds up the advancement of science, technology and culture with its consequent impact on society (offer of new, better and cheaper goods and services and creation of new demands for social satisfactors that change the internal and external economic and political environment).

New technologies arise usually in developed countries and represent for developing countries not only a challenge but a threat to increase the scientific and technological gap and their dependence with the corresponding economic and social impact that will sooner or later affect both (1).

Being unwise to marginate themselves from international trends, developing countries will be forced to import completely or partially the new technologies and develop their own infrastructure capable of coping with them while they are still engaged in trying to master previous technologies.

We must realize that in most developing countries the already mentioned catalytic effect of information on the development of science and technology and on the diffusion of culture is hardly recognized and that they depend, to a large extent, on information generated in the developed countries and therefore not as cheap and as easily accessible to them as it is for its producers. The often poor communications, the language barrier and the technical, political and economic limitations play definitive roles on the access to information in these countries.

While developed countries are normally self-sufficient in their document holdings, most developing countries have to import a high percentage of the documents they need. There are often only a few, if any, institutions endowed with the proper documental infrastructure to support research and development activities in the advent of modern information technology.

This is probably the most important reason why developing countries cannot produce or adapt new technologies simultaneously or better, modularly, in different places and are forced to respond monolithically at the place where the most appropriate human and material resources are located, trying later to develop additional resources that can be disseminated.

In doing so, developing countries have to face one of the probably most crucial problems that threaten the enterprises they undertake: this is discontinuity (2). Despite the adverse conditions, many problems have been faced and solved successfully and even originally in developing countries, but discontinuity has in most of the cases prevented the survival of those results.

THE NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO (UNAM) AS SPONSOR OF A MULTIPURPOSE INFORMATION CENTER

UNAM is a macro-system engaged, by its very nature, with the higher education, research and diffusion of cultural activities in the country. It hosts in one main campus plus five peripheral ones and thirteen experimental stations within the nation, around 300,000 students, almost 10,000 at the post-graduate level, 27,000 teachers, 3,000 researchers and over 23,000 clerical staff (3). UNAM takes 10% of the national budget for research activities, owns one fourth of the country's resources for research and produces one third of the Mexican export - quality research.

UNAM also hosts the country's most important multidisciplinary collection of scientific, technical and humanistic documents in its over 140 departmental libraries plus the National Library and the National Periodicals Library that also belong to the system. It is a member and permanent site of the Union of Latin American Universities and shares herewith a regional concern in higher education and research activities.

UNAM therefore represents one of those places within the country with the proper infrastructure to face the challenge of information technology in an effort to diminish the already mentioned scientific and technological gap between developing and developed countries. Its approach has been to produce the human resources that may cope with such modern technology and while doing so, not only better support its own research, teaching and cultural activities but supply the country with the properly trained personnel and developed or adapted technology to be used nationwide.

THE INFORMATION CENTER FOR SCIENCES AND HUMANITIES (CICH) AND ITS MULTIPURPOSE - CHARACTER

CICH was created by the UNAM in 1971 with the previous mentioned objectives. Due to the multidisciplinary and complex characteristics of UNAM as well as to the

lack of trained manpower and of other similar centers, CICH was forced to evolve as a multipurpose information centre within a university.

By calling it multipurpose we want to stress that it had to develop simultaneously in many different directions and fields of action of information technology that are normally handled separately by specific institutions or information centers in the developed countries.

THE CENTER AS PRODUCER OF CURRENT AWARENESS PUBLICATIONS

As an abstracting and indexing organization, CICH has evolved by preparing and publishing computer generated current awareness information tools covering the most outstanding international periodical literature in science and humanities but very specially the ones produced in and on Latin America.

For this purpose it has developed the proper technology for the production of KWAC, KWIC, KWOC, permuted term, citation and table of contents indices using non-conventional hardware. This means that special software and information input routines had to be designed and developed instead of using the already implemented software packages available for conventional hardware. Although slower and with a higher degree of difficulty, leading often to mistakes that had to be corrected and to products that permanently need to be polished, this procedure has permitted the gain of a large amount of invaluable experience in the production and use of this type of information technology, something that would not happen if products of the new information industry had just been bought, adapted and used.

Being able to operate in this way is, of course, an advantage offered by a non-profit educational institution like UNAM, engaged in experimenting with whatever new concepts and technologies arise, independently of their immediate cost-benefit ratios.

