"THE SELECTIVE DISSEMINATION OF INFORMATION SYSTEM (SDI system) OF THE NUCLEAR INFORMATION CENTRE OF THE NATIONAL COMMISSION FOR NUCLEAR ENERGY (CIN/CNEN) IN BRAZIL".

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'Ideas, whether those of art of science, or those embodied in practical appliances are the most real of the gifts that each generation receives from its predecessors. The world's material wealth would be replaced quickly if it were destroyed, but the ideas by which it was made retained. If however the ideas were lost, but not the material wealth, then that would dwindle and the world would go back to poverty.'

(From: Principles of economics, by A. Marshall)

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S U M M A R Y

The economic importance of the contribution of information services of the Nuclear Information Centre of the National Commission of Nuclear Energy - CIN/CNEN, in Brazil is carefully analysed from the point of view of economic analysis.

The interconnection of nuclear information at the international level is discussed, taking a historical overview of SDI systems as the starting point. The main developments abroad and at the national level are described.

SDI systems development is focused at the international level through the data collected from the literature, and the Brazilian situation is presented comprehensively through the data collected by the researcher with 123 users of the SDI systems of the CIN/CNEN

The three principal objectives of this study are:

a. to develop and explore empirical relationships of a system study of the CIN/CNEN SDI service;
b. to develop a user study of the CIN/CNEN SDI service;
c. to develop a document request and supply study of the CIN/CNEN SERVIR service,

At the empirical level, the major objective is to perform a quantitative analysis of the nature and cost of the CIN/CNEN SDI service, providing a description of the service and an analysis of its costs. A final objective is to relate the implications of the theoretical and empirical analysis to some existing linear model which confront the CIN/CNEN SDI system today.

The study of the hypotheses involved the following steps:

a. identification of the production costs of the SDI system from CIN/CNEN;

b. identification of the supply of and demand for this SDI system;

c. analysis of the production costs of this SDI system;

d. analysis of the supply of and the demand for this SDI system;

e. determination of users willingness to pay for this SDI system;

f. determination of real costs and quantities produced by this SDI system;

g. use of statistical methods for testing the hypotheses on some of the variable relations under study.

An overview of research results is presented. The approach

adopted by the researcher is focused on the cost analysis of the SDI service from CIN/CNEN and on the value of such service to its users, mainly in relation to its supply of and demand for information.

Some recommendations for further research work are proposed, taking into account needed changes toward a new society.

1. FRAMEWORK OF THE STUDY

1.1 INTRODUCTION

Development is a complex social process which rests in large part upon the internal innovative capabilities of a society. It involves socio-cultural change as well as economic growth and is concerned with the people's welfare - their material, cultural and spitirual well-being. Development comprehends qualitative and quantitative changes and progress in the whole fabric of both individual and social activities. Some of the aspects of human activity that are part of development include adequacy of food, clothing, health and education; the quality of the environment for work and leisure and facilities for interaction and cooperative work despite geographical and socio-cultural distances separating people. Others are the ability to use information and participation in decision-making processes; capacity and facilities for use of leisure time in a productive way; and continued improvement in the standard and quality of life. The reduction of gaps between developed and less developed parts of society within a country and among countries is of particular importance in the global progression toward establishing a new international economic order (1).

Information and information products, like most other commodities and services, are influenced by the development milieu, that is, the economic, social, political, technological, and cultural context. Countries which have developed the capability to generate knowledge and scientific, technical and managerial information communicate such information efficiently and utilise it in development activities. These countries demonstrate an accelerated pace in their industrialisation and wealth-producing capacity. This, in turn, generated more knowledge and innovation as well as their application to still further development. On the other hand, a large number of

countries, mostly the developing countries, find it difficult to provide for the basic needs of their populations, including such items as food, clothing, transportation and communication. These difficulties are due, at least to some extent, to inadequate access to knowledge that could help convert resources into the goods and services needed (1).

Development planning implies the efficient management of resources of all kinds in order to create the knowledge, skills and capability to produce the goods, services, facilities and opportunities necessary for achieving national goals. Efficient management implies the making of gainful decisions at the right time and the ability to direct the development process toward the desired goals. In a given context a decision is only as good as the adequacy of the information available to the decision-maker and the efficiency with which he processes and applies the information.

An inevitable conclusion from a development planning exercise is that, irrespective of the development milieu and plan model adopted in a country, a vital input to good planning is timely and reliable data and information. This includes for example, information on internal and external influencing factors, availability of the required resources, forecasts of trends, experiences in other countries with similar conditions and utilisation of the same or similar technologies. Such information is necessary to determine priorities for development vis-a-vis national development goals, optimal allocation of available resources, choice of appropriate means, methods and technologies. Non-availability of timely and reliable data and information has often led to poor planning and the results achieved by implementing such plans differing totally from original goals and expectations. Awareness is growing that national development planning and its implementation are supported by good information systems. The results tend to be more satisfactory both in respect to target achievement as well as in the use of planning as a tool for minimising risks.

Therefore, developing countries are increasingly concerned with systems that could provide development planners, administrators and information personnel with timely, reliable and adequate data and information (2)

1.2 CONSTRUCTION OF HYPOTHESES

The economic importance of the SDI service from CIN/CNEN to government is nowhere explored, and it is only during the period since work was begun on this theses that some careful analysis on the subject has been published. Generally the questions which have not been carefully analysed include:

a. the rationale for maintaining the Selective Dessemination of Information service of CIN/CNEN as a non-profit public institution rather than a private institution in terms of the distinguishing characteristics of this specialised service;

b. the nature of this SDI service and how its distribution is related to users benefit; and

c. the allocation of resources to and within this SDI service.

What is an SDI system? An SDI system is a system, either manual or computer-based, by which those documents that are likely to be of interest in a study are selected for the researcher from a mass of publications produced. In the manual system this is done by information workers who scan the incoming literature and are aware of the information requirements of those

individuals who are to be served. In a computer based system the information requirements of each individual are indexed to form a profile and these profiles are then compared with the indexing of the documents entering the system. Where the match is sufficient, details of the document are sent to the individual possessing a matching profile. If the researcher returns an assessment of the relevance of the notifications to his particular interests, his profile may be modified to reflect his requirements more accurately. A variation of this SDI service tailored to the requirements of the individual is the standard-profile SDI service in which a profile is established to cover a stated subject, an aspect there of, which can be sent to any number of subscribers.

The aim of this study is to identify an operationally viable methodology whereby the value of the SDI service can be quantified and compared with the costs incurred in the provision of such services.

A general methodology for the evaluation of this particular SDI service, from the Centro de Informações Nucleares - Comissão Nacional de Energia Nuclear (Nuclear Information Centre/ National Commission of Nuclear Energy) - CIN/CNEN, will be considered. A detailed description and definition of this service will be provided in a later chapter. It is the intention of the researcher to study how efficiently this non-primary service is produced and to what degree users' wants are satisfied. The scope of this study is confined to the nuclear energy community in Brazil and the sample population of users from which the researcher will estimate the benefits of the SDI service is taken from the R&D personnel in this field. The contributions of this study to our understanding of the economic nature and social implications of the operation of the SDI service are found in both the conceptual and empirical analyses which will be presented below. It would be a mistake to judge the worth or value of the study on only one

level to the exclusion of the other. It is also important to recognise that the conceptual and empirical analyses of this study have important implications which may be extended to the remainder of the public economy.

Viewing the research within the larger framework, it may be seen that the specific objectives of this study are multiple. There are three principal objectives of this analysis:

a. to develop and explore empirical relationships of a system study of the CIN/CNEN SDI service;

b. to develop a user study of the CIN/CNEN SDI service;

c. to develop a document request and supply study of the CIN/CNEN SERVIR service.

A prerequisite is to review a representative sample of professional economic and information science literature as it relates to this topic.

Another objective at the empirical level, is to perform a quantitative analysis of the nature and cost of the CIN/CNEN SDI service, to accomplish this objective it was needed:

a. to provide a description of the CIN/CNEN SDI system;

b. to analyse the costs and the time saving benefits.

A final objective will be to relate the implications of the theoretical and empirical analyses to some existing linear model which confront the CIN/CNEN SDI system today.

The scope of any study must perforce be circumscribed in both its conceptual and empirical aspects. Being one of the first analyses of this SDI service, it should be evident that the potential ground to be covered is vast, and that only an incremental approach to the subject is viable, which by definition is the nature of a first step.

This work is dedicated largely to a case study of real production costs in the CIN/CNEN SDI system, and the researcher will abstract from the data of the questionnaire survey the specific case of CIN/CNEN, which resulted in an analysis of the distribution of costs and the benefits which are derived from the operation of this SDI system.

Summarising the main points the following hypotheses may be formulated:

> The core of the research was to find out the time saving benefits to users of the SDI system of CIN/CNEN and to investigate how the supply of and demand for information relates to this community.

The hypotheses formulated are:

1. The use of the SDI system of CIN/CNEN is basically less costly to users when compared with the cost of users searching for information by their own means;
2. the supply of the SDI system from CIN/CNEN is a function of the demand for it;
3. users willingness to pay for the SDI system from CIN/CNEN is a function of the supply of this service;
4. Cost/user relations in the SONAR/SDI have a suitable increment when the quantity of users increases;
5. The cost system shows a trend of:

   . constant decreasing rate of fixed cost as a function of the production structure adopted at CIN/CNEN;

   . constant decreasing rate of average total cost as a function of the production structure adopted at CIN/CNEN;

   . variable costs increase at a variable rate as the number of users increases.

The study of the hypotheses involved:

. identification of the production costs of the SDI system from CIN/CNEN;

. identification of the supply of and the demand for this SDI system;

. analysis of the production costs of this SDI system;

. analysis of the supply of and the demand for this SDI system;

. determination of users willingness to pay for this SDI system;

. determination of real costs and quantities produced by this SDI system;

. use of statistical methods for testing statistical hypotheses on some of the variable relations under study.

1.3 METHODOLOGIES

1.3.1 Questionnaire Survey

The objective of the questionnaire survey is to access the relative value of the SDI and document supplying services of the CIN/CNEN and to measure users' willingness to pay for them. A survey of scientists engaged in the field of nuclear energy in Brazil was adopted to achieve this objective. This survey may be divided into three distinct but related parts. These include the formulation of a questionnaire, the sampling procedure, and the use of the questionnaire in the sample field.

The formulation of the questionnaire was influenced by the type of data and other information that was to be obtained, and also by the method of analysis adopted. In the present study, the questionnaire was formulated to evaluate the preferences of

the users' community being treated in this study. The end result was the formulation of a questionnaire containing a set of questions aimed at producing measurements of relative value of the SDI and document supplying services from CIN/CNEN and that had been subjected to extensive testing with nuclear energy scientists sampled.

In order to generate the data required for the analysis, it was necessary to comunicate with the scientists who are engaged in nuclear energy work. Ideally each scientist concerned with field work should have been sampled. This was not feasible because of the large number of scientists.

The procedure followed to reduce the number of scientists sampled to manageable proportions was determined to some extent by general principles that were to be followed in the selection of a sample.

Perhaps the most important procedure relates to the statistical characteristics possessed by the total population from which the sample is drawn.

In order to do so it was helpful to use a text on questionnaires and sampling procedures from the U.S. Department of Defence entitled Sampling Procedures published in 1963 (3).

The methodology adopted was based on the assumption that the social welfare function of the investment took place on the occasion of the creation of CIN from CNEN in 1970. The objective established to fulfil this function was to set up an SDI system in order to supply information in the field of nuclear energy in Brazil, with particular reference to those users working in priority areas included in the National Development Plan of Brazil (4) (5) (6) (7) (8) (9) (10). Taking this approach into consideration the researcher selected the priority areas included in the National Development Plan. The subjects treated in the plan were translated into descriptors acceptable within

the structure of the data base system and the International Nuclear Information System thesaurus - INIS.

The researcher applied a computer program to select those users within priority areas.

From the total user population in CIN of 1562,40% had profiles within the priority areas of nuclear energy. From the second computer run 630 users were selected of which 456 had only one profile in the SDI system. The next step was to apply the sampling procedures program from the US Department of Defence resulting in a sample of 125 users, with a specification level of great discrimination. The researcher decided therefore to use the lot size within the range of 500 to 1200 once the selection was of 456 users.

The questionnaire was written in Portuguese and the researcher included a translation of the questions into the English language in Appendix 1. The questionnaire was divided into five sets of questions which were given to each user sampled.

The approach adopted of giving only a few questions each time until the whole questionnaire was completed was due to the fact that the researcher did not want to overload the users with all 36 questions at one time. The total number of questionnaires sent was 125, which represented a sample of those users within priority areas in the field of nuclear research.

The researcher used two approaches to reach these users, by letter and by personal contact. It took long time to have the questionnaires sent back. The researcher had to make contact with users several times and only in the end of 1979 were all answers received.

The first set of 6 questions was designed to verify what kind of information users need and how they use it. Questions 6 to

9 were aimed at verifying how users' time is allotted in their work or in searching for information. Questions 10 to 12 were made to check the importance users give to information services. Questions 13 to 17 were aimed at evaluating cost/benefit in relation to the SDI service. That last group of questions, 18 through 36, were necessary for analysing and correlating the previous questions in terms of information supply and demand.

Most of the procedures and measures used to analyse the sample were designed before the questionnaire was ready. The researcher first correlated all questions in a matrix to decide what outputs would be desirable for data analysis.

The next step was to start making up the questionnaire itself. It was submitted to extensive testing among officials of CIN/CNEN and was also evaluated by Mr. Tom Wilson, from Sheffield University. Once all comments were analysed and incorporated or not, another matrix was made to finalise the level of correlation to be adopted.

To ensure a good response level in the sample the researcher used the process of grading whereby a value is allotted to a particular service, in this case to the SDI service of CIN. A grading process was adopted in the sample for subjective values given through users' opinions and was proven to be very useful, yielding interesting comparisons in the rankings.

This research made no use of objective measure in the sample. Nevertheless it counted the number of references sent to the users and photocopies demanded by them as well as all the costs incurred to run the system and ease of use time for the user.

This may cause the related question of reliance upon the grading process to arise. Alan Carter in his article Economics of the University based on a survey done by the American Council for Education - ACE, comments that objective bases for

grading are employed for comparison with subjective ratings and correlation coefficients which are calculated between results obtained by different methods. In his survey it was found that subjective evaluations can render an accurate ranking of quality better than alternative objective measures, such as the number of university fellows involved, or the number of books in the library (11).

In her sample the researcher was interested in the behaviour of the nuclear scientist as an information user in CIN/CNEN. Of interest as well was the supply and demand for information, time saved by users of the SDI service once they did not have to look for information themselves and users' preferences in information sources and services.

The sample was made using a nonrandom approach based on the main objectives of CIN as stated previously and also as made in the research being done by Wolf in The Economics of Technical Information Systems, where it is shown that no systematic upward or downward bias in the results are caused by the difference in selection procedure (12). In the light of this it was concluded that the selection method used provided a reasonably satisfactory basis.

1.3.2 Statistical Methods Used

The statistical methods used are here summarised.

a. Linear regression - simple and multiple:

A regression analysis was utilised to determine the functional relation among some of the quantitative variables under study. The Study of regression was made basically using the coefficient of determination to measure the significance of this relation. So, values under 0.5 indicates an unsatisfactory regressive model.

The regression study involved these variables:

V 52	Willingness to pay - WTP
V 58	Age
V 59	Years of experience
V 60	Salary
V 61	Supply
V 62	Demand

b. Correlation:

Pearson's correlation coefficient was calculated to determine the degree of dependence among some variables under study.

c. Statistical hypothesis tested:

- The T - test was used to compare groups which had been assembled according to a particular characteristic. All the tests were done at a 0.05 level of significance.
- The Chi-Square test was used when needed to verify the dependence among factors involving qualitative variables. The Chi-Square test was then used to hypothesise the interdependence among variables. The test was also applied at a 0.05 level of significance for contingency tables with a sample greater than 100 in the majority of cases.

d. Descriptive statistics:

Data description of some variables was made by the construction of frequency distribution tables. With respect

to these quantitative variables the researcher used statistical measures such as: mean, standard deviation, median, total amplitude and mode. These results are presented in Chapter 6 together with the tables containing frequency distributions.

The Statistical Package for the Social Sciences - SPSS, version 7, was used in the calculation required. The computer used was the Borroughs 6700, through the auspices of the Department of Statistics of the University of Brasilia.

1.3.3 Cost Analysis Used

The cost analysis has been based on the production data collected in the CIN/CNEN.

The variable cost and fixed cost were used to help determine the existing cost characteristics in relation to the production level.

The concepts of fixed and variable costs had considerable application in this Study together with average and unit costs.

To proceed with the cost analysis the researcher based her work on the following principles and criteria as well as those detailed in Chapter 5.

1.3.3.1 Elements for costing

While the practice of a so called building block system for unit costing is by no means offered as a general model to be followed in all situations, it does seem to offer sufficient

flexibility to be applicable to a variety of cost control requirements (13). Its capability has also proved that in actual use year-to-year projections of unit costs have, on the whole, been shown to be accurate, except where marked variations in volume from the projected figures or equally identifiable changes in operational techniques or policy have invalidated the assumptions inherent in the forecasts.

Since information systems are subject to varying workloads, an effective approach to costing seems to be unit costing. However, the lack of a one-to-one relationship between inputs and outputs makes it necessary to select relatively small elements for unit costing which constitute building blocks from which final costs for an output can be assembled. The cost system identifies an item of cost by several kinds of tags. These tags are: Product, Project and applications.

Definitions:

a. A product represents a coherent set of activities which result in the production of identifiable units which can be counted for the purpose of costing in an information system. Generally, in most information system there will be activities which support several products and which have no meaningful count measure for their output. These should be considered products for the purpose of collecting their costs, which can be distributed to the products they support on some rational basis.

b. A project identifies a significant set of activities being costed. It might be the implementation of a product line on production for a certain class of customers.

The methods and procedures for collecting the costs of the systems that produce and disseminate the SDI and the document supplying services of CIN/CNEN have the objectives of calculating the elements for costing. The amount of resources used in the production of these two services is the cost in money terms. The collection and allocation of costs was manual for most of the study.

The methodology used was based on the collection of data according to the following classification:

. Labour costs refers to all existing manpower;

. Usage of local and non-local computer;

. Rent for xerox, telephone and IBM program products;

. Stationery and office expenditures;

. Acquisition, cost of literature, coupons and hardcopies.

The researcher allocated these expenditures among products, projects and applications (contracts with other enterprises). These costs were classified as follows:

. direct cost

. indirect cost

. fixed cost

. variable cost

Fixed costs refers to outlays which remain constant or unchanged regardless of the number of output items by enterprise. For the products and services offered by the CIN,

these fixed costs include the expenses incurred directly and indirectly for labour and computer rental, space rental, insurance, communication lines, peripherals.

Variable costs refers to outlays that varies proportionally to the amount of business done or the volume of goods produced; they are costs directly associated with the level of activity. For the CIN services these include the cost of computer processing, materials and stationery, output printing and reproduction, mailing and distribution. Each of these expenditures increases with the larger number of users in the systems, but the rate of increase can vary. Total cost is the sun of fixed and variable costs.

1.3.3.2 - Cost allocation system

The collection of costs has been mainly made to set up fixed and variable costs in order to analyse cost behaviour characteristics (see table 49 and figure 23 in Chapter 6) so, the production costs set up were helpful to establish the production structure level at which the system would allow a large dilution of fixed cost (see figure 26 in Chapter 6).

The cost rates (tables 50 and 51, figure 24 in Chapter 6) were analysed on the basis of the production costs collected (table 49 in Chapter 6) which allowed the researcher to identify the various levels of rates at which the number of users is sufficient to compensate the investment made at the CIN/CNEN SDI System.

This study does not show individual cost data. All cost data

has been aggregated and explored to analyse total, fixed and variable cost behaviour characteristics.

Labour costs were calculated based on working hours and average salary for each professional category at CIN/CNEN. Work activities were set up within intervals of time in order to use this data with appropriate costs incurred within a specific functional category in one given activity. It has not been allowed to the researcher to show this data once it has received the label of confidential.

For bibliographical support and indexing activities the researcher used the Personal Allocation Worksheet already in use at CIN, since they can have their cost/time directly alloted.

For other activities involving management, advisory work and administration in general, the allocation of cost was a proportional distribution.

Photocopies are a major expenditure as the document supplying service and uses almost 99% of the existing machines for delivery.

The researcher estimated unit costs for the products offered by CIN dividing by area within the CIN organisational chart:

Collection of costs

a. Labour costs:

Area 1: relates to bibliographical support collection time

needed for each activity through the proper form. The activities developed by Area 1 are continous.

Area 2: relates to computer support due to the diversified activities and personnel profile involved in computer programming, analysis, data entry and operation, the procedure has been as follow:

Analysis: hours devoted to projects, products or system;

Programming: The same as above;

Operation: Rate of man/hours by percentages of local computer usage divided among projects/products/applications;

Data entry: same as above.

Area 3: relates to indexing activities same procedure as Area 1.

Area 4: relates to administrative support and management. Management (includes advisory board directors, secretary and managers), has been rateable among labour costs from each Area and projects/products, all functional costs/hours has been collected for the organisation. The calculation has been: multiplying activities allocated hours by the cost/ hour of each function to obtain total incurred costs of CIN in relation to each function to accomplish each activity.

b. Computer usage:

The researcher used the computer accounting provided by the computer centre for hours of computer usage. Those hours were used to obtain a proportional distribution for the operation and data entry labour allocation costs.