1. Alerta-Información Multidisciplinaria en la Universidad

Designed to collectively promote the use of high quality specialized current journal literature within the scope of UNAM's interests, often shared by other higher education institutions of the country and of Latin America, a fortnightly, low priced, multidisciplinary current awareness information "package" called ALERTA (Información Multidisciplinaria en la Universidad) was published from 1974 to 1979 (6) (7).

After a manually processed sample issue, its main section (basic bibliography in KWOC format), covering about 86% of the references, was computerized and gradually later, so were the others. The first programs were written in Cobol for UNAM's Burroughs 6/700 computer and the production routines that faced the punching and verification of cards with information that had previously been coded on fixed formats by CICH's multidisciplinary staff, have been described elsewhere. (8)

Later on, programs were re-written in Basic Plus for CICH's own Digital PDP 11/40 minicomputer and direct access on disc through CRT-terminals was implemented. Proof-reading was done on printouts and corrections were made on-line. At a further stage, programs were designed to select from the Science and Social Sciences Citation Indices magnetic tapes, leased under previous agreement with ISI, the references to papers corresponding to either fixed journal issues or special interest profiles designed and constructed in accordance to the philosophy behind the different sections' coverage. A separate file was built with this material and screening of the retrieved references, allocation of accession numbers, Spanish keywords, corresponding sections and other additional information was one on-line. Proofreading on printouts and on-line corrections were made and a computer produced final printout was then duplicated by an Offset process.

By 1979, the on-line retrieving capability of the world's outstanding specialized literature, acquired by CICH since 1977, the degree at which the UNAM's information users had evolved and the need to devote CICH's efforts to produce non available current awareness information tools of domestic and regional multidisciplinary core periodical literature, caused the suspension of ALERTA's publication. During its 6 years of continuous publication, some 6.5 million articles out of ca. 300,000 issues of about 6,500 different journal titles were scanned and around 500 000 papers dealing with 25 different branches of knowledge were indexed by some 1.5 million key-words.

2.. CLASE-Citas Latinoamericanas en Sociología, Economía y Humanidades.

Very poor support was found in ALERTA by UNAM's and Latin American researchers in relation to social-, economic-sciences and the humanities because their main interests happen to rest on problems faced by the country, by the region or by countries with similar social structure. This type of research is normally published in domestic vehicles unfortunately very poorly covered by the well known international indexing and abstracting services.

Since 1976, CICH publishes within those fields and on a quarterly basis, a full computerized bibliographic index of current high quality Latin American journal literature indexed by tables of contents, keywords, authors. corporations within countries and citations, as well as by countries of origin and disciplines of the journals processed (6) (9).

Some 260 different journal titles from 20 Latin American countries presently account for ca. 700 issues per year yielding some 6,000 references in 15 different disciplines and 34, 000 citations.

Programs were also first written in Algol for the Burroughs 6/700 and later in Basic Plus for the PDP 11/40. Some 50 different ones, most of them related to the citation indexing module are presently being used. Each article is analyzed throughout its contents by CICH's specialists; pertinent information coded on it and later punched on disc and processed. Printouts for proofreading are produced, corrections are made on-line and the definitive listings are then printed for their Offset reproduction.

The system contains presently some 30,000 references with ca. 7.10^7 characters and grows at an average rate of 5.10^6 characters per year.

3. PERIODICA-Indice de Revistas Latinoamericanas en Ciencias

Published quarterly, it represents an effort to compile with a multidisciplinary approach, the product of Latin American research in science published in the most outstanding domestic periodicals and therefore, mainly in Spanish and Portuguese languages.

Periódica offers a medium of introducing thousands of Latin American students. teachers and even researchers, blocked by the language barrier from the access to the most important contribution to science published in other languages, to the use of specialized information.

Started in 1978 as an index to Mexican periodicals in science, its coverage was extended in 1980 to this type of journal from the entire region.

Periódica is presently monitoring some 300 different journal titles from 20 Latin American countries. Most of those titles (ca. 70%) cover the life sciences and yield some 900 issues per year containing around 6000 articles (10). These contributions are indexed by tables of contents, permuted Spanish and English keywords, authors with their corresponding addresses and institutions by their country of origin. Journal titles covered by each issue are indexed by country, by

discipline and alphabetically.

The process for Periódica in the PDP 11/40 uses 140 programs written in Basic Plus by CICH's staff, giving on-line access to 18 catalogues and allowing the recording of new journal titles (title, internal code, ISSN, coden, frequency of publication, editor and its address and the way it is obtained), the allocation of these data to currently incoming issues, the input of coded information by CICH's staff in special input sheets, the ordering of listings for proofreading, the typing of corresponding corrections and the issuing of final printouts for Offset reproduction.

Data input includes: authors, codes for institutions, departments, sections, city state and country of origin as well as zip codes and P. O. boxes; article titles, codes: for disciplines and sub-disciplines to which they are allocated, for types of documents analyzed, for the type of treatment the author gives the subject, for the languages used in the article and its abstracts, for the geographic areas treated in the article; Spanish and English keywords, codes for avoiding their permutation by the system, for journals as well as for their countries of origin and disciplines they cover and collation data for each article.

The files of Periódica hold today some 15,000 references occupying around 7.10^6 characters and grow at a rate of 3.10^6 characters per year.

4. Bibliografías Latinoamericanas

The compilation of data used for one of Alerta's sections was continued and in 1980 a new bi-yearly index was launched by CICH with them.

The purpose is to compile, process and make easily retrievable, under a multidisciplinary basis, the product of the export-quality scientific and humanistic research of Latin America published in non Latin American periodicals and in a second section, the contributions on Latin America detected in those journals.

This rich and highly dispersed material is indexed by authors, corporations, countries of origin, disciplines and keywords (using a KWIC index). It also includes a keyword frequency index and a geographic index (only for the second part) (11).

Some 3000 papers are yearly recorded for the first section and another ca. 2000 more for the second. These are published in some 2000 different journals that have to be scanned out of several thousand periodical title issues.

Around 30,000 references with 1.10^7 characters are stored and an annual average growth of 2.10^6 characters is being observed.

Very interesting bibliometric figures on the growth, countries of origin and corporations, fields of knowledge covered, type of periodicals used for publication and combinations of these parameters have been obtained (11-14) and some additional studies thereupon are in process (15).

Produced manually from 1974-78, the Latin American Bibliography published in Alerta was computerized during 1978. The pertinent references scanned from over 6000 different periodical titles were punched on disc together with their allocated disciplines, corporations and addresses. Today, special interest profiles have been designed and kept within the system by "save commands" in order to periodically retrieve the pertinent references from different databases through the on-line process. A high percentage of retrieval is obtained when compared with direct scanning of the journals and an enormous amount of time and effort is saved by using the new information technology in this way.

The off-line printed references are scanned, codes for discipline, country, region, corporation and address are allocated and data are accessed to the computer

through a terminal. Printouts by discipline are produced for proofreading purposes. Corrections and allocation of sub-disciplines are entered and new proofreading listings by author, reference, corporation, discipline and region are produced and corrected. Comprehensive records are generated, duplicate entries detected and cancelled and the KWIC index is generated, followed by the keyword frequency index. Finally the printout for Offset processing is produced. Some 25 programs in Basic Plus are run for this purpose on the PDP 11/40; 5 of them devoided to the KWIC indexing routines.

CICH AS LITERATURE PROCESSING CENTER FOR AN INTERNATIONAL ABSTRACTING SERVICE

As processing Center of Latin American literature for Aquatic Sciences and Fisheries Abstracts published by Cambridge Scientific Abstracts and supported by a program of International Cooperation coordinated by FAO, CICH has to identify, obtain, screen, record, abstract in English and index the Latin American literature within the system's scope, following fixed input standards and formats and regularly send its product to the editor to be processed for the production of tape and printed formats.

Some 1,300 records per year are being processed from documents originating in 16 different Latin American countries. Two thirds of the records correspond to periodical literature (150 titles) and the remainder to monographs and so called gray literature. A yearly average increase of 35% in periodical literature has been observed (4).

CICH AS A NODE OF AN ELECTRONIC MESSAGING-COMPUTER CONFERENCING SYSTEM

In order to keep the coordination of the mentioned international input activities, a continuous exchange between the publisher, FAO and the different input centers has to be maintained. Therefore, in addition to the yearly meetings of the editorial staff and the advisory board, an electronic messaging and computer conferencing system is used (5). CICH has also taken advantage of this system in order to gain experience with such a tool derived from modern information technology.