The computer is paid off so the operational cost was counted in relation to the amount of resources needed, and it was considered as sunk cost.

c. Materials and stationery: It has not been taken into account each kind of material for each activity but for all the material supplied by area.

d. Acquisition: These are the costs incurred with the document supplying service in order to buy hardcopies and institutional bonus.

The researcher classified costs as follows:

a. Labour costs =

directly fixed cost - DFC	Labour costs directly involved in products AREA 1, 2 and 3;
indirect fixed cost - IFC	Management and Administrative Labour costs involved in Area 4, fixed overhead costs.

b. Computer costs =

/3 = direct variable cost-DVC	Computer processing of all products of CIN accounting to 99% and including support, peripherals, etc;
indirect variable cost - IVC	Computer processing by other institutions;
/370 = DFC	Computer rental including support, peripherals, communication lines etc.

c. Materials and stationery =

DVC = Materials used for computer processing;

IVC = Stationery.

d. Reprography

DVC = Varies according to document supplying service production.

IVC = Varies according to requests received

1.4 STRUCTURING THE STUDY

As has been indicated, the analysis is qualitative for the most part and indirectly measured, based on economic and information theoretical models. The nature of these methodologies will become clearer as the researcher works through the analysis below. This is clarified in more detail in Chapter 5 "Theoretical approaches and Methods". The general procedure is as follows: Chapter 2 and 3 will present an overview of SDI systems. Chapter 4 contains a description of the CIN/CNEN SDI/system which has been choosen as the case study for the empirical analysis. Chapter 5 as the beginning of the second part of this study, is an attempt to sketch some theoretical methods applied within the SDI system, and to approach different measurements of the CIN/CNEN system.

Chapter 6 is a discussion of the results obtained from an analysis of the economic aspects of the system and demand for and supply of benefits of the system.

Chapter 7 seeks to tie together the main conclusions of the preceding analysis and relate them to a new decision-making policy for that system and attempts to make some recommendations for further research work.

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2. HISTORICAL OVERVIEW OF SDI SYSTEMS

2.1 THE ORIGIN AND DEVELOPMENT

Science is a cumulative body of knowledge integrated into a system of communication. Through observation and experimentation the raw data of information are obtained. These are then analysed, worked and eventually formed into an organised body of scientific knowledge. This new knowledge enters the communication system as new information and is added to the body of knowledge already accumulated.
The system of communication, however, is slow. It may take as much as eighteen months before a research result is reported in a journal. Another year may elapse before an article is reported in an abstracting journal. The root cause of the problem is the exponential growth in the volume of information. This growth goes on inexorably in spite of appeals to reduce the profusion of publications. At least a million papers a year are produced by, and offered to, the scientific community (1).

The problem becomes one of selection. The research writer has no desire to be omniscient; he does not even wish to be able to read every article available. But he does need assistance in selecting what he must read from among the vast number of documents available. He needs to be aware of developments in his own field. He wants to know what has been done, as well as what has not been done, as no researcher wants to duplicate the work of others. Neither does he wish to follow paths which have already been proven erroneous. He is interested therefore in unfruitful studies as well as those which were successful. Furthermore, he wants to know who else is working in the field, where the work is being done, and for what purpose, since he realises that it is the sum total of contributions from a great many people that eventualy will solve a particular research problem.

The situation calls for the dissemination of information on a highly organised and selective basis. The principle of dissemination of information on a selective basis is not new to the library world. It has existed from the time that the librarian became aware of the information needs of the users of his library and took steps to call their attention to newly acquired items of information of potential interest to them. It began then, as a courtesy service to certain patrons of a library. This manual selective dissemination of information known as a current - awareness service, has reached various degrees of sophistication. Very often incoming journals have been scanned for pertinent literature, the references obtained have been disseminated in various forms.e.g., in information bulletins, technical bulletins or indexes to current literature with or whithout abstracts. To that extent each individual user was alerted by what has been of necessity, an omnibus of references to a selected group, is a moot question.

The pace and scope of human activities has accelerated through the years and a formidable mountain of information accumulated, the sheer bulk of which has created tremendeous problems. Although the volume of recorded knowledge grows exponentially, the time available to any one man for searching for the information he needs is limited. The proportion of all the knowledge in a field in which a man can claim to be fully informed has grown steadily smaller. It became evident therefore that apart from the duplication of effort and cost at the various information centres where the scanning of the literature was being carried out, the traditional methods of disseminating pertinent literature had become quite inadequate for dealing with the problem of efficient selection. New tachniques were necessary. Computers began to be utilised to speed up the process and to provide new possibilities to the current-awareness service by individualising it and aiming to supply the user with only

those references pertinent to his particular need and field of interest. This indidualised information service, known as Selective Dissemination of Information - SDI, is offered as an attempt to solve the problems created by the amount of recorded information available.

Hans Luhn of the IBM Corporation is generally credited as being the first to develop the concept of mechanised selective dissemination of information. Central to his proposals for a business intelligence system, of which SDI is a part, was the service concept. He maintained that operation of the system must require as little effort as possible on the part of its users. Scientific communication can thus be made more effective by extending the obligations of the provider of new information to disseminate it more selectively, thereby reducing the effort necessary for the user to become aware of it (2). Each document entering the proposed system is abstracted and assigned a coded document pattern based on key words taken from the text. Each document pattern is then matched with a pattern of terms which make up the profile, describing the user's interests and an abstract is disseminated if the weighted proportion of codes in the document pattern which matches those in the profile exceeds a predetermined threshold. The same abstracts and indexes are to serve in both dissemination and retrieval (i.e. retrospective searches). Document provision is part of the system and profiles are updated with the patterns of documents as requested by the user, which is a process described as selective acceptance of disseminated information.

The system concept is broad and is not confined to matching papers received from external sources with individual profiles. There are several different types of match criteria which are used by SDI systems to select relevant documents for each user. The most popular method is the use of weighted terms. In this type of system, the user assigns a weight to each term in his interest profile according to its relative importance in the selection of relevant documents. A document is selected

if the sum of the weights of the terms which match the user profile is equal to, or greater than, a predetermined threshold. Another type of match criteria commonly used by SDI systems is Boolean logic. In this case, a user profile consists of a list of terms related to each other by the logical connectives "and" and "or", and documents are selected if the document description fulfills the conditions of the Boolean statement. A third type of match criteria in use is one in which the terms in the user profile may be designated by "must" or "not". A document having a "not" term is never selected for the user. A document having a "must" term is always selected unless overriden by a "not" term. An undesignated term is considered a "may" term. A document having no "must" or "not" terms is selected if it has certain number or percentage of "may" terms in common whith the user profile (2).

The service concept developed rapidly in the early 1960's. The use of computer facilities also was a fact of rapid growth in the area. Another factor in the development and expansion of SDI services was that the publishers of abstracts and index journals and other publications began making tape versions of their bibliographic citations available. These tapes were a by-product of the publications process. The American Chemical Society was one of the first publishers to decide to provide on an experimental basis references from it's "Chemical Titles" in magnetic tape form in 1962 (3).

The availability of government financing to support the development of regional information processing centres in the USA in order to provide computer-based retrospective and current-awareness searches is the third factor in the rapid growth of SDI services. The National Science Foundation - NSF, funded centres oriented toward providing services to the academic community, while the National Aeronautics and Space Administration - NASA, funded others directed to commercial service. SDI was then transformed into a service offered by

a wide variety of information facilities instead of being limited to a single company.

It was only in 1965 that the first commercial SDI service was begun. This service was the Automatic Subject Citation Alert - ASCA, offered by the Institute for Scientific Information - ISI, publishers of the Science Citation Index. SDI was offered by centres in universities, industries, non-profit organisations and state and federal government. A variety of professional organisations appeared in 1968, for example, the Association of Scientific Information Dissemination - ASIDIC and in 1969, the American Society for Information Science, Special Interest Group on SDI-SIG/SDI, convened its first business meeting (3).

In 1970, as a result of a previous meeting, the European counterpart of ASIDIC, known as the European Scientific Information Dissemination Centres - EUSIDIC, was formed. A number of conferences and symposia were also sponsored during this period. Financial constraints, due to the cutting of government subsidies have led to increased interest in the establishment of regional and national search centres (4).

The factor of competition has appeared and rapid growth of retrospective search service offered on-line. SDI is an expensive service to provide and centres must face the problem of charging users to recover costs or of finding institutional or other funding to support their continued existence.

2.2 MAIN DEVELOPMENTS ABROAD

Despite rapid growth in utilisation of SDI systems in the sixties, their present use is still relatively limited when compared with their potential. In 1971 a very small percentage of the professionals in science and technology in the western

world were using computer-operated services (5).

This situation may have been due to a number of factors:

a. people generally are reluctant to use that which is unfamiliar;

b. there may have been a lack of advertising on the part of the information centres;

c. the cost of the necessary magnetic tape files is high and the idea that information is a commodity that must be paid for has not yet been fully accepted;

d. the interest of many scientists overlap into several fields and several magnetic tape files need to be searched on a regular basis in order to satisfy their needs.

e. the problem of incompatibility of magnetic tape files, renders it difficult to search more than one tape with a program.

Each supplier of commercially available magnetic tape files uses a different computer system to produce his tape. Therefore an information centre using magnetic tapes from more than one supplier will have to overcome the problem of incompatibility. Early work was done on this problem by the Royal Institute of Technology in Sweden. Already in 1966, an information retrieval system was designed in which all magnetic tapes were converted to a common format as received, thus allowing a single search and print to be used (6). By 1970, the Royal Institute of Technology in Sweden, the Illinois Institute of Technology Research Institute - IITRI, Chicago, USA, and the National Science Library, Canada, were using standard file formats based on the Machine Readable Catalogue - MARC system for re-formatting commercially available magnetic tape files. All the data bases are now converted to this standard format.

The long-range answer to this problem of incompatibility therefore seems to be the international standardisation of formats, content, indexing methods and programming language used.

In 1972, about 200 different magnetic tape files were identified but only forty-eight have been used by information centres to provide SDI services (7). Apparently the problem of the cost of literature-on-tape still inhibits its use.

It would appear that the SDI, like many other services is priced at the level at which the customer can be induced to pay, rather than being based on the actual cost of production and reasonable profit.

A study tour of SDI centres in the United States, Canada and Europe was undertaken by Spicer (3) in 1972 to examine the state-of-the-art of SDI and the following facts were revealed:

a. Commercially available tapes:

Magnetic tape files are available on a commercial basis and have been supplied mainly by publishers of secondary journals where magnetic tape files are a by-product of the computer type-setting activities for the publication of the journal. This means that the formats used have been more suited to journal publication than to SDI searching. As these formats vary from tape to tape, the problem of different formats will continue until a standard international format is agreed upon. The generally accepted short-term solution is the conversion to a common format of all files used, thus allowing a single search and print program to be used. The question of overlap is still a problem and is receiving careful attention among suppliers. The merging of magnetic tape files by information centres is considered to be impractible because of the different selection criteria, indexing methods and time lags.

Restrictions relating to the form and number of copies of output and the creation of subfiles are imposed by suppliers; matters relating to these restrictions have to be negotiated by the information centres conducting the tape purchase.

b. costs: information centres can subscribe to magnetic tape files either under a lease or licence agreement. Under a lease agreement the centre may provide services within its own organisation without payment of royalties. A licence agreement is needed if services are offered outside the organisation. The subscription to magnetic tape files is only a part of the total costs of providing a computerised information service. The real cost involves much more.

It has been found that industrial information centres usually run their SDI services on cost-effective lines, using well established techniques. Because of the experimental approach of academic institutions where more sophisticated and novel techniques are used, there is little effort to provide SDI services on a cost-recovery basis in these institutions. Government funded organisations generally operate on a semi-cost-recovery basis. While pricing policies vary from the empirical to the sophisticated, experience would indicate that charges should be made from the start of the service.

c. interest profiles: In the USA the tendency appears to be for the information centres to construct profiles on behalf of the users. In Europe the tendency is to involve the users to some degree in the construction of profiles. A profile design manual and continuing liaison between user and centre appears to be essential. Standard profiles are now being offered. These are fixed and are intended to meet the common requirements of a wider audience. They require little maintenance and are used in some centres to introduce new subscribers to the principle of SDI services.

d. computer programs: The development of SDI computer programs requires several man-years. Until recently those programs

which were available for searching magnetic tape files had search times proportional to the number of search terms in the profiles. Programs have now been developed in which the search time is proportional to the logarithym of the number of terms in the profile. These programs are commercially available, but it must be kept in mind that modifications will nearly always be necessary. Use of the same computer as that for which the program was developed does not preclude the need for changes. Differences in computer installations often necessitate alterations in programs.

e. Matching techniques: Although some programs make possible very sophisticated matching techniques, the general trend seems to be towards simplicity. Experience has taught that single Boolean logic, together with the option of weighting and truncation of terms, is quite adequate for an excellent SDI service (3).

Although SDI services have improved greatly over the years, they are still in an early stage of development.

As soon as costs decrease, it will be an accepted procedure for a user to dial an information centre, type out his query to search the data base he requires, and modify his query as he sees the references retrieved.

2.3 DEVELOPMENTS IN BRAZIL

Developments of SDI systems in Brazil started only in the seventies and is still relatively small. These systems are funtioning mainly on a manual basis and there is only one system commercially available. The only one having a subscription fee is the Technological Research Institute of São Paulo depending on the type of profile, standard, group or individual. This system although commercially available has no more than 150 users.

All the data presented in this chapter was collected by the researcher during 1979 which involved field work with structured interviews.

2.3.1 C.A. - Atomic Energy Institute of São Paulo

In August, 1974, a manual service of selective dissemination of information was established in the Division of Scientific Information and Documentation - DIDC, at the Atomic Energy Institute of São Paulo - IEA. This service was aimed at supplying information both selectively and regularly, for the primary research being developed by the scientific community at IEA and was under the direct responsibility of a librarian from the Dissemination of Information Department in DIDC.

Among the preliminary conditions for the establishment of the SDI, one was to find librarians willing to work at DIDC. In order to be admitted to the DIDC librarians must have had some background in chemistry, physics and mathematics in their high school program and they must attend higher level courses in chemistry and physics which are taught by IEA researchers. This scientific training is necessary because librarians must be able to maintain a dialogue in the same language spoken by the researcher.

By January, 1976 the SDI manual service had developed 25 profiles according to the research areas in the IEA: Chemistry, physics, mettalurgy, reactor engineering, radiologic protection, etc., when this manual SDI was discontinued due to reasons not related to its development. Apparently users were very satisfied with the service while the SDI was in operation.

In May, 1978, the SDI manual service was reinstaled with no alterations in its operational systems as it had already proven to be satisfactory.

a. Establishing the User's Profile

A profile is formulated through contact with the researcher

by the SDI service. The librarian must interview the researcher as many times as necessary to define, delimitate and accurately establish the aim of his proposed question as well as the manner by which the service will be able to assist him in his literature search.

After the personal interviews, the SDI user fills out a form relating to his profile which includes the following data:

- User's name
- Organisation to which he belongs
- Research title
- Subject description
- Descriptors
- Material to be scanned: periodicals, reports, etc.
- Source indication
- Language selection
- Delivering Form

b. Establishing Descriptors

Descriptors are selected according from the Thesaurus of International Nuclear Information System - INIS, but the user is free to include other descriptors he may consider more explicit, extracted from similar systems or even suggested by the reading of other works.

c. Selection of Material to be scanned

The List of Current Publications Received by Purchase, Exchange or Donation and the Library Bulletin help the user and the librarian responsible for SDI to form a list of periodicals, abbreviated headings of reports - full size or microcard, and secondary sources to be scanned.

d. Language Selection

The user specifies the languages he is familiar with, so

that the bibliographic reference works sent to him will be written in those languages.

e. Delivering Form

The user decides whether he wants to receive a card containing bibliographic references pertaining to the documents selected by the librarian or a xerox copy of the selected documents.

f. On Receiving the profiles

Profiles are numbered according to entry order in the SDI service and are preceded by the abbreviation PF which was the only change introduced in the SDI as formerly the profile sequence number was preceded by the letter P. only. This new designation was adopted because the material selected for the former profiles is kept for eventual consultation for a retrospective survey of the SDI service since its initiation. Profile forms are filed in individual folders, in increasing numerical order according to the profile number.

g. Catalogue development

The catalogue of periodicals is ordered according to titles, recording the oficial abbreviation and the number of the profile for which the periodical was selected. The titles of these periodicals are in the card catalogue. The librarian in charge of SDI records the numbers of the issues received.

The catalogue of reports which is part of the Catalogue of Selected Periodicals and Reports, is ordered separately according to abbreviated report titles. The profile number of the user interested in a particular abbreviated title is added to each card and the number of cards must match the number of profiles.

In the case of the catalogue of descriptors, a card is prepared for each one and the number of the profile or profiles is covered by each descriptor. The catalogue is ordered alphabetically according to the descriptors.

A follow-up on the service was made after the profile system had been in use for nearly one year. Profile users were contacted in order to evaluate the performance of the service in an attempt to detect when and to what extent information retrieved by the SDI was contributing to the setting up of their research work or if there were any suggestions for modifying the service to obtain better and more immediate results.

The users stated unanimously that the SDI service enabled them to keep up with the literature published in fields relating to their research topics in addition to saving them a considerable amount of time.

One of the users pointed out that retrieval through the SDI had a direct influence on his research one of the retrieved works referred to equipment at that time unknown to him and which could change the course of his studies, if he had known about it. The relevance degree of the service was between 99 and 100%.

Some might question the validity of keeping a manual SDI service when there are so many automated services available. The receptivity to the service by the researchers, the degree of relevance attained, and the results obtained as a support to primary research in the IEA, demonstrate that such services still deserve their attention.

It is necessary to point out that:

- such a service only serves a small community which is the reason why it accounts for the primary research of the Organisation.
- the rate of updating is satisfactory as it is not necessary to take into account the time lag between the processing, indexing and dissemination of a paper in secondary sources.
- retrieval is rather specific since it is not necessary to keep to the Boolean logic or to any other retrieval methods once reasoning and logic enable one to identify

the research approach and to analyse the contents of documents according to his specific approach.

. a great many manual SDI subscribers use other systems as well, nevertheless, they like to keep their profiles in this service because the work is done with material available in the library.

2.3.2 The Technological Research Institute of São Paulo

The Technological Research Institute of São Paulo - IPT, has been setting up an SDI system processing Compendex tapes, which are produced by Engineering Index Inc. and are supplied on a monthly basis.

The system which IPI has set up includes:

. Processing and storage of interest profiles;

. Revising Compendex tapes in order to make the data base a suitable format for processing;

. Researching the data-base and retrieving references relevant to each profile.

. Printout of personalised lists employing the System of Addressing Tags (SEND) developed at IPT.

The following considerations guided the development of the software in the SDI system:

. Modularisation of programmes and files permitting use of the small IPT computer (B-1726).

. Use of Cobol programming which makes conversion into other systems possible.

. Conversion of Compendex tapes into IPT's own format which allows for the processing of other tapes as well as the setting up of a data bank in order to introduce a retrospective search system in a second stage.

A profile is formed by a series of terms representing the user's interest and interrelated in a logic expression. As the Compendex tapes are made in the United States and the indexing of references is in English, the profiles are also in English. In order to minimise the resulting problems the Thesaurus of Engineering Index is used as a reference, however, profile development is not limited to thesaurus terms since indexing is based on free vocabulary.

The terms describing a particular profile are given tags (letters from A to Z) which indicate, for example, author's name (type A), text words (type B), Coden (type K) or Engineering Index (type C) and Card-A-Lert Classification. Each tag can be formed by one or more terms to be interpreted as synonyms without the necessity of specifying them individually in the logic expression.

The logic expression, which includes the profile terms, is formed by the different labels, parentheses and the operators "and", "or" and "no". Each term, which can be made up of one or more words, has a limit of 40 symbols. In order to provide more flexibility word truncating on the right and/or on the left is possible.

All information about the user needed for addressing system use is on the back of the application form. The same application form is used to modify or cancel interest profiles. Interest profiles of the system's users are punched on 96 column cards and are stored in a disk file after consistancy processing, ready for research processing in the data base.

The program used for profile filing and updating (including or cancelling profiles) is as follows:

. consistency review: checking alphabetical and numerical fields, logic expression label validity against profile term validity, operator validity, term type validity and logic expression formulation. Connective and operators are not

allowed. Profiles with errors are rejected and such errors are recorded in a list.

. logic expression expansion: correct profile logic expression is expanded by introducing sub-labels connected by the operator to the different terms appearing under the same label (synonyms).

. profile search in data base:

Terms can be looked up by title, author, headings, sub-headings, free-language terms, cross-reference terms and Card-a-Lert codes, according to each specification and according to Compendex tape format. At this stage no research is done in the abstract field. Such research not only requires too much time but is also irrelevant in most cases.

Logic expression evaluation is made through the use of a file in which are stored, step by step, the results of each search-true or false, as well as the result of partial logic expression evaluation-true or false.

Both document numbers and profile numbers which are related are recorded in a WKELEOK work file. When a document number is not related to the profile, the number and the state of the expression that forms such a profile is recorded in another state work file. This procedure makes it possible at a later stage to try to retrieve documents by looking up the terms in the abstracts (when the term specification calls for a search in abstracts) using both state and abstracts files. Documents retrieved in this stage will be added to the WKELEOK file.