THE CENTER AS A DATA BASE PRODUCER

In this aspect, CICH is engaged in two main fields:
1. The construction and maintenance of a database of Latin American scientific, technical and humanistic current periodical literature with three fundamental outputs: the four CICH's current awarenesspublications, the sociometric and bibliometric data retrieving capability and the on-line interactive search mode that is at present at a developmental stage.

2. The polishing and maintaining of a database with on-line interactive capability for the subscription process to scientific, technical and humanistic periodicals ordered by the over 100 different departmental libraries of UNAM, a process for which CICH is also responsible.

Main outputs of this database are : a) a yearly general list of periodicals obtained by subscription with their subscribing libraries, also indexed by library and country of origin and KWIC indexed by title key-words; b) yearly renewal lists for agents and publishers; c) daily lists for the delivery of periodicals to the departmental libraries (including titles and collations of received issues); d) quarterly listings of invoicing status for each library; e) quarterly listings of holdings received by each library; f) yearly union list of holdings containing titles, changes, ISSN, frequency and country of origin; g) occasional listings per library containing title, collation and invoicing data for selective departmental budgetary charges and h) listings in general and split by agent or editor of statistical figures on number of invoiced and uninvoicedsubscriptions, number of subscriptions by frequency of publication and number of subscriptions with incomplete holdings.

The system presently takes some 40.10^6 characters on disc for the on-line retrieval and in addition ca. 80.10^6 characters on disc for batch operation, representing 350,000 records of journal issues accumulated since 1976 with an annual growth rate of ca. 10%.

The software for these databases has also been produced by CICH for a Digital PDP 11/40 in both cases and also for a Burroughs 6/700 in the second case.

CICH AS AN INFORMATION CENTER FOR SCIENCES AND HUMANITIES

1. SDI Services. Since 1976 CICH has been providing a SDI service to users within and outside the university. For this purpose, the magnetic tapes of ISI's Science and Social Sciences Citation Indices, found as the most appropriate for the university's needs of multidisciplinarity and currentness, were leased during three years. The corresponding software was installed and put to work by CICH's staff on a leased IBM computer and a weekly service for personal profiles as well as for general topics was kept. Unfortunately the severe and apparently unsurmountable problems with the clearing of the tapes through customs distorted the philosophy of an alerting service and forced CICH to drop the use of the tapes and initiate the use of the on-line retrieval capability of the different databases offered by Lockheed. This represents a nice example of how information technology may overcome even apparently unsurmountable problems.

A large experience was however gained in profile construction techniques, administration of SDI services, ISI's data base structure, installation of foreign software on leased hardware, keeping weekly production, custom clearing and servite delivering routines and later on, taking advantage of profile saving commands and off-line printing resources of the on-line accessible databases.

Some 100 individual services are rendered at the present time, representing a 450% increase when compared with 1975 figures. About 60-70% of the users belong to the UNAM. Medical, biological and chemical sciences as well as engineering are the preferred fields.

2. Retrospective bibliographic search services. Since 1972 CICH has been offering a retrospective bibliographic search service run manually, using mainly CICH's and UNAM's indexing and abstracting journal holdings, until 1977 when the on-line search technique became available to the Center. A dramatic rise in the service rendered was immediately observed (Fig. 1). CICH is at present using data bases offered by Lockheed, SDC, BRS, New York Times, Questel, Infoglobe, CIS (Chemical Information System), Medlars and ISI and it is probably not only the heaviest user of on-line retrieval of scientific, technical and humanistic information in Mexico (using around 40 monthly hours of connection time) but also the one using a greater variety of databases (some 100 to 120 different ones per year).

An average of 3 databases per search are used and some 800 searches per year are processed with an average of 12,000 monthly off-line printed references.

Continuous updating of the staff in charge of this service is achieved by its regular participation in workshops and seminars organized either by the database producers or as part of information science meetings and congresses. CICH itself has hosted several ones. A large experience has been gained in this so important activity and resource brought to life by the information technology.

CICH AS A PECULIAR SUBSCRIPTION AGENCY

As already mentioned, CICH is responsible for taking care of the subscription process to periodicals for over one hundred of the university's departmental libraries which deal with all kinds of disciplines, keep separate budgets and take autonomous decisions.

Almost 10,000 subscriptions accounting for about two million US dollars are presently being processed. Another institution has not been found yet with such a complex system for a centralized subscription service. In order to face this challenge, CICH was forced to develop the previously described computer assisted system and corresponding data base.

THE CENTER AS A DOCUMENT PROCUREMENT SERVICE

Some 8,000 document procurement orders, 75% for UNAM's staff (50% for researchers) are provided yearly by CICH.

These requests are received mostly from libraries or individuals that were unable to locate and/or obtain those documents by themselves. Around 75% are imported by CICH from foreign countries and requests thereof are frequently made by telex in order to save time. Computer ordering has not yet been found satisfactory.

CICH AS A SPECIALIZED REFERENCE LIBRARY, AS A LATIN AMERICAN PERIODICALS LIBRARY AND AS A INFORMATION SCIENCE LIBRARY

250 different indexing and abstracting publications in sciences, humanities and technology, many of them not found elsewhere in the country, are received at CICH's library usually to complement, rather than duplicate, others received at UNAM's different departmental libraries.

Some of these are received in microformats and proper reader-printers are available for their use.

1200 different Latin American periodical titles covering all branches of science, technology and humanities and used for CICH's database and publications are also received and kept for their use and provision of document procurement services. Some 50 other periodical titles, dealing with information science and technology as well as a collection of books and reference works in that field are used for CICH staff's continuous education and can be found and used at the library.

Around 3,000 users, 70% interested in sciences and technology, visit CICH's library during the year.

CICH AS A COMPUTER CENTER

In order to cope with modern information technology and develop its own know-how, CICH felt it necessary, from the very beginning of its activities, to rely on suitable computing facilities and their corresponding human infrastructure.

One of the goals was to involve and even train young computer science specialists in information science activities and to integrate them into a team with specialists of other fields in order to better understand and face the problems for the development of the most adequate technology and services.

The existence of a computer center within the UNAM provided with large hardware resources (an IBM 360/40 and a Burroughs 6/700) caused CICH to implement its first activities on such equipment. But very soon it became evident that the large number of highly specialized and sophisticated jobs required by CICH to be run on the batch mode, available by that time, and keeping fixed programmed periodical routines, could not be successfully faced by a central staff and equipment attempting to simultaneously serve other 3,000 users, with a large variety of demands within the UNAM.

On the other hand, it was felt necessary for CICH's computing staff to gain direct access, preferably from the center itself and through on-line interactive process, to programs and hardware.

In 1975 a detailed study was undertaken in order to detect the most suitable hardware and software that could face, within short and medium time spans, CICH's needs and at the same time be afforded by the center's available economic resources.

The Digital PDP 11/40 minicomputer was selected because it permitted, among other interesting features, a modular growth in capacity.

CICH's hardware was installed in 1977 and the Unit for Informatics has since then implemented, in addition to the different processes already mentioned in the context of this paper (see Fig. 2), several administrative routines that have simplified and made CICH's activities more efficient. The Unit is aimed to care for the system's analysis and design as well as to do the necessary programming and maintenance activities for supporting the center's needs and services. Its staff is presently integrated by an electronic engineer (head of the unit), a chemical engineer with a master's degree in planning and systems design, one systems analyst and three programmers.

Present hardware facilities include the PDP 11/40 minicomputer central processing unit with 256 Kbytes of central memory, with a RSTS/E V7.0 operative system, two disc units with a total capacity for 264.5 Mbytes and two disc packs, one magnetic tape unit for dual density mode 800/1600 BPI and 9 tracks, one punched card reading device with capacity for 285 cards/min., one printing unit for 300 lines/min., one floating point processor, 14 CRT-terminals and two decwriters, plus some software packages (Basic Plus 2, RMS 11K and Sort 11). The average use of CICH's hardware is of 200 h/month.

THE CENTER AS A TRAINING INSTITUTION IN INFORMATION SCIENCE AND TECHNIQUES

One of the center's most important activities and successes has been to identify, recruit, train, maintain, increase and produce a multidisciplinary staff of young professionals, most of them graduated from the UNAM itself, willing to make the information science and techniques a second profession. While most of them have been trained on the job and by continuous educational academic activities in and outside the center, in more recent times and due to the availability of greater manpower to support the routine activities, CICH has been able to afford the transitory partial or total absence of some members of its staff that have undertaken post graduate studies in information science or related disciplines.

UNAM has also recognized this staff working on supporting research activities, as a special type of its academic staff called academic technicians, a unique feature in Latin American universities.

CICH's academic staff is presently composed of 45 people working full time and covering some 20 different branches of knowledge. Some 30 other persons have left the center during the last 10 years and are working now with other institutions. 15% of the staff has post graduate study degrees, 40% BS degrees and 45% is composed of students.