It should be noted that modularisation of files and profile selection enables retrieval of a given profile in documents referring to former months without having to process every file for every profile.

. Listing printout:

SDI librarians look up information in the files in order to process output in the form of listings according to each

element of WKELEOK. Before printing such information directly, however it is recorded in another WKOBRAOK file.

This file is classified according to a numerical profile order and the documents are listed according to users. Information about the user is then looked up in the TAG file and his name printed on the listing. Address tags are made for mailing the lists to non-institute users based on this file. Full references are always printed, including abstracts, for every soccessful search.

The SDI system has the goal of supplying updated information to IPT technologists as well as to non-institute clients. Through contacts with IBICT, the Brazilian Institute of Information in Science and Technology, an attemptwas made to organise a system compatible with others already in existence and to work out a pattern to be adopted throughout the country.

More data-bases can be processed depending both on users requirements and the various technical and scientific fields in general. The IPT technologist having bibliographic references produced by the SDI system will be able to ask for the forwarding of the documents through the Institute library. After a period of normal operations statistics will be elaborated on the use of the system to check which are the areas most in demand, the number of assigned references, etc.

User's feedback is extremely important in an SDI system. From the information obtained by the user on the relevance of the references given to him,as well as from the document demand itself, analysis will be made on interest profile accuracy and on their possible adjustment.

The relevance and utility of an interest profile is not necessarily limited to one person. On the contrary, it may concern areas and subjects of interest to a group, a project or even an organisation.

The first profiles processed in IPT were of interest both

to groups and projects. In this way, it has been possible to supply information to all the Institute areas and, little by little, to individualise profiles. Non-member users of the Institute are attended by the system after it has been in operation six months. That is, when problems occurring during the establishment of the system have been overcome and the necessary adjustments made.

2.3.3 Vale do Rio Doce Company

In 1976 the Selective Dissemination of Information Project was established with the idea of including all Vale do Rio Doce Company - CVRD technologists. A lack of human resources delayed development and establishment of the Project, however, this situation did not cause the Technical Information Department - DITEP to risk its future by limiting expansion of its activities at present, survival of the Project depended on its own expansion, causing a series of initivatives with the purpose, of mastering technical information.

Concerning the objectives of the department and the performance of the documentalists it was clear the project required testing on a laboratory scale aiming at:

- personnel capability through direct experience, to decide on the project feasibility in a large scale.
- programmed development by means of rational allocation of tasks, keeping in mind a more effective system, as well as a higher information quality.
- subsidy collection appropriation, in order to re-evaluate DITEP services such as bibliographic material acquisition, collection re-allocation, improvement of technical processing, etc.

From the users' point of view, the key factors leading to the establishment of the SDI were:

. the organisation technologists' increasing need of being supplied with specific information, as well as the impossibility of handling the rapid growth of documents concerning the organisation.

. expansion of the organisation, requiring its employees to be up-to-date with technological advancements.

Considerations for project development included:

. concentration of a larger number of research technologists who normally have steadier and non-superficial interests.

. unit location in an area where there is a greater lack of information and scarcity of bibliographic resources.

. smaller internal migration of technologists alloted to a given unit.

. presence of a documentalist working in the unit's technical file which would provide local support.

Such files were the basis for the first SDI experience in the Technological Research Department of Vale do Rio Doce Company in Belo Horizonte, Minas Gerais.

Methodology was determined after studies, analyses and discussions were made of the information desirable to obtain. Among the alternatives proposed the most advantageous were:

. structured interview, that is an interview including a questionnaire, although such an alternative implies that interviewers are required to travel, resulting in higher expenses for the Project. In this case, two document specialists were appointed, aiming at greater effectiveness within the closen methodology, especially in the collection of evaluative indices solely available through direct observation.

. direct observation of bibliographic search tools normally used by technologists in their daily work. An effort was

also made to identify reading habits and interest levels, both in and out of the organisation; technologists attitudes towards research, types of institutions to which they belong, publications most relevant to the updating of their work, identification of experts with whom technical information exchange is maintained etc. Private technical files were also examined "in loco".

. collection or identification of typology of documents elaborated by technologists in the organisational area where they work, theses, surveys, follow-up, travel reports, etc.

After collection and analysis of other form models, a questionnaire was made up in such a way that the user was not allowed any ambiguous interpretation in order to obtain an accurate answer to each question.

Duplication of questions with the same meaning but a different formulation was intentional, so that veracity of answers could be checked. The questionnaire, though long (54 questions), was not tiring due to its formulation as an informal conversation. The use of the multiple choice method and the organisation of questions according to the degree of importance were adapted.

a. Questionnaire Structure:

. Introductory text guiding document experts on oral presentation to the potential SDI user includes the purpose, immediate objectives and the importance of the personal interview.

. group of questions conceived to collect data characterising the technologist:

- cultural data: specialisation courses, scholarships, institutional affiliation, value judgement on search authorised sources, most frequently consulted publications, intellectual productivity, both in and out of his organisation (theses, monographies,

published articles, etc.), participation in congresses and seminars, language familiarity etc.

- data on the technologists relationship with CVRD and DITEP: the organisation of invisible college configuration, record of evaluating reviews of some DITEP services - research upon request, published bibliographies, bulletins, etc.
- specific data on the technologists work performance in the organisation, base for selective dissemination of information.

. group of questions through which the interviewee evaluates the methodology of the questionnaire: interview evaluation by the technologist, his suggestions for improvement, etc.

b. Interview Achievement - Evaluation:

The interview, as structured and applied, met expectations. A high degree of accuracy of information characterising users was achieved.

Some questions in the questionnaire had to be reformulated to avoid an erroneous interpretation, but they were immediately corrected by the interviewers. The document experts' performance with interviewed subjects helped in improving relations between technologists and DITEP.

It was stated that is was impossible to achieve a high degree accuracy on the kind of data sought by technologists in publications, when considering only their field of concentration together with the periodical titles circulating among them. Such information was not enough to ascertain their type of interest, that the additional data obtained through interviews was necessary. Subjects usually searched in the technologists regular work, like in the patent department, bid department, equipment department, etc., were relevant for the accuracy sought.

Knowledge of subjects listed in the technical files organised for technologists direct use in their own work units made it possible to evaluate their actual research needs.

c. Data Tabulation and User's Profile Composition

All data collected in interviews was tabulated with the analysis of the collected material, so that user's profile was finally established.

Personal data for the technologist was transferred to individual cards in the following order: name, position, function, address and telephone number, languages, list of specific descriptors of his field, as well as of correlated areas, his participation in projects being developed and his favorite periodical titles.

At the same time, a catalogue was made covering the specific matters related to themes the technologists are interested in receiving information about.

Descriptors in English were included to facilitate collection of sources that would feed the system in a later stage.

It was then observed that:

. a great number of highly specific descriptors were correlated;

. impossibility of keeping and controlling a personalised system;

. alternative ways of gathering interests according to technologist groups, without disregarding relevance of information to be supplied.

d. Establishing Bibliographic Sources to feed the System

Utilising work being performed by the DITEP Central Library, periodical titles were listed and classified according to subjects with the addition of an abstract of regularly published material, their arrangement, periodicity, and other secondary subjects also listed by periodical, as well as showing permanent sections, patents, new books, congress roll. Abstract service in charge of periodical indexing are also included by title.

Abstract services were also listed and analysed in order to analyse their form, periodicity, services rendered, and titles of publications regularly indexed by such services and bought for DITEP collection. This study resulted in the creation of the Abstract Service Profile.

In a larger stage comparison was made between data from Periodical Profiles and from Abstract Services by checking them with the DITEP collection, which led to the following conclusions:

- at first SDI should only be feed with material already available in the collection;
- informing the technologist, gradually, on all findings of bibliographic research and then, depending on his interest, trying to obtain further information from other organisations;
- after checking validity of the information obtained through publications and abstract services, to expand collection by means of new periodical title acquisition. Higher correspondence rate between the collection and such abstract services should be sought, since these services actually comply to its stated purposes as well as to CVRD users interests.

Bibliographic material was collected preferably in abstract services as:

. they list a great many documents, thus saving time in manual search in periodicals;

. most of these works adopt specific subject ordering, whenever they have not indexes to facilitate search;

. a ready abstract is advantageous, affording higher level of selection;

. DITEP regularly receives eight services fully covering the requested subjects.

In addition to systematically collecting data from the abstract services, DITEP undertook the task of documenting and indexing articles selected by its team of document experts and practitioners in Engineering, Economics and Geology. It also made use of papers presented in congresses, catalogues of translations made by DITEP, institutional reports, new patent listing as publishers promotions and divulgation of material, specialised bibliographies and the DITEP catalogue of article indexing, etc.

e. System Maintenance

The listings for the system maintenance were compiled alphabetically according to subjects using terminology adopted by technologists and formalised in the DITEP.

References and abstracts were numbered in sequence to facilitate the requests for copies articles. Numbering followed listing so that the alphabetical order of subjects coincided with the numerical order. References and abstracts obtained were photocopied to be added to the listings.

There is no pre-determined periodicity. The number of

references to be sent was not established, since it depends on the volume of information collected as well as on its quality. However, it could be observed that no more than 15 references were included for each subject.

An answer card is also sent with the listing containing the user's name and DITEP's address which he use to request articles in which he is interested. Having received this card, DITEP makes arrangements for documentation delivery and proceeds to bibliometrical studies.

Copies of documents available in the central library collection are automatically forwarded. In order to provide other papers, application is made to the interlibrary loan system and frequently to the British Lending Library Division to acquire copies of articles not available in Brazil.

From the above conclusions it was inferred that:

- the accuracy of a user's profile was estimated by means of the increase of requests in the number of articles for which the users were applying.
- the collection of endogenous information in the organisation was produced with an indication of the source that is, who produced what kind of information. It is suggested to set up an infra-structure consisting of a collecting service in order to obtain such information systematically. As a consequence of endogenous information, it is now possible to study the descentralisation of documentation units which will be responsible for keeping the integration of the technical memory in CVRD.
- DITEP can not at least under the present circunstances, supply personalised information, however, substitution in attending to groups with specific and common interests has been one of the final aims of the Division.

. A review should be made of procedures and indexing criteria, outlining a new policy for this service.

2.3.4 The library of the Public Health College of São Paulo University

The library of the Public Health College of the University of São Paulo - FSP - has tried, over the years, to keep a complete and current collection of technical and scientific periodicals and bibliographies - indexes and abstracts, to meet to the interests of teaching and research personnel in the field of public health and hospital management. Its current collection supplies conditions for the development of notification services for its users. The Library Reference Department has a weekly exhibit of the latest fascicules received which may be lent to users, and it publishes the Library Bulletin. However, these services are not sufficient as more dynamism is needed. Indexes and abstracts are not well used, in spite of the fact that the library collection is good in the fields of public health and hospital management. Thus, services concerning prospective bibliographic surveys carried out by means of indexes and abstracts, completed by a more aggressive circulation of newly received periodicals, as well as adequate facilities to locate and obtain documents, may be the way to vitalise the system.

With the exception of faculty members, who generally have their own study methodology, the users of the FSP library who need bibliographic support are graduate students.

Increasing the activities of the FSP Library Reference Department became a primary target and a project was worked out to develop an SDI service for FSP graduate students. This service was to be adapted to their immediate needs, as well as to the library's resources, aiming to contribute not only to a higher quality in dissertation work, but also to the

improvement of human resource capability in public health and hospital management.

In December, 1977, there were 249 students attending the graduate course at FSP (at both master's and doctor's levels). Being at different stages in their degree programs, the period for completion of their work varied from 12 to 60 months. Some students were doing course work, others were beginning their research projects, and still others were at the stage of writing their dissertations. As the project was planned to attend up to 60 students, the selection of participants should be based on the following characteristics:

a. those who had defined their work plans, by the end of the first semester of 1979;

b. those who were at the beginning stage of their bibliographic information search;

c. those were appointed by their advisers and were, preferably, faculty members.

According to those criteria, 60 students were selected and the system was set up in March, 1978. In addition to those students, their respective tutors were also included bringing the total number of participants to 83. Of the 60 students, 23 were members of the FSP Faculty, 31 were residents of São Paulo, and 6 were from other States.

The profiles of the students were established by means of forms and personal interviews. The tutors did not have individualised profiles since their profiles were a result of those of the students.

The forms included personal data about each student as well as data on:

a. stage of his course,

b. proposed date for finishing research and presentation of dissertation or thesis,

c. best descriptors representing the research subject were chosen from the medical subject headings used in the National Library of Medicine- NLM in the United States. These descriptors were taken as a model although other descriptors were added according to indication by students and/or tutors. Afterwards, such descriptors were defined when working out the card index.

d. bibliography indication (indexes and abstracts) as to which publications best cover the subject under study.

e. titles of journals from the FSP library collection best representing the field of work. The students enrolled on Master's degree were interviewed together with their tutors.

The selection of interests to build profiles used data obtained from the interview forms which were registered on cards making up the profile card index.

Two card indexes were organised, one for the students and the other for the tutors. Cards were numbered, both individually and sequentially, the difference being the letters or the number given to the tutors, the cards were in numerical order. Another alphabetical card index was organised and addressed to the profile number.

The elements obtained from the forms (profile number, name, address, number and name of tutor descriptors, journals, indexes and abstracts selected) were registered on the advisees cards. The tutor's cards only contained his advisee's number and name.

Index cards for control of information selected and sent to members were worked out from profile cards.

a. Card Index of Journals
The journals selected by the 60 students from the library collection were registered on cards organised in alphabetical order. Each card also contained the number of the students and tutors profiles, issue, number and year of the fascicule sent noted on the card back.

b. Card Index of Descriptors
Two card indexes were organised with their descriptors in Portuguese and English.

c. Card Index of Books
All books selected for the members were registered on cards organised in alphabetical order by author with the number of the user's profile.

2.3.5 The Rio de Janeiro State Secretary of Health

At the Centre for Scientific Information for Health of the State Secretary of Health of Rio de Janeiro, the programs for planned acquisition are part of the basic structure necessary for effective inter-library cooperation. Therefore they have been developing several systems for information transfer set up by means of agreements and conventions among institutions in the same geographical area with the same specialisation, even if there is no administrative link connecting them.

The goal is to assure access to pertinent information for a greater number of users ensuring more complete coverage of specialised literature through control of a larger number of titles, consequently promoting better use of available resources.

An important advantage is the elimination of unnecessary duplications, both in the collections and in the tasks to be achieved, for better utilisation of financial resources to be achieved through allocation of expenses for information acquisition and management to the program members.

As it is possible to assure access only to that information available, programs must be based on effective criteria of selection which permit most efficient identification of collections for the specific interests of potential users.

Becoming aware of these interests through the study of users has been a main concern of services created to spread information. Such knowledge is basic to all SDI systems that try to reach high levels of exhaustivity and relevance with the least margin for "noises" through continual evaluation of utilisation and other feedback.

Users' specific interests however have proven to be variable, although within a certain area of relevancy. Thus dissemination of information available in the system assumes an importance equal to that of supplying bibliographic material specifically selected in the first interview.

Permanent evaluation of utilisation of the collection through an analysis of requests resulting from such dissemination has resulted in better adjustment and modification of users profiles as well as directing the decisions of acquisition programs enabling them to achieve a high level of relevance by means of exact criteria selection.

The experience of the Scientific Information System of the State Secretary of Health of Rio de Janeiro is a good example of the interdependence of information dissemination services and acquisition policy. This is a centralised acquisition system permitting both information dissemination and utilisation of all journals by all users in some way connected to the Secretary of Health, independent of their specialisation and of the Agencies in which are concentrated the current titles collection.

By following channels of information as they enter the system

through flowcharts of work done by processing and dissemination agencies, subdivided in four stages, it is possible to verify the interdependence of acquisition policy and information dissemination and the need for their mutual feedback.

a. First Stage - At the Centre for scientific Information for Health:

Every journal received, by purchase, donation or exchange, is entered in the planned acquisition department of the Technical Processing Service of the Center for Scientific information for Health - SUPC.

After being registered the journals are sent to the collective catalogue department to be registered in the Vise Record and are then sent to the SDI service department. This procedure is completed in an average of 24 to 48 hours.

In the SDI department the summaries are duplicated by xerox to be sent to the various agencies of the Secretary with current summaries listings in which journal titles are noted in alphabetical order and all data for identification and numbering to facilitate requests for articles are included.

The current summaries listings are numbered in sequence by year and are put out on Fridays, with all the journals received during the week included.

On Mondays both the current summaries and their respective listings are sent to every entity of the Secretary of Health, while journals are kept at the department together with a list on which is noted the loan dates.

b. Second Stage - in the units of the system:

The current summaries and their respective listings are received in the units and the librarian in charge checks, them in, signs the receipts and separates the listings from the summaries. The listings are filed, whereas the summaries are disseminated among library users.

Users note in the summaries which articles are relevant to their interests or those that, in their opinion should must be acquired for the collection of off-prints in the library. The librarian takes the listings, notes the requests, provides the current summaries in folders according to every journal title, for future use and requests, by telephone, the articles of interest to the unit.

Every week the librarian requests a xerox copy of the articles from the SDI department, preferably by Thursday, so that the articles can be sent together with the new current summaries and their respective listings on the following Monday.

Requests by telephone are made by reference number indicating the title in the listings and the page of the requested articles.

c. Third Stage - from the Centre for Scientific Information for health:

The Selective Dissemination of Information Department receives the telephone request, and records it according to listing numbers, titles and pages of articles on a special form:

- It puts together the requests from the units and the individual users.
- It provides xerox copies of articles requested, using the references to each article on cards on which the inquirer's name is noted.
- It checks the copies with the request, and reference cards with the articles, filing the cards in alphabetical order by author.

Copies of Journal articles are separated according to their destination. Those that are to remain at SUPC are sent to the journals department for registration, storage and consultation; those for the other libraries are listed

together with the articles requested and are sent on the following Monday to the unit libraries where they will be available to users.

The unit librarians check the journal and article listings and sign the respective receipts. After being registered in the kardex the journals are made available to users and copies of the articles are sent to those requesting them. All articles sent must receive off-print treatment for further utilisation.

All utilisation by means of lending, xerox-copy or consultation must be recorded in daily statistical data to be consolidated monthly in statistical reports.

Each unit sends its monthly statistical report to the SDI department at SUPC by the fifth of the month.

d. Fourth Stage:

Information enters the SDI department in the form of statistical reports to be utilised in the different units and by journal title, speciality and user.

Scanning the statistical reports, the SDI department works out the different consolidaded statistical charts that will provide a complete view and a comparison of journal utilisation in each unit.

The consolidated statistical charts are taken to Secretary Board to be examined to see if there is need of changing the system. The Board holds monthly meetings with the different department heads for evaluation of the charts and reports and for making any necessary decisions. In these meetings utilisation of statistical data in the various units is compared to evaluate how well the system is functioning.

This evaluation examines to what extent the acquisition policy is related to the real interests of users through an analysis of the following data:

- the percentage of titles listed in the bibliographic surveys made for SDI or for individual users which are not available in the collection.
- the percentage of utilisation of each journal title by individual users in their units, as compared to requests of xerox copies of articles of the same title made by other units in the system.
- the percent of utilisation of each title in the whole system.

e. System Feedback

As a result of the evaluation made during the meeting of the department heads, consolidated data are sent to the acquisition department so that modifications may be made in the acquisition policy, which is reflected in the following decisions:

- Re-allocation of the collection transferring journal titles from one unit to another when utilisation indices justify such a measure.
- Keeping titles or substituting them, once the importance of each title has been evaluated according to its use in the particular unit, as well as in the system as a whole. Substitution may be made in case there are other journals which better meed the users' interests. New acquisitions are made whenever non-existing titles in the collection are verified and whenever such titles are considered important and relevant in bibliographic surveys. The acquisition department can provide their purchase for users if the request for lending demand has been keeping a constant level or showing continuous increase.

In addition to the above, other considerations in acquistion of new titles include: the difficulty in obtaining them through inter-library loan; the non-existence of a title in the libraries of the Biomedical Librarian Group in Rio

de Janeiro or its being available only in libraries difficult to reach.

The experience in the Scientific Information for Health Centre shows that the system feedback with statistical data from the SDI department directly influences the planned acquisition department in the determination of a policy which provides adequate collections for the specific interests of the users.

The success of the system depends on the smooth functioning of the Planned Acquisition Department Policy as the input mechanism and on the SDI as the output mechanism. These two mechanisms are interdependent one on the other as part of a continuous process.

2.3.6 Embrapa

The Brazilian Enterprise of Agricultural Research - EMBRAPA - was set up by degree law no. 5.851, of December 7, 1972. It is a public enterprise, linked to the Ministry of Agriculture, to promote, coordinate and do research aimed to produce know-how and technology to be used in national agricultural development. It's purpose is also to give support to executive agencies, through formulation, orientation and coordination of agricultural policy throughout the country.

Foreseeing the increasing informational needs implied in the new structure, and Information and Documentation Department - DID - was set up to act as the coordinating centre for the information sectors in the EMBRAPA research units.

As a first step in setting up the DID an acquisition program was put into operation with both national and international funds. The users were attended through a manual SDI Service Called Vecom and a photocopy inter-change service based on the resources of the network known as the Bibliographic Commutation Service.