Multidisciplinarity of the staff and command of English, at least as a foreign language, is mandatory since it has to identify, analyze, access, retrieve, interpret, translate and supply information in practically all branches of human knowledge. It is also felt that the best way to match the user's interests and needs with the pertinent information is by having a human interface that both shares with him the same profession and masters the modern information storing and retrieving techniques.

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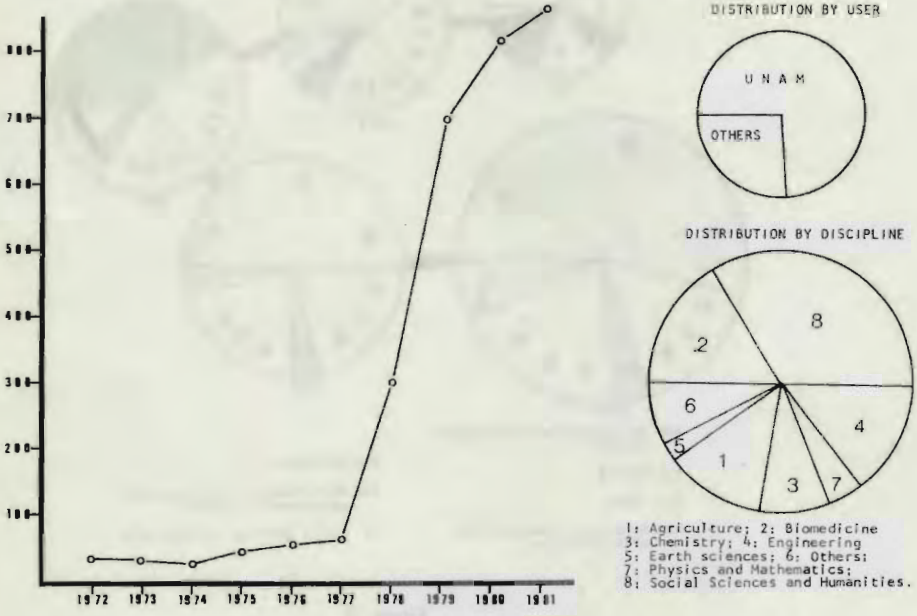

Figure 1
RETROSPECTIVE BIBLIOGRAPHIC SEARCH SERVICE

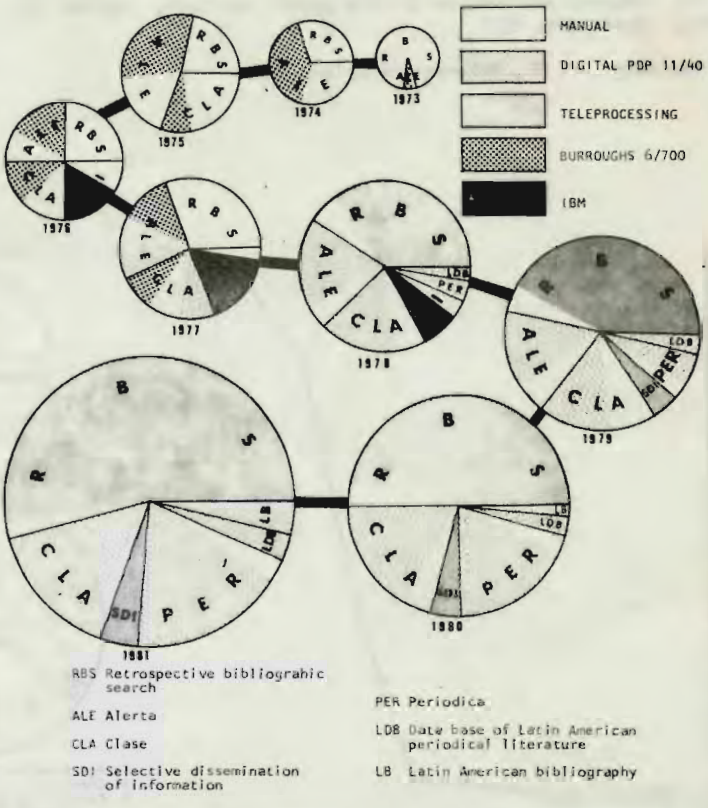

Figure 2
EVOLUTION OF INFORMATION SERVICES
AND THEIR COMPUTERIZATION