VECOM was later eliminated from the DID programming due to high operational costs and also because of the difficulties inherent in a manual processing system.

The Bibliographic Commutation Service, howewer, helped by the development of the collective catalogues and also by agreements which gave it access to the bibliographic funds of the National Agricultural Library - NAL - in the United States, as well as to the British Library, became the Department "success case".

In a second stage of development, because of structural changes in the company, DID developed the Technical Scientific Information System - SITCE. This system is made up of three non-specialised information units called resource centres; 22 product-specialised information units called national centres; 24 execution library units in state or territorial level, 9 libraries in research state enterprises and 25 libraries incorporated in the system through agreements.

Objectives and targets of SDI/EMBRAPA are as follows:

a. to improve researchers level of technical/scientific skill, to increase produtivity in the generation of scientific knowledge as well as of technological innovation;

b. to keep researchers up to date and to guarantee human resource development;

c. to minimise the time wasted by librarians, document experts and users of agricultural information;

d. to rationalise utilisation of Bibliographic Commutation and Centralised Acquisition Services in the EMBRAPA Technical Scientific Information System.

Once the system has been implanted for users in EMBRAPA, the idea is to start attending institutions connected with EMBRAPA. In this case the number of profiles will increase to approximately 5.000. In a third stage of development the intention is to

extend the service to Argentina, Chile, Paraguay and Uruguay.

The development of this service is based on the availability of:

a. an IBM 370/145 computer and the necessary peripheral devices which are installed in the National Centre of Genetic Resources - CENARGEN - and of the equipment of the Output Service in the EMBRAPA Quantitative Methods Department;

b. an automation team supporting these activities at the DID;

c. a team to implant and develop the SDI, made up of three librarians, two with master degrees, two agronomists, a psychologist and a mathematician;

d. a basic collection of specialised dictionaries, vocabularies and thesaurus to be utilised when developing the vocabulary of each profile;

e. magnetic tapes of these systems: the Agricultural On-Line Access, produced by the National Agricultural Library in the United States, which includes nearly 12.000 bibliographic references a month; the Commonwealth Agricultural Bureau - CAB - with 100.000 entries a year; Biosis, including the Biological Abstracts and Rio-Research Index with 240.000 entries a year; and the Food Science and Technology Abstracts from IFIS with 17.000 entries a year. The system will soon be working with Chemical Abstracts and the World Textile Abstracts tapes;

f. retrieval programs for the National Agricultural Library, with some modifications, aimed to optimise its functioning.

SDI/EMBRAPA output project has the following basic stages:

. Developing the user's profile;

. Analysis of technical process, vocabulary and codification development;

. Card punching and magnetic tape recording;

. Retrieval operations;

. Print-out checking;

. Reproduction of printouts;

. Delivery process.

Profiles are worked out by the users themselves, oriented by librarians or by SDI team components using forms made up of three sections.

The first section is for identification of the user by name, research unit and address. The second section includes a narrative description of the user's research project which is part of an enterprise as well as two bibliographic references related to the subject and of relevence to the user.

The next section is used for key-words, in which the users are asked to indicate the words they normally use in their bibliographic searches through indexes, bibliographies and abstracts.

There are still two sections of technical and administrative usage, one for numerical control of profiles, and the other for page correlation in case a profile has more than one page.

Profile establishment varies according to circumstances. In some cases the SDI team goes to the research units, while in others, the librarian of the unit is called to the main office to be trained in profile formation together with researchers.

In order to facilitate the work and obtain good profiles there is a manual available for users with explicit instructions for filling out the form and another one for both librarians and users containing ideas and fundamental principles of the service.

The profile forms are received by DID and analysed by an

agronomist who interprets the contents, separates the keyword groups and decides which logic is to be used. Then the librarian checks to see if there are similar profiles to avoid unnecessay duplication of effort.

The next step concerns vocabulary development or the translation of the user's keywords, into English to which is added all the necessary synonyms - scientific and/or common names, plural and/or singular. This operation is one of the most exacting in the process as it determines the percent of "noises" which will occur in the retrieval process. The system also provides for code utilisation covering thematic categories and is generally responsive to the organisation needs for printed versions. At present idiomatic limitations of profiles are being made.

The words thus chosen as codes are structured as microtopics interconnected by the Boolean logic and codified in the entry forms. The are two kinds of entry forms. The first one is designed to incorporate the user's personal data and the logic expression, while the second one contains the profile codification, in which will be used as many sheets as necessary.

Codified profiles are sent to the department of quantitative methods output service, where they are punched and/or recorded on magnetic tape. After this operation, they are recorded on disks, in the user's files and the systems profiles.

Retrieval is based on the simultaneous identification of keywords in bibliographic reference and profiles and is performed by a computer running out personalised reports called a printout. These printouts are also the form for common listings, as they are printed on flexible cards. Each time a listing is obtained an evaluation is made on the printout contents to verify retrieval relevance and/or detect processing errors.

SDI/EMBRAPA has administrative control devices providing information retrieval according to subject, user and research unit, in addition to the statistical information put out by the computer. Printouts are distributed to all EMBRAPA units through an internal delivery system or by mail to convenant institutions. Delivery is not made directly to the user, but through the local librarian to promote interaction between the librarian and the researcher.

In addition to the verifications performed in DID, printouts are evaluated by the users by filling out the questionnaire form included in each printout. This questionnaire is a means for getting service relevance indicators, as well as for evaluating the potential of non-centralised libraries.

In a preliminary study done for the third meeting of EMBRAPA librarians in the state of Ceará, a relevance of 81% was determined. The service of bibliographic exchange after SDI implantation grew 64%. Because the automated SDI service represented an innovation to most researchers, a publicity campaign was organised to disseminate information about operational principles and to create receptivity to the use of the service.

This educational campaign about the service relied on two basic tools:

. visits to the research units where conferences were held;

. printed communications.

Users were instructed about their registration in the system, the utilisation of printouts and they were also informed that they could formulate as many profiles as necessary to cover their research activities. Alterations and addenda to the original profiles can be asked for from the local librarians who keep a copy of them.

Another factor that contributed to the success of the system was the possibility of getting copies of the documents quoted in printouts, as the users could count on:

. the library in their unit.

. the bibliographic exchange service which put at their service the collection of the DID, the National Agricultural Library and the British Library.

. the centralised acquisition service of DID.

2.3.7 The Library of the São Paulo Veterinary Medicine and Zootechnique College

In 1974 the Library of the University of São Paulo Veterinary Medicine and Zootechnique College - FMVZ-USP - decided to provide a faster and more direct contact between faculty members and the library collection by means of disseminating the table of contents of received journals. It began, therefore, to disseminate this material through the table of contents of current journals in Veterinary Medicine, which were being sent to all of the college's professors, as well as to all of the libraries of Veterinary Medicine throughout the country. This was the first attempt at dissemination directed to all professors without any specification as to interest subjects or research lines that were being developed in the institution.

Once it was decided to establish an SDI program, the bases were worked out for current actualisation, in such a way that their interests would be directly related to the information units received by the user. The main purpose of such a program was to serve professors engaged in clinical and experimental research by providing them with the most up to date material received by the library in the form of books, journals, bibliographies and indexes, etc. Therefore the dissemination services of the library were divided in two different groups: one attending general users and the other addressed to individual users.

On a small scale the SDI program was used in the library to serve those disciplines having more difficult access to information. Priority was given therefore, to matters relative to the Animal Production Department as this department was located in Pirassununga a city some distance from the main campus. The allocation of subjects by department was as follows:

Preventive Medicine and Animal Health Department	- 1
Animal Production Department	- 6
Medical Pathology and Clinic Department	- 3
Obstetrics and Surgery Department	- 2

In order to know accurately what kind of information should be sent to researchers, users' interest profiles were developed through questionnaires and interviews. All information fitting the profile specifications is selected by comparing document contents with the subject matter requested by the user.

These are the criteria for selection and collection:

- analysis of all contents of books and journals received
- analysis of all bibliographies and indexes received
- Selection of information according to interest profile subjects
- typing, duplicating or photocopying two copies of the references.

One information card is sent to the user, as soon as it is processed. All information is sent out quickly no matter the number of selected references. Therefore no calendar setting dispatch dates are necessary. The second card is filed at the library making up a bibliography on the subject.

The criterion of sending a full copy of the document to the user was not adopted. Only the complete bibliographic reference followed by an abstract is sent whenever it is

part of the selected document.

Through a feedback device the library is informed about the degree of program utilisation. This information can be obtained by means of interviews, questionnaires or informally through a simple communication from the user. The most convenient medium found was to send a short questionnaire for evaluation accompanying the information. Data on the user's attitude in relation to the program is very important as it reflects both his positive and negative reactions to the service.

Based on questionnaires a combined evaluation of the program is performed periodically, tabulating data and analysing statistics to be informed of the relevance and irrelevance level, of distortions shown and of modifications needed.

There are two kinds of evaluations necessary: the first is related to the bibliographic material and the second is related to the program user's behaviour.

These items were considered regarding bibliographic material:

- most requested bibliographies
- information collected from bibliographies and journal titles received
- number of national and foreign journal titles available in the library or not, but also recorded.

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3. THE INTERNATIONAL NETWORK OF INFORMATION SYSTEMS

3.1 MAIN INTERNATIONAL SYSTEMS

The growing importance of information accessibility has been expressed in many ways by many authorities in the last few decades, since there is an ever increasing need to put scientists and engineers in contact with the work of others. Many methods have been adopted by information workers to deal with this problem and considerable duplication of effort has ocurred.

The researcher intends to show the current world situation of international information systems as well as existing trends. The researcher chooses to illustrate this situation with the figure 1 which shows clearly the information systems in development.

At the international level there is the United Nations International System of Information on Science and Technology - UNISIST - which has the responsibility of coordinating, normalising and promoting international systems. Then there are the sectorial systems at international level including the International Nuclear Information System - INIS, the Agricultural Information System - AGRIS, and the Development Science Information System - DEVSIS - others may be in planning. National Centres in different countries are connected with the international system. These national centres are in charge of collecting, processing and sending information to the international system for the purpose of interchanging information. The selection of items to be included, as well as coverage, is entirely the responsibility of the national member. The decision on which service to provide to the scientific community belongs to the national centre. There may or may not be a national centre for the coordination and normalisation of the functioning of sectorial centres in order to facilitate the compatibility of formats and services and

the interchange and integration of efforts (1).

A good example of an international sectorial system already operational is the INIS. One very effective approach has been the use of computerised selective dissemination of information - SDI. Being aware of this duplication of effort and of the effectiveness of computerised retrieval, the International Atomic Energy Agency - IAEA - planned the International Nuclear Information System - INIS - as a computerised service based from the outset on international cooperation. Through participation in INIS, member states were offered the unique opportunity of being providing with an SDI service on nuclear information on a national basis.

3.2 THE NUCLEAR SCIENTIST

Nuclear information is a term used to cover the information generated in the disciplines of nuclear science and technology. Nuclear science is defined as the study of the production, properties and phenomena of atomic nuclei, subatomic particles, gamma rays and X-rays. Nuclear technology is defined as the application of nuclear science to other sciences and engineering and conversely, the application of other sciences and engineering to the problems of nuclear science (2).

The main producer and user of nuclear information is the nuclear scientist whose vitality and effectiveness are testified to by the dynamic growth and development in the field of nuclear science. In the days of Copernicus and Galileo scientists confined their thoughts to books usually published after long delays, to papers presented at meetings of academies and to letters written to other scientists. The scientist pursued truth for truth's sake, and the term scientist could not be acquired by studying a discipline but was the expression of recognition by one's peers (3).

In this century the situation has changed. It is a recognised fact that the national power has come to depend on science and that the scientist community has become larger. The nuclear scientist emerged in this community after World War II. During the war years intensive research in the field of nuclear science was carried out under conditions of extreme secrecy. When the veils of secrecy were lifted, centres for nuclear research were established in the developed countries. Their establishment coincided with the widespread trend towards teamwork in the experimental sciences and in the industrialisation, so to speak, of scientific research. Government sponsored research and large-scale industrial research were characteristic of this era. Nuclear research centres had the benefit of considerable material resources, together with youthful and highly qualified staff who were attracted not only by the material advantages, but also by the prestige that goes with the novelty of a domain at the forefront of knowledge. Because of the newness and the complexity of the field and because of the requirements of industrial and military secrecy, nuclear research centres turned inward and sought in their own midst the answer to all the questions that might arise as their work progressed. Nuclear research centres became multipurpose interdisciplinary bodies. The scientists engaged in nuclear research were being drawn from many disciplines, including physics, chemistry, metallurgy, geology, and even engineering since the growing field of nuclear technology also needed the services of highly skilled engineers (3).

3.3 BIBLIOGRAPHICAL AND DOCUMENTATION SERVICES IN NUCLEAR INFORMATION

The scientists and engineers engaged in the field of nuclear science needed to be constantly alerted to new development in their field in order to avoid duplication of effort. Because of the nature of the subject matter there was more than the

usual volume of unpublished information in the form of reports, internal memoranda, preprints and conference papers which did not appear in published proceeding (4). This tended to exacerbate the normal difficulties entailed in the retrieval of information. Gradually, the information store generated by nuclear scientists and engineers increased in size and the problem of its control was anticipated by the three main nuclear powers. Three abstract journals of note emerged, Nuclear Science Abstracts *, Refereativnyi Zhurnal ** and Bulletin Signalétique ***. These abstract journals are important because of the control which they endeavoured to exercise over nuclear literature.

The Nuclear Science Abstract was by far the most important guide to literature on nuclear science and therefore merits more detailed treatment. In began publication in 1946 as the Abstracts of Declassified Documents (4). Initially it was intended to cover only technical report literature of the United States Atomic Energy Commision - USAEC - since a large part of the information made available as the result of atomic energy research was issued in the form of technical reports. Report numbers were proliferated at a rapid rate and as it was not unusual for distributing agencies to superimpose their own numbers on those of originating organisations; considerable confusion existed. In 1947 the title was changed to Nuclear Science Abstracts when its scope was broadened to include material from USAEC reports. Today it covers reports, journals, books, patents, reviews, theses, conferences and other similar literature. Selection is based on subject content and nothing is excluded solely on the basis of form, origin and language.

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* Nuclear Science Abstracts (semi-monthly) Published by the Division of Technical Information Extension, USAEC, 1947 and onwards.

** Refereativnyi Zhurnal. All-Union Institute of Scientific and Technical Information (VINITI). Moscow,1953 and onwards.

*** Bulletin Signalétique. Section 4, Physique Nucléaire (monthly). Cente de Documentation du Centre National de la Recherche Scientifique, Paris, 1940 and onwards.

Items not included are popularised articles, textbooks below the graduate level, theses below the doctoral level, material more than two years old and material existing only in the form of abstracts or short communications, except for papers summarised in the Transactions of the American Nuclear Society. Each semi-monthly issue of the Nuclear Science Abstracts includes four indexes: corporate author, personal author, subject and report number. These four indexes are cummulated in separate volumes, quarterly, annually, and five-yearly.

Referativnyi Zhurnal, the second most important publication in the field, is issued by the All-Union Institute for Scientific and Technical Information - VINITI, which was established in 1950 to centralise the processing of all technical literature in the Union of Soviet Socialist Republics - USSR. VINITI receives literature in 86 languages from 110 countries and this literature is processed in the 164 issues of the journal. It is policy of VINITI to divide the various branches of science and technology into specialised issues. Information on nuclear science is concentrated in the various issues in the field of abstracting services of the USSR, indicate that thesis topics form a ramified network spread over many other issues of Referativnyi Zhurnal.

The Bulletin Signalétique, the third important publication, is produced by the Centre National de la Recherche Nucléaire in Paris. It began publication, in 1940, then coverage of literature on nuclear science was initiated in 1947. In 1961 a separate section on nuclear physics was created. This became"Nuclear Physics and Technology" in 1969, and in 1970, "Nuclear Chemistry and Technology". Since then two new sections have been introduced: "Nuclear Chemistry" and "Isotope Applications".

An emerging interest in the establishment of an international nuclear information system made it imperative that answers be found to certain questions. Two of the most important were:

a. What sources were the most productive areas of nuclear information?

b. What percentage of nuclear information is contributed by each country?

3.4 THE INTERNATIONAL NUCLEAR INFORMATION SYSTEM - INIS

3.4.1 Development

As early as 1964, the International Atomic Energy Agency - IAEA, as defined in its statute, was created "to foster the exchange of scientific and technical information on the peaceful uses of atomic energy" (1). In taking steps to carry out these statutory obligations, the Director General invited one consultant from the USSR and one from the USA to outline an information handling scheme that would provide comprehensive coverage of the literature; incorporate up-to-date cooperative procedures for obtaining data; and to provide the latest techniques for storage and retrieval. Thus began a four-year study to determine operating policy and systems development involving about fifty information specialists, many of whom were internationally recognised.

In 1969 the proposal to create INIS was approved by the Board of Governors and then by the General Conference of the IAEA. The decision was made to put the system on an operational basis as early as possible in 1970 with a limited subject scope to be expanded step by step. Today the collection has items which represent approximately 90% of the world production in the nuclear area (Figure 2).

The general operating rules for INIS are contained in manuals referred to as the INIS Reference Series. Although a considerable effort was expended by consultants and various specialists available to the agency by member states (Figure 3) in outlining these rules, an immense amount of work remained

to be performed by the agency staff itself or through contractual arrangements. This consisted of the preparation of the detailed operating procedures and the organisation of subject indexing, abstracting and descriptive cataloguing rules in a clear and concise manual form.

3.4.2 Products

First there are the computer magnetic tapes which contain detailed bibliographic records and subject descriptors for all of the literature reported by INIS. They allow the selection of items by any of a large number of different parameters (subjects, titles, authors, institution, etc.), the printing of lists in preferred sequences, and the generation of indexes. The carrier language of the computer records is English, although titles are also given in the original language (transliterated from non-Roman alphabets when necessary).

The second product is an indexed announcement bulletin known as the INIS Atomindex. One free subscription is given to the depository nominated by the government of any member state of the IAEA, and additional copies are sent to the centres that provide input to INIS. INIS Atomindex is also available for sale to any person or institution anywhere in the world.

The third product is abstracts on microfiches. Every item on magnetic tape record and in the INIS Atomindex is identified by a serial number. For every item an abstract is available in at least one of the official languages of the IAEA (English, French, Russian, Spanish). These abstracts are sequenced according to the serial number and microfiches are prepared at a reduction factor and provided with a title that can be read by the naked eye. The INIS abstracts-on-microfiche are available, like the INIS Atomindex, by manual subscription to any person or institution anywhere in the world.

The fourth product is a full text of non-conventional literature on microfiches. Many of the items recorded by INIS are articles in scientific and engineering journals or commercially published books. However, many of the items which are identified as "non-conventional" literature including laboratory technical reports, pre-conference papers and theses are not readily available through commercial channels. These non-conventional items currently comprise 30% of the items in the INIS Atomindex (5).

3.4.3 Costs and operating policy

INIS being a shared system in which the participating member states and international organisations cover the literature published in their area, the extent of effort is proportional to the program size and, therefore, within the limits of the participants' financial capability.

The agency's costs for INIS, including computer costs, equipment, allocated costs and administration costs were US$ 2.153.100 in 1978 (approximately £ 1.200.000), and US$ 2.654.900 in 1979 (1).

The IAEA has primary responsibility for the operation of INIS, and for the continous review of methods and procedures incorporated in the system through its funding of the agency's budget and through its investment in personnel and equipment resources at the national level. Therefore, the agency follows a policy of consulting with participants in a variety of ways before major changes are instituted.

Several means are employed to implement this policy. First contact is maintained with the established liaison officers of INIS members, designation of liaison officers is a requirement for participants in the system, by means of INIS Circular Letters. These letters primarily cover announcements

of such items as descriptors of changes and their effective dates. In most instances involving relatively minor changes, the proposals are first circulated to liaison officers by means of INIS Technical Notes. While from the foregoing it might appear that the agency is concerned only with changes and their effect on the workings of INIS, staff members continually serve on working groups developing systems such as UNISIST and AGRIS to help assure future compatibility and some serve on Committees of the International Standard Organisation - ISO.

3.4.4 Data processing

Input is submitted by national INIS centres (figure 4) either in machine-readable form or in the form of a worksheet. A number of different forms of machine-readable input can be accepted, provided that their format conforms to INIS rules, which are as follows:

a. Magnetic tape, should either be:

   . in the INIS magnetic tape format as described in IAEA-INIS-9 (INIS magnetic tape specifications and Record format);

   or

   . in the INIS alternate input format, i.e., in the form of a paper tape image on 9-track tape;

b. Paper tape should be in the INIS paper tape format as described in IAEA-INIS-8 (Paper tape specifications and Record Format).

c. In a form suitable for OCR (Optical Character Recognition) processing.

Worksheet input is converted to machine-readable form within the Secretariat, using on-line data entry techniques. Input

in a form suitable for OCR processing is converted to magnetic tape using an optical character reader which can couvert into machine-readable form texts in both the Latin and Cyrillic alphabets. Copies of non-conventional literature submitted with the input are sent to the INIS clearinghouse for microfilming and preparation of microfiches.

Machine-readable data is converted by program into internal working format. Each record is divided into two components, bibliographic data and abstracts and subject descriptors. Each component is then processed by the appropriate set of checking programs. Whenever the computer detects errors in the input these are flagged on a reference list which displays all the records processed. The data are then split off into the following files:

. bibliographic and abstract file

. bibliographic error file

. indexing file

. indexing error file

At the end of each processing cycle these four files are brought together and a final consolidated output file is created. The final file becomes the input for further programs which include:

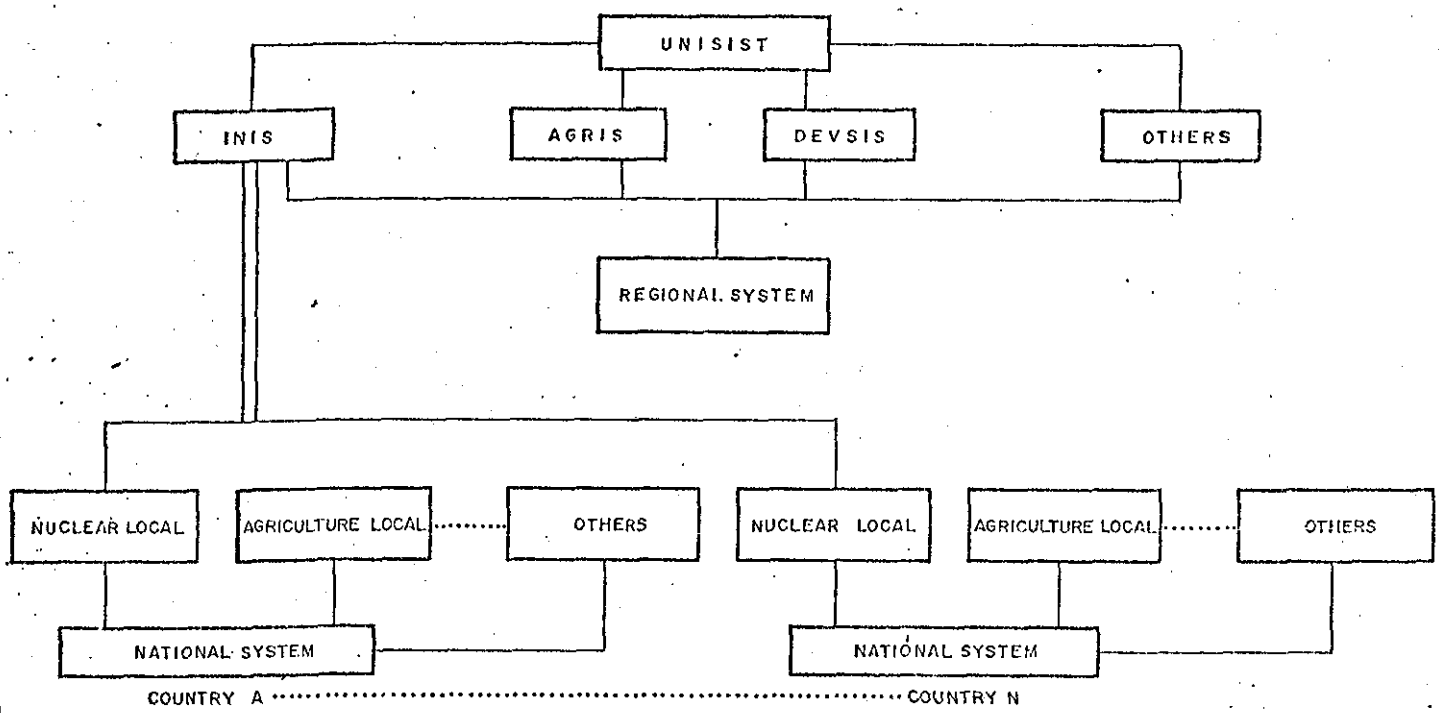
. creation of the INIS output tape in the INIS distribution format;

. creation of a photocomposition tape from which photocomposed pages of the INIS atomindex are produced;

. creation of an inverted file copy of the INIS data base for use in retrieval by means of either STAIRS - Storage and Retrieval of Information System of IRMS - Information Retrieval and Management System.

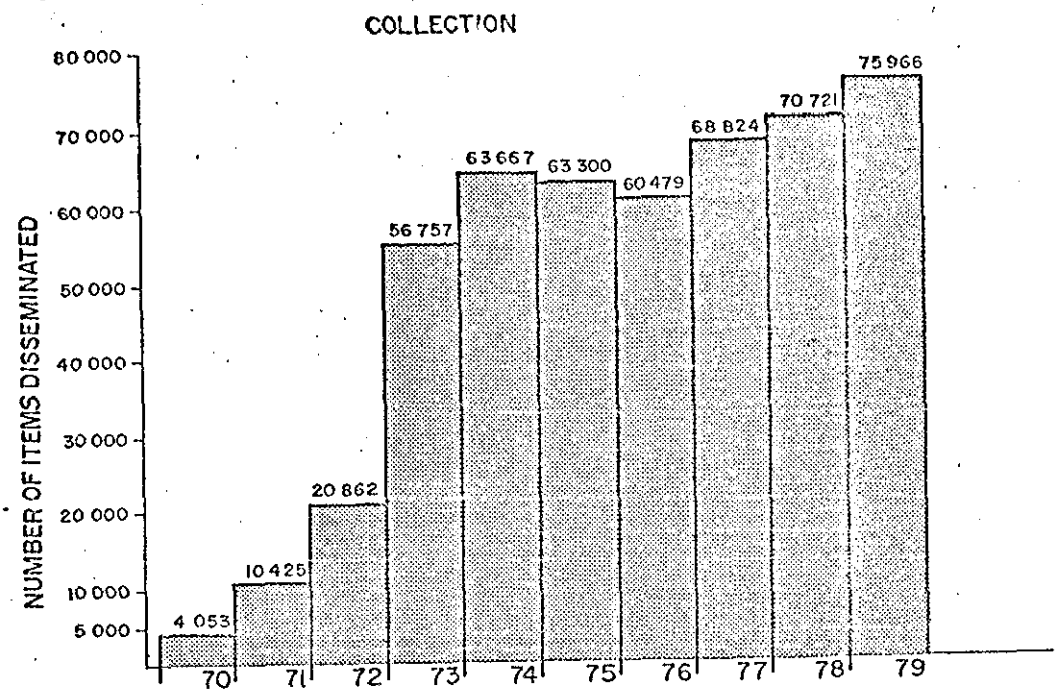
A generalised flowchart of the INIS computer processing cycle is produced in figure 5.

Figure: 1 International Network of Information Systems



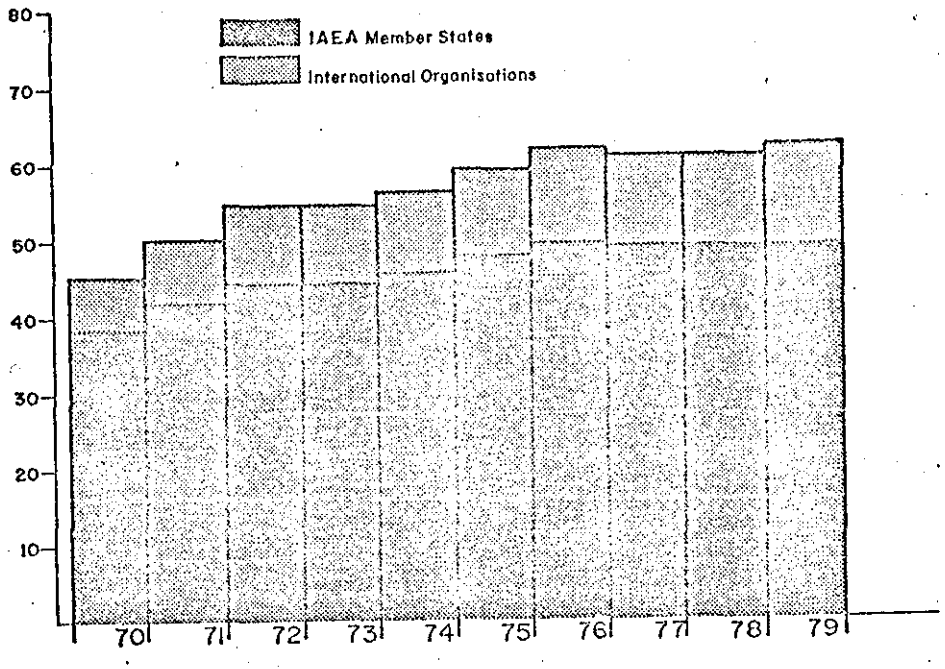
Source: Comissão Nacional de Energia Nuclear. Centro de Informações Nucleares Produtos. Rio de Janeiro, 1979

Figure: 2 INIS Collection



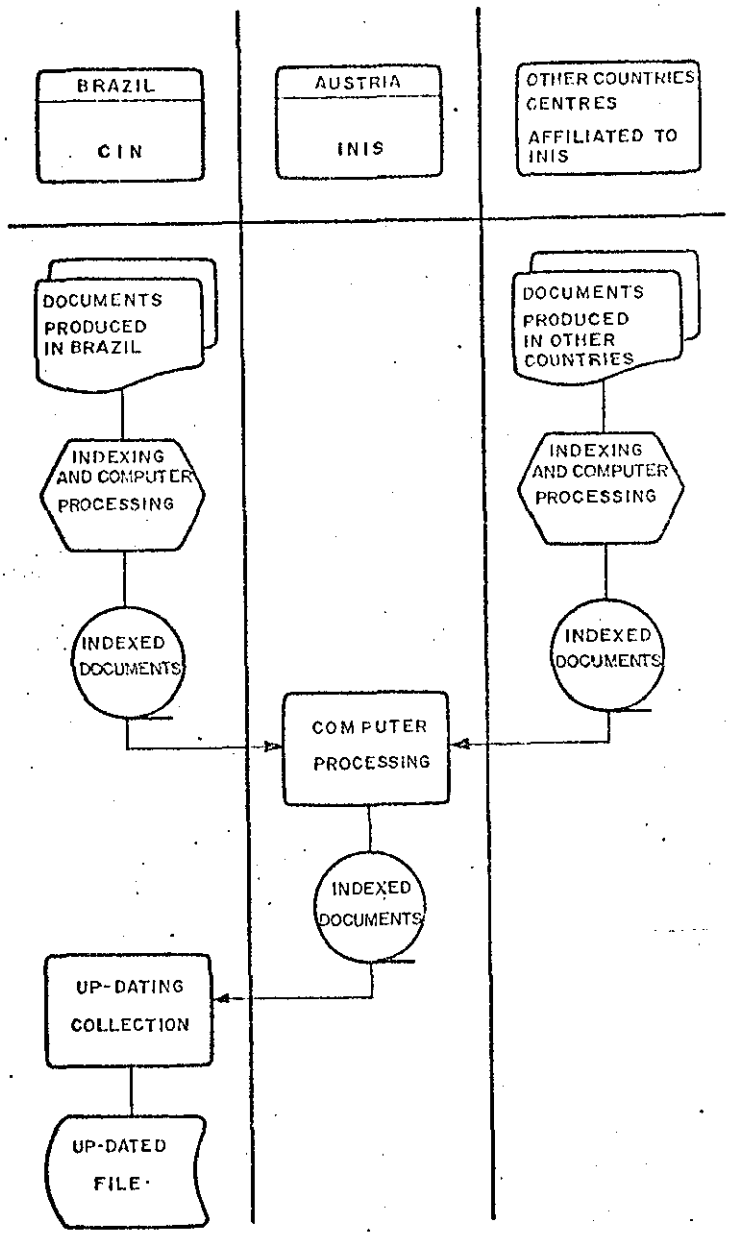
Source: Comissão Nacional de Energia Nuclear. Centro de Informações Nucleares Produtos. Rio de Janeiro, 1979

Figure: 3 Number of Participants



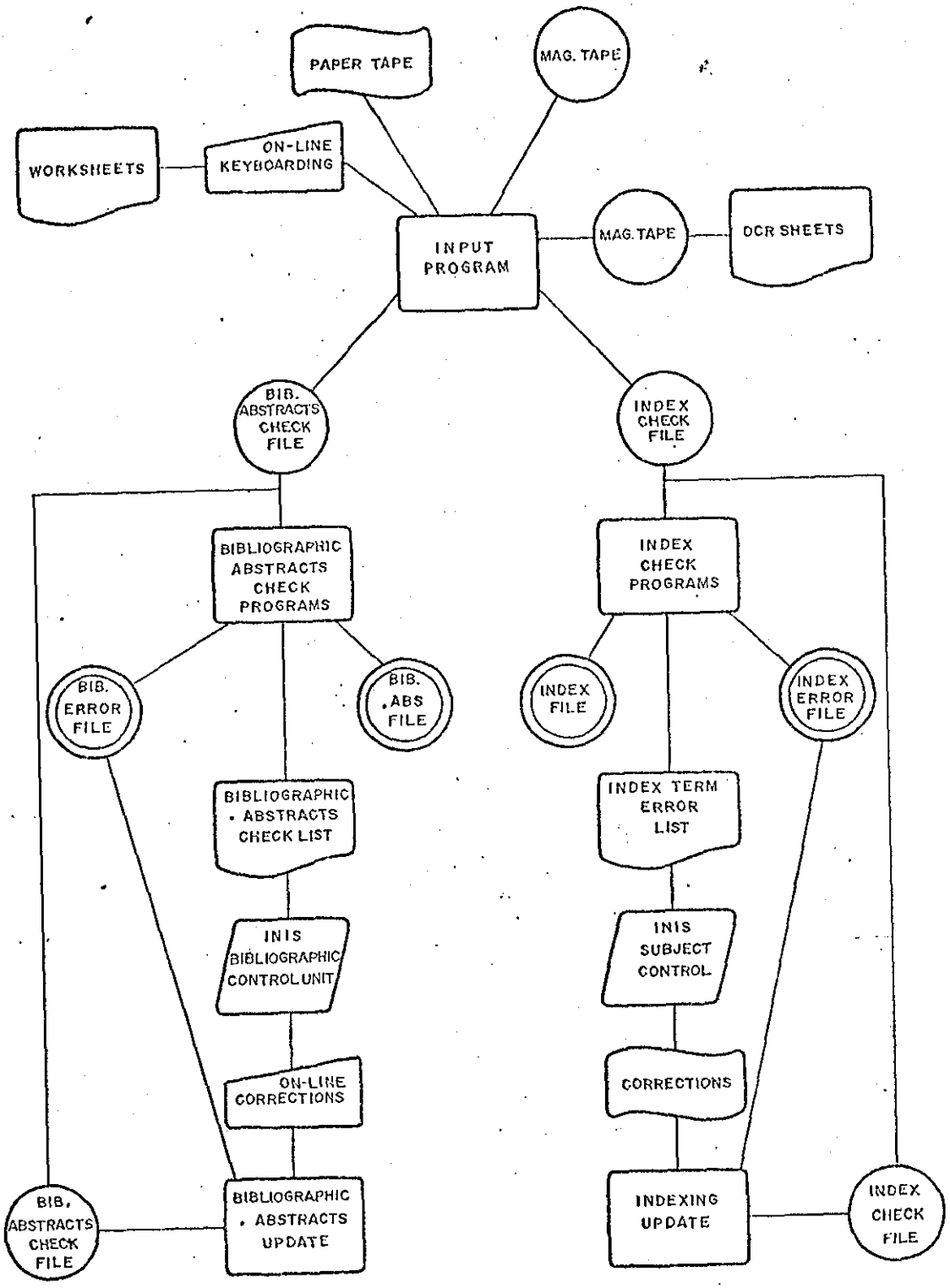
Source: Comissão Nacional de Energia Nuclear. Centro de Informações Nucleares Produtos. Rio de Janeiro, 1979

Figure: 4 INIS Flowchart



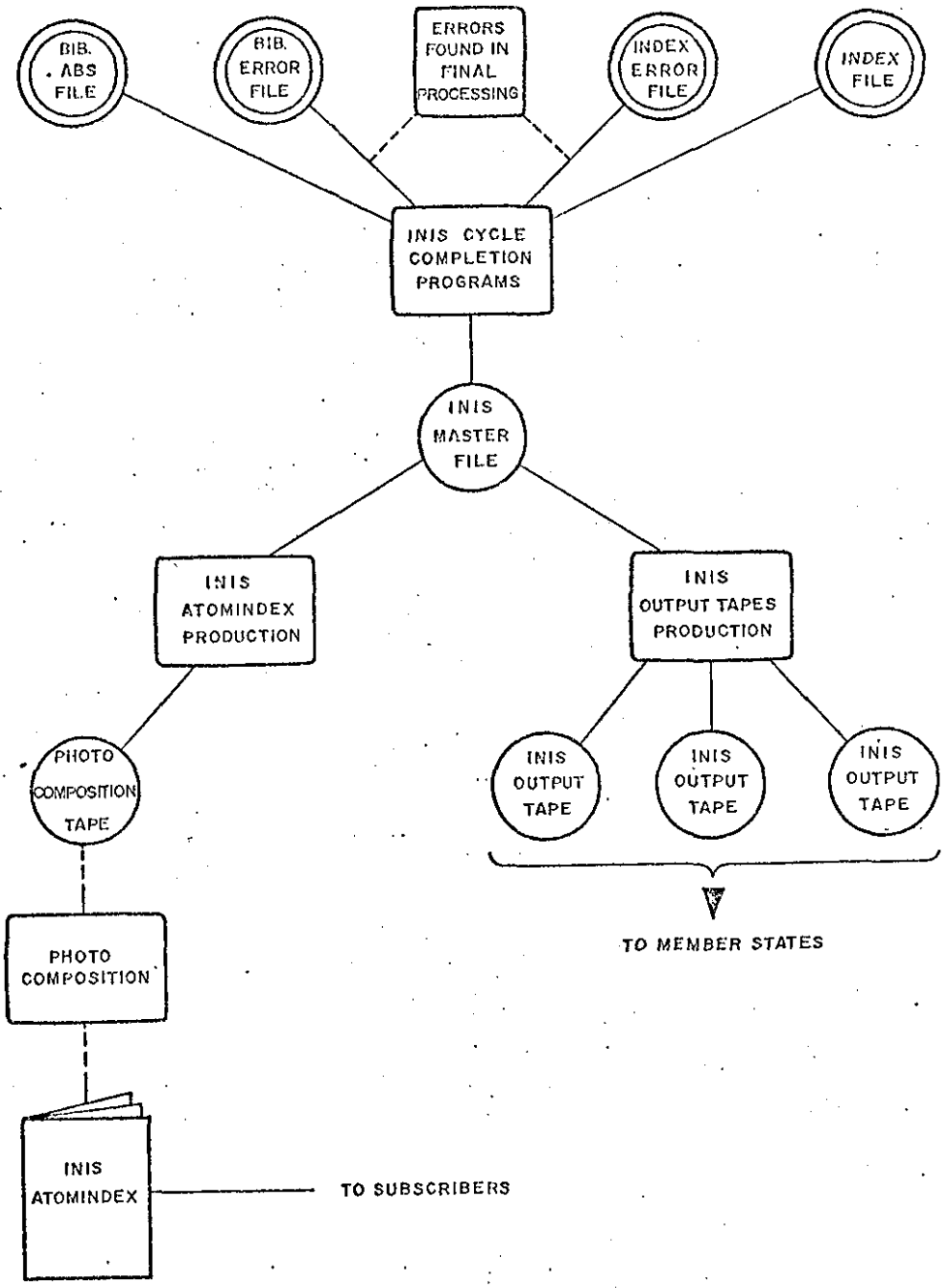
Source: Comissão Nacional de Energia Nuclear. Centro de Informações Nucleares Produtos. Rio de Janeiro, 1979

Figure: 5 INIS Computer Processing (Part 1)



Source: Comissão Nacional de Energia Nuclear. Centro de Informações Nucleares. Produtos. Rio de Janeiro, 1979

Figure: 5 . INIS Computer Processing (Part 2)



Source: Comissão Nacional de Energia Nuclear. Centro de Informações Nucleares Produtos. Rio de Janeiro, 1979

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2. SHANNON, R.L. Nuclear Science Abstracts: a 21- year perspective IN: Handling of nuclear information. Proceedings of a Symposium organised by IAEA, Vienna, Feb. 16-20, 1970.

3. NEEL, L. Fundamental research in nuclear research centres. Atomic Energy review, 4:1966.

4. ANTHONY, L.J. Sources of information on atomic energy. Oxford, Pergamon, 1966.

5. PELZER, C.W. International information networks. ASLIB proceedings, 24: 38-55, 1972.

4. THE NATIONAL NETWORK OF INFORMATION SYSTEMS

4.1 MAIN NATIONAL SYSTEMS

The concept of a global policy on Science and Technology has developed in Brazil since 1964 with the organisational change that occurred, in the National Council for Scientific and Technological Development - CNPq. Nevertheless, it is only since 1972 that this policy has been consolidated through the I and II Basic Plan for Scientific and Technological Development - PBDCT, within the objectives and goals of the I and II National Development Plan - PND.

The task of implementing this policy is the responsibility of those, who participate in the organisation of a national system of scientific and technological development, including scientific and technological information.

The chapter of the II PBDCT on supporting activities includes scientific and technological information with the aim of providing elements for the decision-making process at the political, scientific and technological levels (1). Even after goals are defined through the II PBDCT there is still the need to re-define the information and documentation resources within the country as well as which information is more necessary to individuals and institutions in the development of scientific and technological research in Brazil.

In 1976 the Brazilian Institute for Information in Science and Technology - IBICT, was created to implement the policy on information. This Institute incorporated the former Brazilian Institute of Bibliography and Documentation which was created in 1954 as a national centre responsible for the documentation of Science and Technology and was the pioneer in the application of computers to bibliographic information in Brazil. The Project "IBICT - 1976" which was the basis for the creation

of the IBICT presented as its main points:

. the enlargement of the network for collecting and disseminating documents;

. the coordination of the technical processing of scientific and technological information;

. the acquisition of foreign data bases in different fields of knowledge;

. the implementation of the union catalogue, and specialised bibliographies;

. the optimisation of existing library collections in Science and Technology.

The IBICT has also begun the operation of an international retrospective search service through telex, using the ORBIT system from the System Development Corporation - SDC - of the United States. There are also different agreements being signed in order to implement the National Union Catalogue and the elaboration of the specialised bibliographies.

The present situation of information services was studied and presented in a paper entitled "A INFORMAÇÃO CIENTÍFICA E TECNOLÓGICA NO BRASIL" by Garcia (2) that identified 82 systems, services, information and documentation centres existing in different specialisations.

These systems referred to above are concentrated in Rio de Janeiro, Brasília and São Paulo as shown in table 2.

The main observations of this report indicated that:

. 93.9% of the systems are in the governamental sector, see table 1;

. 95.2% of the systems are concentrated in the States of Rio de Janeiro, São Paulo, Minas Gerais, Rio Grande do Sul and

the Federal District (table 2)

. 70.8% are in operation and 29.2% are in the planning stage, see table 3;

. the specialisations which have more developed information services, are:

Agriculture	8.6%
Industrial Technology	7.3%
Transport	8.6%
Metallurgy	7.3%
Economic Planning	7.3%
Scientific and technological information	8.6%
Geosciences	6.1%
Medical Sciences	4.9%

As may be observed in the nuclear energy field only the CIN/CNEN uses the INIS data base and the Institute of Nuclear Energy Research - IPEN - uses the Nuclear Science Abstracts data base. The areas with a more complete coverage, open to external users and with recognised quality of services pointed out in the report are:

FIELD	INSTITUTION NAME *
AGRICULTURE	EMBRAPA BINAGRI
MEDICAL SCIENCES	BIREME
NUCLEAR ENERGY	CIN/CNEN
SIDERURGY	USIMINAS
SCIENCE AND TECHNOLOGY IN GENERAL	IBICT PROMON, S.A.

FIELD	INSTITUTION NAME *
LAW	PRODASEN
TRANSPORT ENGINEERING	IPR
PETROLEUM	CENPES/PETROBRAS

4.2 THE NUCLEAR INFORMATION

The Nuclear programs in Brazil began in 1951 when LAW N.1310 created CNPq with the monopoly control over atomic energy. The National Commission for Nuclear Energy - CNEN - was later created in 1956 by LAW N.4.118.

The main institutions linked to CNEN are:

- the Institute of Radioactive Research - IPR, created in 1953 which later changed its name to the Nuclear Development Technology Centre;
- the Institute of Atomic Energy - IEA, created in 1956 and today called the Institute of Nuclear Energy Research - IPEN;
- the Institute of Radio Protection and Dosimetry - IRD created in 1959;

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* EMBRAPA - Brazilian Enterprise of Agriculture and Cattle breeding Research
BINAGRI - National Agricultural Library
BIREME - Regional Library of Medicine
CIN/CNEN - Nuclear Information Centre of the National Comission of Nuclear Energy
USIMINAS - Siderurgical plant of the State of Minas Gerais
IBICT - Brazilian Institute for information in science and Technology
PROMON - Promon Engineering
PRODASEN - Data processing Centre of the Federal Senate
IPR - Highway Research Institute
CENPES - Petroleum Research Centre

. the Institute of Nuclear Engineering - IEN - created in 1963;

. the Centre for Nuclear Energy in Agriculture - CENA - created in 1966.

Nevertheless, in 1971 LAW N.5740 authorised the CNEN to create a society called the Brazilian Company of Nuclear Technology - CBTN, with all the institutes linked to the CBTN. In 1974 LAW N. 6189 transformed CBTN into the Brazilian Enterprise of Nuclear Technology - NUCLEBRAS, while IPEN remained an independent institute. The IEN and IRD became part of the CNEN.

Nuclear policy in Brazil has only been well defined since the signature of the agreement with the Federal Republic of Germany in 1975. In reality, field work activities started well before 1975 once the need for nuclear research caused the creation of the CNPq (3).

4.3 DESCRIPTION OF THE NUCLEAR INFORMATION CENTRE/ NATIONAL COMMISSION OF NUCLEAR ENERGY - CIN/CNEN

The researcher will proceed now with a description of the Centro de Informações Nucleares/Comissão Nacional de Energia Nuclear - CIN/CNEN - which is the Brazilian organisation acting as a representative national body in the INIS system of the International Atomic Energy Agency - IAEA.

CIN was the first information centre in Brazil having an experience operationally tested within the field of information retrieval systems. CIN was organised in 1970 at the same time that the INIS system was set up in order to collect the national intellectual production to be included in the world collection in the area of nuclear energy. Among this collection there are approximately 1000 works of Brazilian scientists.

The literature received from INIS (Figure 6-7) each fifteen days amounts to 2500 items of information which are processed in the computer and selectively disseminated among 1562 scientists, lecturers, engineers and technologists.

In the CIN five systems have been developed: PAI, SONAR, SUPRIR, SERVIR and SABER. PAI (Processamento Automatico de Informacao - Automatic Information Processing) is a system developed by CIN in order to collect, store and send Brazilian documents in the field of nuclear energy to INIS. The format adopted is totally compatible with those from other international information system such as AGRIS, International Food Information Systems - IFIS, DEVSIS, etc. (4)

The phases of selection and treatment of the items of information received from INIS (Figure 8-9) are taken into the CIN/SDI system which automatically scans all literature against the user's profile. The user is not an institution, but an individual. The service which provides the SDI is called SONAR (Sistema Orientado para Notificacao Automatica de Referencias - Oriented System for the Automatic Notification of References) (Figure 10).

Another service provided by CIN to the users is the Retrospective Search of Information, in which a great number of published studies on a specific subject are retrieved and analysed in order to avoid research duplication and effort. This service has an automatic system comprising more than 300.000 items in the data base and is called SUPRIR (Sistema para Usuarios de Pesquisa Retrospectiva em Informacoes Referenciadas - System to the Users of Retrospective Search on Referential Information). SONAR and SUPRIR are the two services providing bibliographic information to users.

There is also a service to provide copies of documents on request by users called SERVIR (Sistema de Envio, Recuperacao e Verificacao de Informacao Requisitada - System of Delivery, Retrieval and

Verification of Information Requested). SERVIR (Figure 11-12) service takes all necessary steps to satisfy users' needs and requests regardless of problems of distance, in or outside the country, or of language barriers.

The other service providing technical support to CIN is SABER (Sistema de administração de Banco de Dados por esquema Relacional - Data Bases Management System through a Relational Scheme).

4.3.1 Overview of CIN users

Users of CIN/CNEN constitute a significant part of the more highly educated personnel in the nuclear sector in Brazil *. Twenty-eight percent of the users have a master's degree or doctor's degree, or 16 percent have master's and 12 percent have doctor's degrees. Approximately 42 percent of nuclear community in Brazil have a university degree, including bachelor's,master's and doctor's degrees. This high degree of specialisation is due to the incentives provided by the PRONUCLEAR Programme. After 1975 this programme has provided for the training of almost 64 percent of all the human resources needed in the nuclear program and has made a great investment in the area (3).

The distribution by year and degree obtained for CIN users is:

Degree	Year	Total (123) %
Master	1955 - 70	11
	1971 - 74	17
	1975 - 79 (1)	72
Total		100

Degree	Year	Total (123) %
Doctor	1960 - 65	4
	1966 - 70	18
	1971 - 74	22
	1975 - 79 (1)	56
Total		100

SOURCE: Data collected by the researcher in Brazil, 1980.

NOTE: (1) The high percentage of degrees completed due to the establishment of the PRONUCLEAR Program in 1975 may be observed.

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* The researcher collected all data presented in this section.

It is interesting to note that the sector grew significantly from 1975 after the main agreement on technical cooperation in nuclear energy was signed with the Federal Republic of Germany (3). The development of information systems in the CIN began in 1970, however most growth in the sector ocurred after 1975 due to investments appearing because of the nuclear cooperation agreement. From 1970 to 1975 there was a lack of resources and dedication to their work among personnel in the sector was the main productive element. An IBM/3 computer was bought in 1975 which facilitated work in the field.

After 1975 the whole SONAR/SDI system was in operation and in 1977 following an analysis of the 75/77 period implementation of improvements in the System were instituted.

In 1976 the agreement signed with the National Scientific and Technological Development Council - CNPq, resulted in the implementation of the Retrospective Searching System, the system of Data Base Management and a new version of the SDI system.

The SONAR/SDI system from CIN/CNEN is the only SDI Service in the nuclear sector in Brazil. It may be assumed, therefore user's have been exposed only to this system as it is the only one and there are very few in other fields in Brazil as well, as may be seen in chapter 2.

CIN users are mainly involved in applied research activities, project elaboration and administrative work as can be observed below and in table 4 :

Field of activity	Percentage TOTAL (123) %
Applied research	26
Project elaboration	19
Administration	16
Field work	14
Technical supervision	8
Teaching	6
Pure research	6
Information unavailable	5
TOTAL	100

It also happens that those users in applied research, project elaboration and field work activities receive larger salaries than those in administration, technical supervision, teaching and pure research, as shown in table 5 .

According to the sample of 123 users the percentage of time spent by work activity is significant in terms of time allocation once on average CIN user does spend up to 65.2% of his time in 10% of cases in administrative work and 43.5% in writing papers.

It may be observed through the following table 6 that CIN users spend more time revising their own work, doing administrative work, writing papers and technical reports than working on projects in 10% of observed cases. Between 31-40% of the cases, CIN users spend 21.7% of their time on a project.

It is interesting to note that a large number of CIN users

are young and initiating their professional life. In 46.2% of the 117 cases observed the users had five to ten years experience and 48% fell in the 30 to 34 years old group. On the average CIN users have been working 8.4 years as shown in table 7 .

Although they have a good educational level, CIN users do not publish much. The statistical mean of CIN user's publishing rate in Brazil is 2.9 p.a. and outside of Brazil is 1.6 out of 123 in the sample and shown in table 8 and 9.

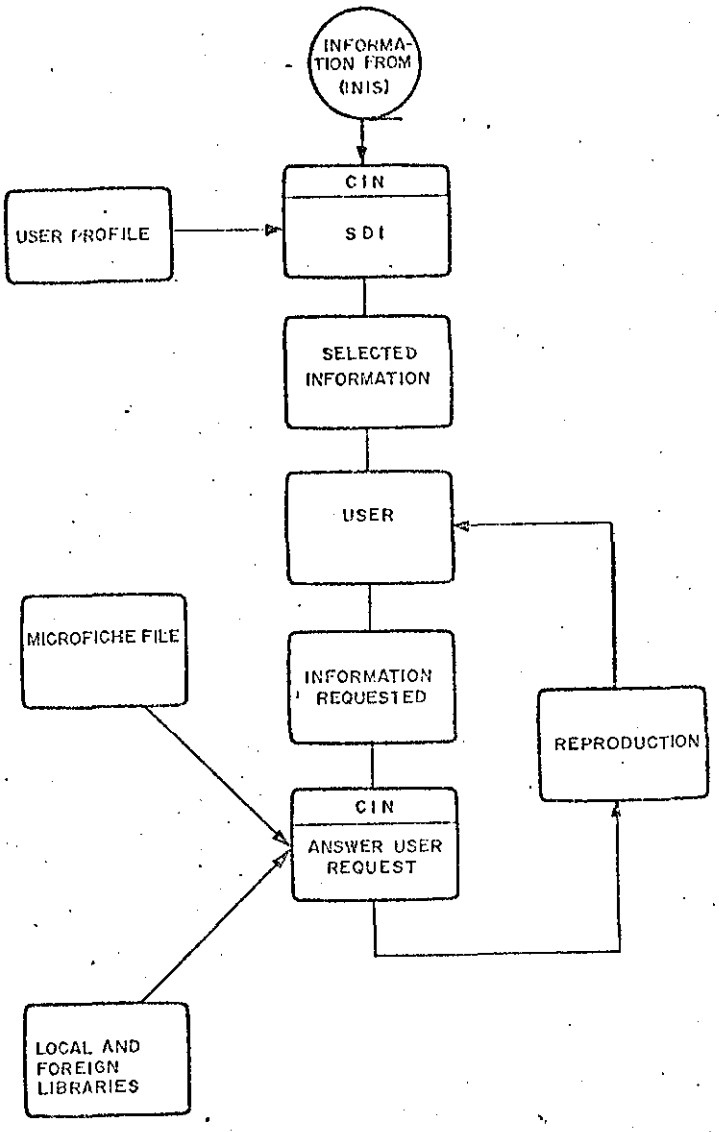
According to data collected from the sample of 123 CIN users, there is only 4.5% duplication of efforts in research projects in Brazil and 40.9% with work being done outside of the country. It is possible that through the SONAR/SDI service informal contacts in Brazil among researchers has increased and has had a positive result in helping to avoid duplication of research efforts.

According to information provided by users themselves their earliest works in the field were published in 1973 and the most recent were published in 1979 and 1980. In an attempt to discover the reason for the low number of published works in the nuclear energy field in Brazil, CIN users were sampled and it was observed that they tend to publish when they are working on a project where one of the by-products is a paper. CIN users indicated that another reason for few published works is that there is no incentivation in the sector to publish; there are no awards, promotion or other recognition given.

The evolution of users in the SDI system shows that this service in increasing each year:

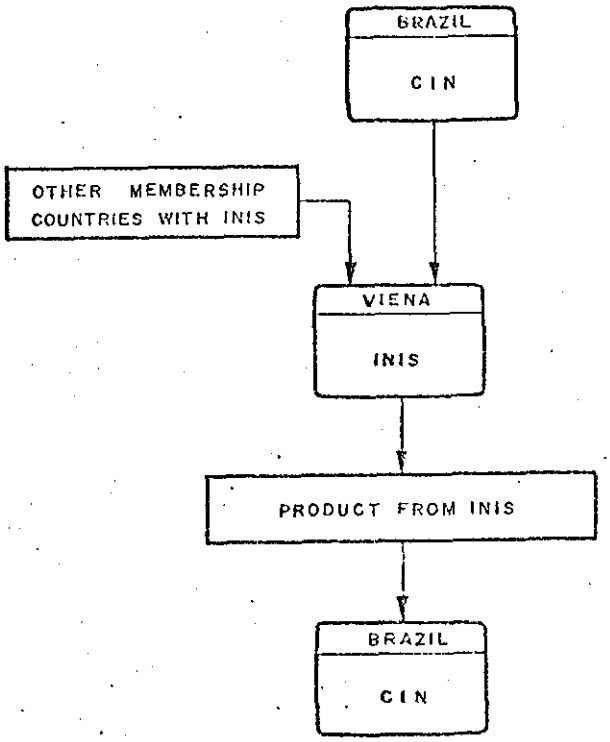
YEAR	NUMBER OF USERS
1970	100
1971	214
1972	218
1973	450
1974	-
1975	208
1976	731
1977	1151
1978	1552
1979	1616

Figure: 6 Selective Dissemination Information System – SDI



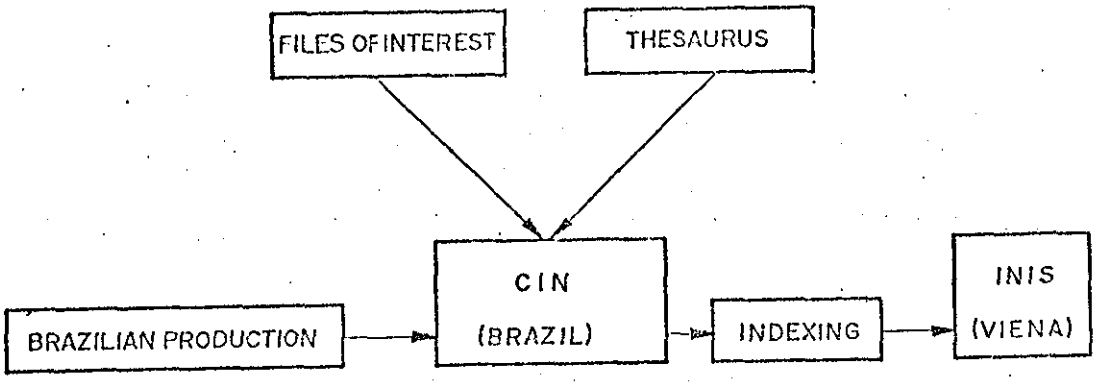
Source: Comissão Nacional de Energia Nuclear. Centro de Informações Nucleares. Produtos. Rio de Janeiro, 1979

Figure: 7 Nuclear Information Centre of Brazil



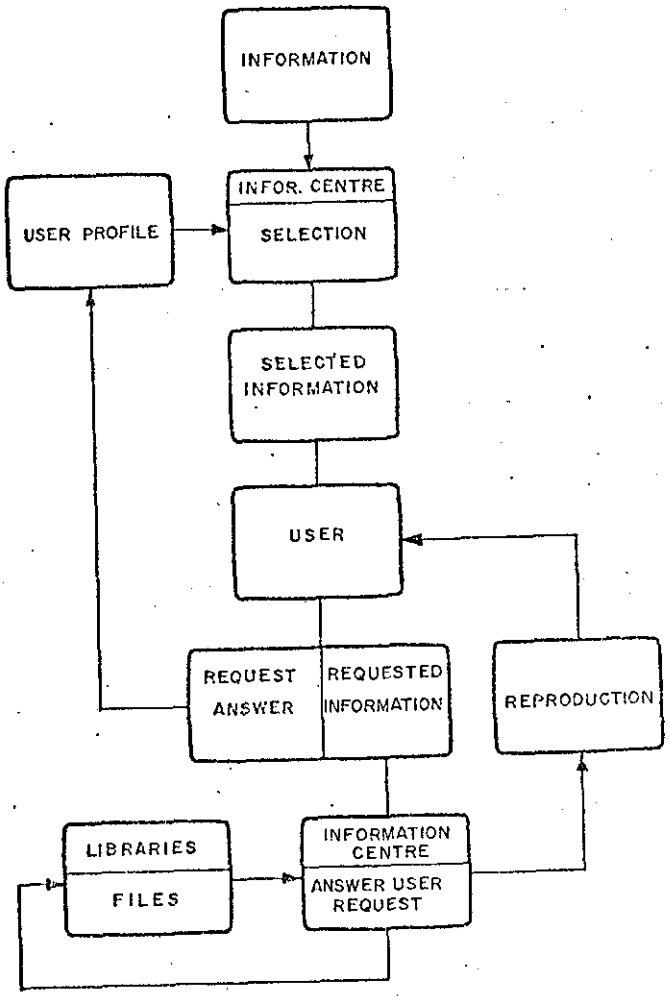
Source: Data collected by the researcher in Brazil, 1979

Figure: 8 Brazilian Production



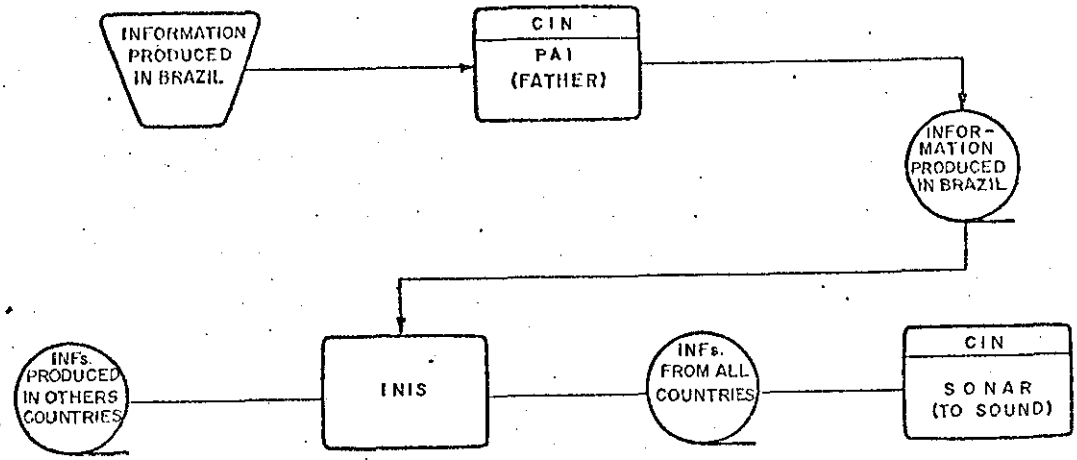
Source: Data collected by the researcher in Brazil, 1979

Figure: 9 Selective Dissemination of Information System – SDI



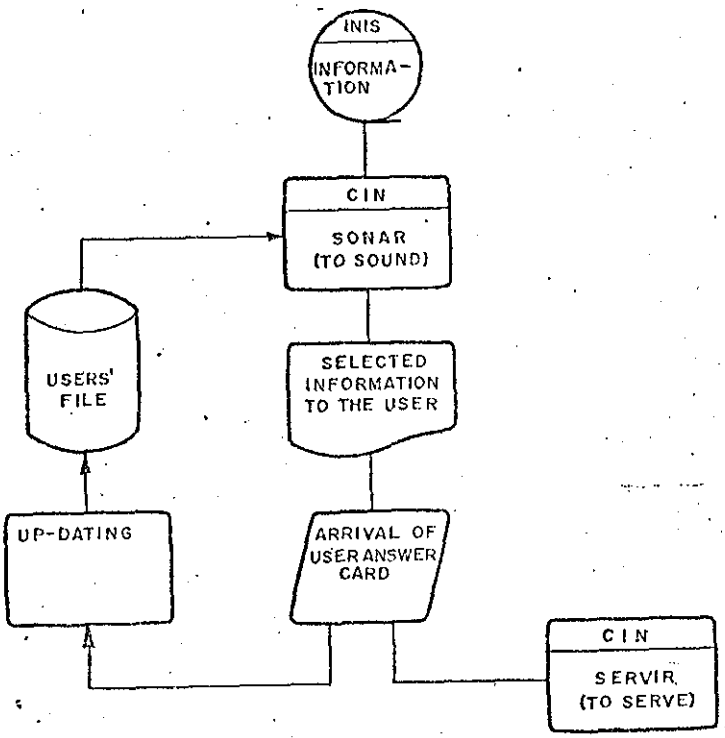
Source: Comissão Nacional de Energia Nuclear
Centro de Informações Nucleares
Produtos. Rio de Janeiro, 1979

Figure: 10 Selective Dissemination of Information System - SDI



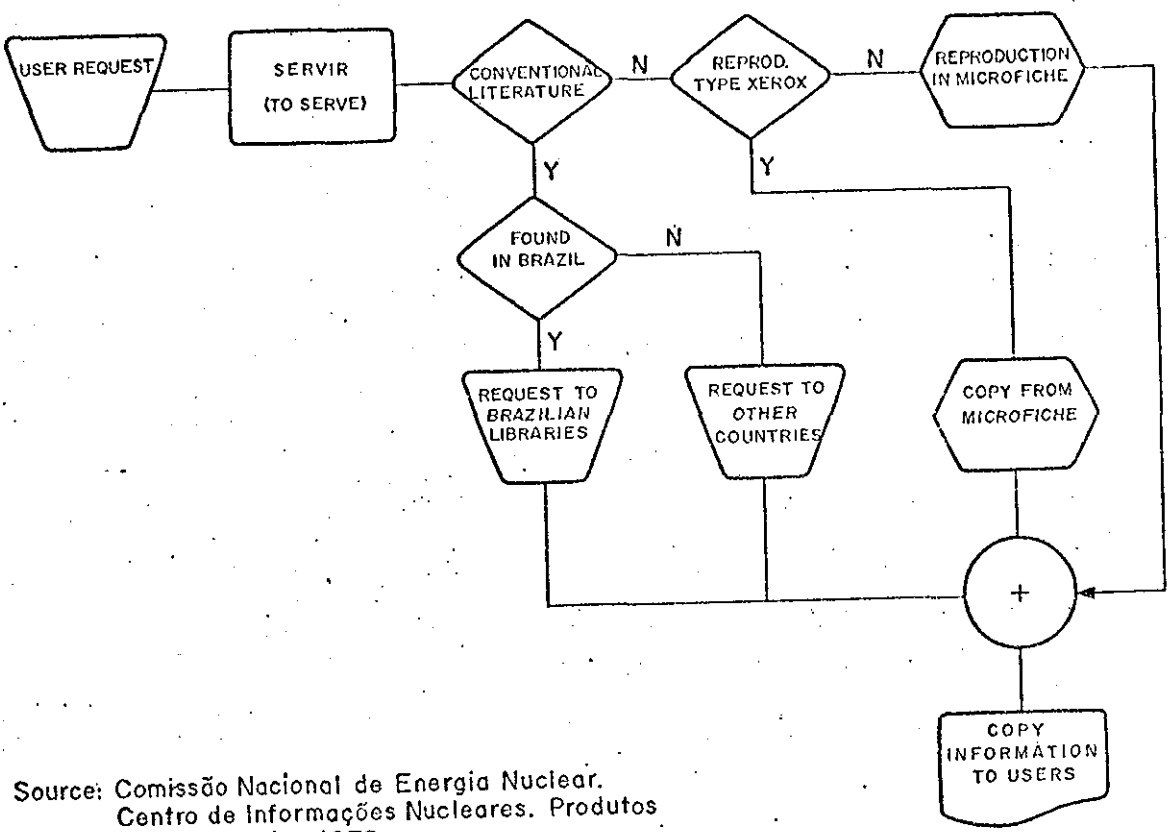
Source: Comissão Nacional de Energia Nuclear. Centro de Informações Nucleares Produtos. Rio de Janeiro, 1979

Figure: 11 Selective Dissemination of Information System-SDI



Source: Comissão Nacional de Energia Nuclear
Centro de Informações Nucleares.
Produtos. Rio de Janeiro, 1979

Figure: 12 Document Supplying System



Source: Comissão Nacional de Energia Nuclear.
Centro de Informações Nucleares. Produtos
Rio de Janeiro, 1979

TABLE 1 : UTILISATION OF DATA BASES IN 1979

INSTITUTION NAME	DATA BASES	PLACE
BRAZILIAN PETROLEUM RESEARCH CENTRE - PETROBRÁS/CENPES	Petroleum Abstracts	Rio de Janeiro (RJ)
BARROSLEARN DIDACTIC PRODUCTION/ TECHNOLOGICAL INFORMATION NUCLEUS	NTIS, ORBIT	São Paulo (SP)
PAULISTA SCHOOL OF MEDICINE REGIONAL LIBRARY - BIREME	MEDLINE	São Paulo (SP)
CNEN/CIN	INIS	Rio de Janeiro (RJ)
EMBRAPA/DID	AGRÍCOLA CAB BIOSIS Chemical Abstracts Food Science & Technology	Brasília (DF)
NATIONAL AGRICULTURAL LIBRARY - BINAGRI	AGRIS	Brasília (DF)
CNPq/IBICT	ORBIT	Rio de Janeiro (RJ)
MINISTRY OF THE ARMY MILITAR INSTITUTE OF ENGINEERING - IME	NTIS	Rio de Janeiro (RJ)
NATIONAL DEPARTMENT OF HIGHWAY RESEARCH INSTITUTE - DNER/IPR	DIRR	Rio de Janeiro (RJ)
TECHNOLOGICAL RESEARCH INSTITUTE - IPT	COMPENDEX	São Paulo (SP)
UNIVERSITY OF S.CARLOS CHEMISTRY INSTITUTE	X-Ray Data Base	São Carlos (SP)
PROMON ENGINEERING	DIALOG,ORBIT	São Paulo (SP)
FEDERAL SENATE	PRODASEN	Brasília (DF)
NUCLEAR ENERGY RESEARCH INSTITUTE - IPEN	Nuclear Science Abstracts Data Base	São Paulo (SP)

SOURCE: Garcia, M.L.A. A informação científica e tecnológica no Brasil. Ciência da Informação, 9 (1/2): 41-81, 1980.

TABLE 2: GEOGRAPHICAL DISTRIBUTION OF INFORMATION SYSTEMS, CENTRES, SERVICES IN SCIENCE AND TECHNOLOGY IN 1979

STATES	N.	%	CUMULATED FREQUENCY %
Rio de Janeiro	29	35.3	35.3
Distrito Federal	19	23.2	58.5
São Paulo	17	20.7	79.2
Minas Gerais	9	11.0	90.2
Rio Grande do Sul	4	5.0	95.2
Bahia	2	2.4	97.6
Pernambuco	1	1.2	98.8
Não-definido	1	1.2	100.0
TOTAL	82	100.0	

SOURCE: Project BICENGE (São Paulo, Rio de Janeiro, Brasília).

TABLE 3: DISTRIBUTION OF INFORMATION SYSTEMS, CENTRES, SERVICES IN SCIENCE AND TECHNOLOGY BY FIELD OF SPECIALISATION AND OPERATIONAL STAGE IN 1979

FIELD - SPECIALISATION	OPERATIONAL STAGE			TOTAL	
	PLANNING STAGE	INSTALLATION PHASE	IN OPERATION	NUMBER	%
SUGAR	1			1	1,2
FOOD			1	1	1,2
AGRICULTURE	1		6	7	8,6
COAL	1			1	1,2
MEDICAL SCIENCES		1	3	4	4,9
LEATHER			1	1	1,2
CRISTALLOGRAPHY		1		1	1,2
REGIONAL DEVELOPMENT		3		3	3,7
LAW			1	1	1,2
ENGINEERING	2			2	2,4
ELECTRICAL ENGINEERING			3	3	3,7
NUCLEAR ENERGY			3	3	3,7
ECONOMIC PLANNING	2		4	6	7,3
EDUCATION		2	1	3	3,7
GEO-SCIENCES			5	5	6,1
FERTILIZERS			1	1	1,2
SCIENTIFIC AND TECHNOLOGICAL		1	6	7	8,6
COMPUTER SCIENCE	1			1	1,2
MATHEMATICS			1	1	1,2
ENVIRONEMENT	1		1	2	2,4
MINNING			2	2	2,4
OCEANOGRAPHY		1	2	3	3,7
PETROLEUM			1	1	1,2
IRON AND STEEL METALLURGY			6	6	7,3
AEROSPACE	1		1	2	2,4
INDUSTRIAL TECHNOLOGY	1		5	6	7,3
TRANSPORT	1	3	3	7	8,6
SCHIST CHEMISTRY			1	1	1,2
TOTAL N.	12	12	58	82	100,0
TOTAL %	14,6	14,6	70,8	100,0	

SOURCE: Garcia, M.L.A. A informação científica e tecnológica no Brasil, Ciência da Informação, 9 (1/2): 41-81,1980.

TABLE 4 : FREQUENCY DISTRIBUTION OF AVERAGE HOURS PER MONTH SPENT IN ACTIVITIES

AVERAGE HOURS PER MONTH SPENT IN SPECIFIC ACTIVITIES	TYPE OF ACTIVITY							
	PURE RESEARCH	APPLIED RESEARCH	TEACHING	ADMINISTRATIVE WORK	PROJECT ELABORATION	TECHNICAL SUPERVISION	FIELD WORK	OTHER NOT INFORMED
2	-	2	-	-	-	-	-	-
5	5	-	5	9	33	18	7	4
10	11	-	14	24	27	5	14	11
13	-	-	-	-	-	-	-	2
15	7	11	-	22	5	15	-	-
20	13	24	20	16	11	15	-	6
25	-	-	-	-	5	-	3	-
30	1	21	9	13	-	5	11	-
35	-	-	-	-	-	7	-	-
40	6	9	-	-	12	-	-	-
50	-	18	5	5	-	-	7	-
60	-	13	-	-	5	-	-	5
70	-	-	-	-	-	-	2	-
85	-	-	-	-	-	-	6	-
99	-	-	-	-	-	-	-	-

SOURCE: Data collected by the researcher in Brazil, 1980.

TABLE 5 : SALARY DISTRIBUTION BY FIELD OF ACTIVITY

FIELD OF ACTIVITY	DISTRIBUTION OF HIGHER SALARIES TOTAL (123) %
APPLIED RESEARCH	43.4
PROJECT ELABORATION	21.7
FIELD WORK	17.4
ADMINISTRATION	8.7
TEACHING	4.4
PURE RESEARCH	4.4
TECHNICAL SUPERVISION	INFORMATION UNAVAILABLE

SOURCE: Data collected by the researcher in Brazil, 1980.

TABLE 6 : PERCENTAGE OF TIME SPENT BY WORK ACTIVITY

RANGE OF TIME IN PERCENTAGE	PROJECT TOTAL (123)	TECHNICAL REPORT TOTAL (123)	WRITING PAPERS (TOTAL) 123	ADMINISTRATIVE TOTAL (123)	REVISION OWN WORK TOTAL (123)
0-10	13.0	39.1	43.5	65.2	91.3
11-20	17.4	30.4	21.7	21.7	8.7
21-30	13.0	21.7	21.7	4.4	-
31-40	21.7	4.5	8.7	8.7	-
41-50	13.0	-	4.4	-	-
51-60	13.0	4.3	-	-	-
71-80	4.6	-	-	-	-
81-90	4.3	-	-	-	-

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 7 : FREQUENCY DISTRIBUTION OF AVERAGE YEARS OF EXPERIENCE

NUMBER OF YEARS	FREQUENCY
2.	11
3.	8
4.	11
5.	17
6.	5
7.	13
9.	5
10.	14
13.	7
14.	6
15.	11
18.	5
19.	4
TOTAL	117

MEAN	8.436	STD ERR	0.463	MEDIAN	7.000
MODE	5.000	STD DEV	5.009	VARIANCE	25.093
KURTOSIS	- 0.864	SKEWNESS	0.557	RANGE	17.000
MINIMUM	2.000	MAXIMUM	19.000		

SOURCE: Data collected by the researcher in Brazil, 1979.

NOTE: Includes 117 observations (6 missing cases).

TABLE 8 : FREQUENCY DISTRIBUTION OF YEARLY AVERAGE RATE OF PAPERS PUBLISHED IN BRAZIL BY SONAR/SDI USERS

NUMBER OF PAPERS	FREQUENCY
1.	22
2	16
3	8
4	6
6	7
7	7
TOTAL	66

MEAN	2.924	STD ERR	0.258	MEDIAN	2.188
MODE	1.000	STD DEV	2.093	VARIANCE	4.379
KURTOSIS	-0.610	SKEWNESS	0.893	RANGE	6.000
MINIMUM	1.000	MAXIMUM	7.000		

SOURCE: Data collected by the researcher in Brazil, 1979.

NOTE: Includes 66 observations (57 missing cases)

TABLE 9: FREQUENCY DISTRIBUTION OF YEARLY AVERAGE RATE OF PAPERS PUBLISHED OUTSIDE BRAZIL BY SONAR/SDI USERS

NUMBER OF PAPERS	FREQUENCY
1.	34
3.	5
4.	7
TOTAL	46

MEAN	1.674	STD ERR	0.173	MEDIAN	1.176
MODE	1.000	STD DEV	1.175	VARIANCE	1.380
KURTOSIS	-0.180	SKEWNESS	1.280	RANGE	3.000
MINIMUM	1.000	MAXIMUM	4.000		

SOURCE: Data collected by the researcher in Brazil, 1979.

NOTE: Includes 46 observations (77 missing cases).

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5. THEORETICAL APPROACHES AND METHODS OF SDI SYSTEMS, COSTS AND BENEFITS

The availability of information and the possession of the means of handling and using information has a significant correlation to the wealth-producing capacity of a nation; that is, the quality and quantity of information handling is an important economic and social indicator. If the actions are to be effective they must be based on a supply of information which is as complete and accurate as it can be made to be (1). The information revolution is moulding the pattern of thinking in many fields. Economists and social scientists are attempting to formulate a new economics of information. In the past two decades, this new economics has ranged over a wide variety of activities in the information field, from the study of specific activities of libraries, to a reconsideration of the role of information in the economic system. For example, in what manner does information contribute to national income. The concept that information is a major non-depleting resource for coverting other resources into value-added goods and services needed by society is gaining ground and is thus a factor of production (2).

Another aspect of economics relates to investment in the information industry. The information industry covers a number of functional elements: the discovery, creation and collection of information; the storing, retrieving, processing and duplicating of information and the distribution of information through various channels and media. It also covers information hardware development and utilisation; as well as the information market or user agencies. There is a parallel here to a commodity industry involving production, storage, marketing, and utilisation. The information industry absorbs large investments and involves a series of complex processes. Thus, information has a cost price and has to be delivered at a selling price corresponding to its utilisation value.

The economics of information can also be viewed from the angle of a change in the concept of power in society. Power is participation in decision-making and the control over the range of the base values of society via sanctions and rewards. Thus as a society moves from a pre-industrial stage to an industrial and on to a post-industrial stage, therefore, land, labour and capital may no longer be the main source of economic power. It is probable that the only resource input into the industrial process would then be human knowledge, the organised information which programmes and governs machine and human performance. Thus, those who possess this resource would have the key to economic power. It is said that know-how is the costliest commodity on the international market today (3). This idea has led society to increasing investment in activities for knowledge and information generation, collection, dissemination and utilisation. Nevertheless, the decision to allocate resources to the different sectors of the economy, including the knowledge and information sector, has to be guided by a national policy that would lead to optimum allocation of the available resources, such that the returns on the investment are commensurate with their costs.

National information policies should then be an integral part of the development policy and should be formulated to guide measures for securing efficacy of expenditures on better information systems, which in turn, would facilitate and improve information flow to decision points.

5.1 EVALUATION PRINCIPLES OF SDI SYSTEMS

A great number of authors state that an SDI service is valid only as a contribution to information dissemination (4) (5) (6), that is an SDI service should be understood simply as another available means for information dissemination. As it

is not able to meet all information requirements of each scientist, it does not make other forms of alert service obsolete. Thus, an SDI service is understood as s supplement instead of being a substitute taking the place of other alert methods.

Understanding SDI service functions should enable users to be aware that such services are far from able to supply all information relevant to their research work. The truth is that an SDI service is only one answer to their information interests and it is necessary to count on other alert services like personal contacts, invisible colleges, or conferences (7).

The information dissemination process involves:

1. collecting the information produced;

2. indexing such information;

3. making users aware of information available; and

4. making such information acessible to users.

In order words, the information dissemination process depends on the capability of several individuals and/or services:

. the author of the information

. the people who collect, organise and index the information;

. those who promote and disseminate the services;

. the document supplying service; and, finally

. the users.

An SDI service is easily understood when reviewing all its aspects: data bases; SDI service centres; search programs; means of communication; costs; the various distribution services and users profiles (8).

Initially primary journals are produced and examined by input centres that make the data. SDI service centres if automated either buy or lease data bases and develop the software for the retrieval of information. The services are disseminated and editors trained, establishing costs and elaborating profiles according to users interest. When such services reach an operational stage, it is necessary to wait for some evaluations to be made so that it is possible to measure the optimal point of service performance, and users satisfaction (9).

Some advantages of an SDI service are: large reduction of time spent by users in examining and selecting current world literature; coverage expansion, aiming as well to cover marginal publications not yet available to users; wider use of library collection by users; incentivation of librarians to more interaction with the users; reduction of experiment duplication and research projects because users keep up with the newest developments in their areas and aid to libraries when selecting and purchasing a larger volume of bibliographic material to be added to their collections (10) (11).

One of the most important aspects to be considered when speaking of SDI services if profile construction.

In general, most SDI services in the world emphasise this part of the operation, because a well constructed profile is considered by many service suppliers to be the key for a successful SDI service (12) (5) (6) (13) (14) (10) (15) (16).

In order to construct a profile adequately, it is necessary to have a background of specific knowledge in the particular field of the data bases being used and knowhow of software for information retrieval so that the best use is made of the data bases related to the specific profiles.

The subject identification generally comes from the users and it can be supplemented by experts working in SDI centres who know the complexities of the data bases, and search programs. It is usually necessary to rely on information experts and search editors to act as intermediaries between user and system.

After it was understood that good profile construction would make SDI services more successful and cost-effective, the current alert services began to introduce more aggressive profile maintenance (8). On-line interactive terminals have been used by many SDI services in profile construction updating and maintenance. This brings time saving benefits to SDI services mainly when users themselves must update profiles because they do not have to wait until the next day to check if the profiles meet the requirements. This waiting-period can vary from one week to one month depending on the data base frequency. The same operation when done in an on-line terminal takes only a few seconds.

An SDI service can be very expensive when fully operated in an on-line terminal. The important point in this case would be profile negotiation and implementation to be made on-line by blocks (6).

Another way of improving SDI systems is to adjust the printout shape to meet users needs (11). This procedure has already been much used in many SDI centres. Instead of receiving computer print-out sheets, users receive computer printouts in the form of cards in the particular size which allows them to make their own card index of relevant references in

their areas. One of the aspects being studied is a preview of the various computer printout forms in to be used in the user's personal card index (6).

Another advance taking place in recent years and utilised by only a few SDI systems is the supply of a KWIC (Key-word-in-context) index of references retrieved by users. In addition to having their own card indexes, users can also have an indexing system which makes it possible to retrieve information in their individual card indexes (17).

The KLIC (Key-letter-in-context) index is other form that is supplied by some services, including the Chemical Abstract Services, to help the user when selecting key-word fragments. This index is similar to the KWIC index but involves only a single term. It alphabetises the term separately within each of its characters as they gather around the character being differentiated. This gives the user the advantage of distinguishing what is the potential for retrieval that can be obtained when using a term fragment in any truncating way (18).

It is believed that the increasing acceptance of SDI services throughout the world will require a few modifications in current information systems such as: development of library networks; more retrieval of information in an interactive basis; better library resources; higher standardisation in data-base output; possible wider acceptance of the use of the Library of Congress Marc (Machine-readable Cataloguing) Project as the standard shape for library interchange; improved input and indexing processes in data base construction; establishment of more centres, like BLLD, in Boston Spa, England, in order to provide improved document supply services; and perhaps, wider acceptance from part of the users of existing material in microforms (8) (6) (11).

The fundamental question to be asked in evaluating the SDI as

a service is the following: given all available bibliographic tools and search techniques, both human and computer, how effective can any such service be in selecting from the mass of scientific literature those items which have the highest probability of interest to each scientist served by the system? In designing an SDI system, some provision must be made for evaluation of the effectiveness of the service. Information on the performance of the system and the degree of user satisfaction is necessary in order to make decisions on how to adjust the system to operate most efficiently.

In most SDI systems the provision of a current awareness service for the user is of primary importance; the records for research in scientific communication are produced as a by-product and are of secondary importance. However, in a system designed especially for research in journal use and scientific communication, these records are of primary importance.

In the personalised current awareness service, the system should provide for as broad as possible coverage of the literature. Broad coverage of the literature is useless unless the SDI system can select a number of references for each scientist with the highest probability of interest to him. Other requirements necessary for the service to be convenient for its users include:

a. the capacity to provide the user with a copy of any article of which he has been notified by the SDI and has requested.

b. participation in the SDI system should make a minimum demand on the user's time and should be an uncomplicated procedure the "response time" or the length of time which a scientist must wait to receive a copy of an article he has ordered should be fairly short;

c. the user should be able to modify his statement of information requirements or profile at any time.

The records generated by an SDI system provide useful data for the study of patterns in scientific communication. Circulation statistics provide a record of the use of journals subscribed to by the library. In addition an SDI system notifies the user of references from a wide number of journals, some of which are not owned by the library. If SDI notifications result in requests for these journals such requests are reflected in decisions on acquisition policy. Data on the number of disseminated references of which the users are already aware, and the means by which they learned of their existence is interesting. Statistics on the use of foreign language journals and on the relative merit of various scientific journals is also useful.

An important factor in the design of an SDI system is the need to evaluate the SDI as a type of service. This is a different matter than evaluating the performance of a specific kind of SDI system. An SDI service should not be considered as a self-contained system but in relation to the environment of information services in which it must operate. This environment includes indexing and abstracting agencies, primary journal publishers and scientific libraries. An SDI system must be able to use these services in a coordinated, efficient way in order to perform its function of providing scientists with information which is helpful to them in their work.

The SDI system attempts to make use of all available bibliographic sources in selecting references to be disseminated to its clients. In addition an SDI system can be expected to use other approaches to covering the literature. For example, citation patterns can be utilised. The user should be able to specify that he would like to be notified of all papers by a particular author or of all publications

from a particular institution. Citation indexes can be used to find all papers which cite a particular author. A survey should be made of all sources, and techniques for searching them decided upon.

The major bibliographic tools used in searching the current literature are produced by centralised indexing and abstracting agencies. Although these organisations are not considered to be an actual part of the SDI system, their policies have an effect on the methods and results of the SDI system. Although the SDI staff may index and abstract a part of the literature in accordance with the special needs of its clients, the system also makes use of the indexes produced by those national organisations in charge of running SDI systems. Characteristics of the bibliographic tools produced by these organisations have an influence on the effectiveness of the SDI as an information service. Among these characteristics are: the comprehensiveness of coverage of the literature; the consistency, quality and depth of indexing and the compatibility of computer indexes. The type of testing and evaluation conducted at this level is primarily done on methods of indexing and their efficiency (19).

The staff of the SDI system should utilise all available relevant information resources and bibliographic tools produced by the centralised services in order to provide the systems services to its subscribers. The SDI staff should be in personal contact with the clients and should be responsible for finding out their research interests and for providing them with relevant references from current scientific literature. The data recorded on each user profile card is useful not only in evaluating the SDI system by using such measures as "recall" and "precision" ratios, but also in determining the usefulness of each bibliographic source in relation to a specific subject field. This recorded data can easily be manipulated in order to study such questions as, "What percent of relevant articles for a given scientist can be found in

the ten most productive journals in his field? "and" What is the average recall ratio of each secondary journal in relation to a specific subject field?" Information of this type is useful in planning the document coverage of future SDI systems (20).

An SDI system should also test the effect of different formats for the presentation of document notifications to users. The most direct method of dissemination is a one-stage system in which each scientist is given full copies of every article selected for him. Intermediate stages consist of bibliographic citations, abstracts and copies of the first page of the article, etc. In a two-stage dissemination the scientist is first given a list of bibliographic citations from which he chooses those for which be wants a full copy. In a three-stage procedure first a list of citations is provided than an abstract or first page copy and finally the full article. Another alternative is a one-stage system in which the scientist is given a full copy of every reference selected for him by the system (21).

In addition to the above data which is recorded for each document notification, there are certain types of information useful in evaluating the system which could be best obtained through interviews and questionnaires. Questionnaires are a valuable means of assessing the effectiveness of the SDI system and its impact on the work of the scientist. Information which could be obtained by this method includes: the scientist's general attitude toward the SDI service; what he would expect of an ideal SDI system; his judgement of the quality of the articles disseminated; whether he is receiving too many or too few citations; any specific incidents in which he became aware of important information through the SDI which was useful in his work and any significant articles located by other means which were not selected by SDI; how much time is saved from his total time and is he

willing to pay for the SDI service. The question relating to the effect of the SDI on the work of the scientist would give a qualitative rather than a quantitative measure of the value of the service to the scientists.

The purposes of an SDI service are:

a. to provide a personalised current awareness service for the scientist, keeping him informed of all research relevant to his interests;

b. to save him time by screening out irrelevant information, this making the 'information explosion' into a manageable situation.

For this reason the two traditional measures of the effectiveness of an information retrieval system, "recall" (or percent of relevant articles selected) and "precision" (percent of selected articles which are relevant) are useful measures for the evaluation of an SDI system. Besides recall and precision, another measure of the performance of an SDI system would be the cost, or detriment to the user, as a function of the relative importance of "miss" (relevant document not selected). One method of evaluation which considers the cost of miss and trash was used by Sprague, Jr. (22) in a comparison of four methods of document selection in a mechanised SDI system at the Aerospace Research Applications Centre. He calculated the cost of miss and trash for various values of "k" using the following equation:

$$C = KM + T$$

where C is the cost or detriment to the user - in terms of number of bibliographic items, which could be proportional to some cost in money in terms of the time of the user and the cost of sending a notice for an irrelevant document, M is the number of "missed" documents, and T is the number of the items classed as "trash". The constant "k" reflects the user's opinion on the relative cost of miss and trash. A user who

wants a few relevant documents with very few irrelevant ones will choose a low value for "k". A high value for "k" indicates that the user wants all relevant documents and will tolerate a large number of irrelevant documents if necessary. For a given value of "k", the system which has the lowest cost is said to be the best.

In Sprague's experiment indexing and document input were constants for the four systems and only the selection criteria - e.g. Boolean logic, number of terms matching, percent of terms matching, or sum of weighted terms, was varied. This method seems very useful for evaluating the performance of a mechanised SDI system because of the emphasis it places on the information requirements of each user, and because it relates cost and performance.

The most important factor in evaluating an SDI system is the effect it has on the work of the scientist. If such a service can increase his creativity, productiveness and efficiency, and can prevent waste from unnecessary duplication of research, then it is a very valuable service.

The SDI system as an industry offers current awareness notifications provided from machine-readable bibliographic data-bases as a product. Three basic groups comprise the SDI services industry: institutions as tape producers, as tape processors and tape users. The SDI is a literature monitoring service, not a fact finding service. As the product of an SDI service is a list of bibliographic citations, it is reasonable to assume that the service will be of most interest to those users who are comfortable working with the literature. Users in academic settings, both students and faculty, appear to be somewhat less willing or able to pay for an SDI service than others. The reason is very probably the existence of library facilities on campus. Industrial users may accept paying for SDI services more readily than most users because of having no library service facilities available, or they

may have their own SDI services. They often have captive subscribers, and the funds to support use of an SDI. Also top management can be made aware of the savings in time and duplicated effort that can be avoided by good literature searching (23).

According to Williams' survey SDI services in general have inelastic demand * because there is no great increase in the demand if the prices are lowered. In this sense they are analogous to medical services, either a need for the service exists or it does not. Those SDI users already being served will not buy more, but new users may be attracted to a service which is willing to renew at a lower price (24).

There are some determinant factors that indicate the elasticity of demand for an SDI service:

. price elasticity of demand for a commodity depends on the number and similarity of the substitutes that are available. If a commodity has many close substitutes, its demand is likely to be price elastic. If prices of an SDI service increased, this class's use would decrease;

. price elasticity of demand is likely to depend on the importance of the commodity in the consumer's budget. Industrial users demand for SDI services might be more inelastic than other users because expenditure for SDI profiles constitute only a small portion of the typical research unit's budget (25).

. price elasticity of demand for a commodity depends on its range of use. If a commodity has a wide range of use, it is

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* The demand for a commodity is said to be price elastic if the elasticity of demand exceeds one in absolute values, i.e., if $|n| > 1$, where expenditure on the product will increase with a fall in price resulting in a elastic demand. Price inelastic if the price elasticity of demand is less than one, i.e., $|n| > 1$. Unitary elasticity if the price elasticity of demand is equal to one, i.e., if $n = 1$, where expenditure is unchanged with change in price.

felt that its demand will be more elastic than if it can be used in only one area. Demand for SDI services would be rather inelastic once an SDI notification itself does not have an apparent range of uses.

According to the economist's definition, the cost of an event is the highest-valued opportunity necessarily forsaken. For example, the cost of providing an SDI service is the value of the most valuable goods and services that could be obtained from manpower, equipment and material used currently in mechanised current awareness service production. This is the alternative cost doctrine (25).

Social costs are the costs to society when its resources are employed to make a given commodity. These costs take the form of external diseconomies as, for example, when a firm pollutes a stream with waste materials or pollutes the air with smoke (26). Such are the costs to the individual firm owner of producing a given commodity.

Fixed costs refers to outlays which remain constant or unchanged regardless of the number of items produced by the firm.

As example of an SDI fixed cost it can be:

. acquiring data base

. creating data base

. converting data base to a format searchable by the system

. purchase data base

. Fixed overheads: computer rental, space, insurance, management salaries.

According to Zais (25) fixed costs in centres which purchased tape data bases instead of making their own, accounted for about 20% of total costs - fixed plus variable, if the centre

had more than 300 users. If the centre had fewer than 300 users, the fixed costs reached as high as 50% of total costs. Similar ratios like 20% to over 61% of total costs, have also been reported. The 61% of total costs figure is attributable to a 40.3% system design, programming and operations costs at one centre which was still in the design phase when the data was gathered. If this category of costs is not included, fixed costs range from 17% to 32% of total costs.

Variable costs refer to the volume of goods produced from the amount of business done. These include:

. cost of staff to formulate the profiles
. cost of computer processing
. cost of output printing and reproduction
. cost of mailing and distribution
. cost of royalties
. overhead costs that are related to staff (social security, vacation, sick leave, etc.).

The main characteristics of SDI costs are:

a. the relationship between fixed costs and variable costs as a function of centre size, with fixed costs generally being a decreasing proportion of centre costs as centre size increases;

b. the linear increase in total centre costs as the number of users increases.

c. the distribution of costs for computer processing, personnel costs, and data base acquisition costs. The proportions normally are as follows:

. computer processing 30% of the budget
. personnel 60% of the budget
. data base acquisiton 10% of the budget

Personnel costs represent the highest percent of operational costs for the majority of centres surveyed and reported on by Zaiss (25). Computer processing costs for an SDI service can vary by a factor of 2 or more, depending on the technique used-inter-cost variability and discount rate. Some of the factors affecting the variability of operating costs are:

. size of the data base

. frequency of search

. efficiency of the search programmes

. quality of the service provided, i.e., number of search terms used, relevant output, etc.,

. quality and organisation of data on magnetic tapes

. salary variations in different countries

. computer rate per hour

. amount of overhead borne by the services.

Average and marginal cost functions are normally used to help in determining prices and in determining if economies of scale exist for the industry. These include average fixed costs, average variable costs and average total cost of SDI service. Average total cost declines over the range of output provided, reflecting the allocation of the fixed costs to larger quantities of output.

Marginal cost is defined (27), as the addition to total cost resulting from the additions of the last unit of output. It is the ratio of the increase in cost to the increase in output for a small increment in output. Marginal cost as applied to an SDI service, could be defined as the additional cost incurred by a centre when it adds one more profile to run a particular data base. It is calculated by subtracting the total cost of "Q" profiles from the aggregate of "Q + 1" profiles.

This relationship between average cost and marginal cost plays a role in pricing when the technique of marginal cost pricing is used. For example when the situation described above exists, that is, when the marginal cost is equal for all levels of output (Q), then the net social benefit maximising solution of setting price equal to marginal cost (P = MC) is not consistent with a pricing objective of total cost recovery since total revenue (TR = MC x Q) is less than total cost (TC = AC x Q). In such cases, if the centres were to set their price equal to marginal cost, they would not cover their costs. Dei Rossi (28) points out that this situation exists for many automated information retrieval systems and is a factor in support of the subsidisation of publicly financed systems, specifically, in those information retrieval systems where there are declining average costs.

According to Dei Rossi (28) information systems with constant marginal costs should have strategies increasing utilisation, which would lead to higher net social benefit, but entail producer loss. In the SDI industry economies of scale appear not to be substantial enough to make it worthwhile for a centre to become extremely large.

SDI Market structure seems to contain several of the conditions necessary to use the price discrimination technique. The market for an SDI service is segmentable (25). Users of an SDI service can be divided into different classes based on organisational affiliations, nature of research, information gathering behaviour, time span of research interests, availability of funds and motivation, innovation, interaction with the librarian - user's work environment.

Most of the centres surveyed by Williams (24), shared the opinion that if the price charged fully recovers the centre's costs, the number of users would decrease. The result,

has been to charge a fee that does not recover the costs with the hope of increasing the number of users until the total cost of providing the service equals the total revenue generated by the service.

5.2 THE USE OF COST-EFFECTIVENESS ANALYSIS

A number of studies have been done by other investigators in which numerous data have been collected on various aspects of libraries and specialised information services. There is also a very considerable amount of evidence of past efforts to analyse and improve the effectiveness and efficiency of many industrial operations and processes. Industry is based on profit and loss. Industries which do not operate on a profitable basis normally do not survive. Profits are usually determined by the comparative efficiency of a given firm and its competitors (29). Efficiency can be regarded as effectiveness viewed from a cost aspect. Although the nature of library operations and services may not be directly analogous to those of industry, certain considerations appear to be worthy of trial.

Cost-effectiveness is an attempt to measure the effectiveness or performance of a policy or investment relative to its cost and so represents a kind of value for money calculation (30). It is more usual to express the end-product as the ratio:

$$r = \text{effectiveness/cost}$$

This ratio means that if project A and B mutually exclusive alternatives with effectiveness measured in the same units for each, and if A is greater than B, then project A is preferable to project B. In case the projects are not non-exclusive and have to be selected from an overall budget, then they should be ranked in descending order of ratio, projects A, B, c.....n.

However, this technique cannot be used to demonstrate that any given project is wortwhile.

The effectiveness of a particular project, policy or system for information transfer is simply an index of the valuable outputs produced by the project, policy or system. There are various problems in defining an effectiveness index combining more than one performance characteristic. It deals essentially with the decision of how much of one characteristic can be traded off for another. Even such a subjective weighting of characteristics may be better than nothing. Nevertheless, this method is made only for purposes of comparison and cannot give any indication as to whether a project is worthwhile. For that purpose effectiveness and cost must be compared in terms of a common unit which is cost-benefit analysis.

The cost-effectiveness analysis of a service will tell how efficiently, in terms of costs, the service is satisfying its objectives. It will show the best available rules in terms of maximising physical benefits subject to a cost constraint or minimising costs for a desired level of physical benefits. Once there is an absence of measures of willingness to pay (shadow prices) the analyst is dealing with cost-effectiveness and not with cost-benefit analysis.

Cost analyses of many operations are available and they are useful for those doing traditional budgeting. They are also useful for one who is trying to compare costs as a measure of efficiency-cost-effectiveness, or for one who is making cost analysis in preparation for a price quotation.

Cost estimates are required for various purposes such as controlling the operations of an organisation, decision-making, fixing prices, ensuring financial integrity and so on. They are generally expressed in money terms. Economic costs are a measure of the value of resources given up in order to produce

a good or to provide or use a service. Accounting costs reflect the flow of funds out of an organisation and change the value of assets held (30).

The important difference between accounting and economic costs is in the treatment of sunk costs. Sunk costs are those costs which have already been incurred and are included in the accounts. However, they are not a measure of the value of resources used at the current time and are irrelevant to decision-making. Therefore, they are not included in economic costs. In accounting, overhead costs are normally allocated between activities in a more or less arbitrary fashion. This allocation does not usually correspond to the amount of overhead, which can be avoided if any particular activity is foregone, i.e., the economic cost, and hence cannot be used in decision-making.

Private costs are those incurred by an individual or an individual organisation, while social costs are the net total of all the costs incurred by anyone as a result of a decision. User costs are those faced by the user of information services rather than by the supplier (31).

Rafael and Shishko (32) studied the library of the Massachussetts Institute of Technology - MIT, with the objectives of (1) providing material for students courses, and (2) providing material in general support of research at MIT. The main conclusions reached for measuring benefits are general methodologies that have been analysed.

The benefit survey found that:

a. there is a general orientation toward increasing the library's role as distributor of materials for use outside the library. A majority of students would alter the present library in order to save money so that lower xerox prices could be adopted;

b. there is a research orientation creating a strong support for marginal increases in acquisition at the expense of other systems; few desire a radical increase (20%) in acquisition at the present budget level, but virtually no one wants to decrease acquisitions; in general a large increase in acquisitions is highly popular;

c. the idea of centralising the reserve libraries is very popular among students;

d. feelings against inexpensive storage systems run high, 1/3 would be willing to adopt one of the systems at the present budget level;

e. different groups at MIT prefer different budget allocations; undergraduates tend to prefer shifting funds from research to reserve, graduates students desire increased access to other collections and lower xerox prices and the faculty (49%) seek departmental libraries and are more likely to support inexpensive book storage;

f. infrequent users of the university library tend to be the most outside use oriented and high users are research oriented.

The MIT library now appears to be oriented toward the latter group. Since there is no relation among major field or department and system preferences, it does not appear that those in the social sciences or humanities are any more dissatisfied that those in engineering and science or that they seek a different basic library. There are no indications that the basic nature of the library would have to be altered.

Rafael and Shishko attempt to solve the problem of how to organise future library resources into a set of programmes that best fulfil the objectives of providing material for student's course work and general support to research at MIT. However, the assumptions made about costs are mainly based on accounting rather than economic principles.

Estimates provided by MIT's central office of the costs of floor space and of overheads, such as maintenance and depreciation, are used without assessing whether or not these reflect current avoidable costs to the library. To the extent that the library is required to pay such costs to the central office on a regular basis, they are economic costs to the library and should be included. To the extent that they are arbitrarily assigned overheads which the library does not actually pay, these costs should not be included.

From the point of view of MIT as a whole, all the costs should be calculated in such a way as to reflect the university's avoidable costs. The library's and the university's costs then coincide and provide the correct basis for decision-making. For example, in making a choice between the current storage system and a compact system-storage by size, they found that the change over would save only 15% of current library expenditure, and that these are only 6.4% of the annual library budget. They assumed that the benefits lost in the compact system are because of greater delays in retrieval and the difficulties in browsing which are likely to be higher than the saving achieved. They concluded that the current system is better.

In this type of comparison the choice of how to measure costs may not be important because any bias affects both alternatives. There can be a difficulty in this case because the most important cost of the system was shelf space, which is a capital good, while the largest cost in the compact system is staff time. The cost of staff time has been measured by current personnel costs, that is, salaries plus other costs varying directly with the number of staff employed, which is the correct economic cost. But capital costs have been taken as a uniform annual cost including the principal and 6% interest depreciated over a period of 15 years. As this accounting procedure is very unlikely to reflect current alternative use cost, the estimated costs of the current system do not reflect

the value of the resources used. This value would be obtained by calculating the return on the next possible use of existing space, taking account of any avoidable interest charge or, if the space has to be newly provided, the rate of interest earned by the next possible use of new funds within MIT.

In general, Rafael and Shishko used costs more in line with economic concepts than most other authors, but they resorted to rather arbitrary methods of allocating overheads and depreciating capital values. They made a study of benefits while some authors have used the same comparative cost techniques attempting to hold the standard of benefit constant. This method is sometimes described as cost-effectiveness but there is no explicit measure of effectiveness employed, it is really a cost minimisation process.

Several papers discuss which measures should be applied in information transfer systems. King and Bryant (20) show a discussion of cost-effectiveness methodology in a variety of information transfer systems and provide a long list of such measures. They refer to factors influencing the cost of operation and those which contribute to benefits. These measures are highly correlated, so it does not matter much which is chosen. The optimal allocation of funds for public libraries has been studied by Hamburg, Ramist and Bommer (30). They approach library activities as a way of satisfying user demands in both a passive and active manner when promoting library materials to create demands and to influence them. As a passive activity the following performance measures are suggested:

. the proportion of user demand satisfied

. the average time it takes to get the document or information to the user

And as active, three measures are suggested:

. exposure counts

. item use-days

. exposure time.

Exponsure means use of library records. Item use-days is determined by multiplying the number of days a document is in circulation by the average proportion of this time that the user spends consulting the document.

Exposure time can be measured directly by asking library users and then averaging the results. These measures are all part of the effectiveness of the library. To get a single measure of effectiveness we need to take into account all of the above variables.

The literature presents many interesting measures for the effectiveness of information systems. There are few cost-effectiveness studies given the problems of accurate measurement and of deciding if criteria are satisfied. The objective of cost-effectiveness is to improve decisions, not to pursue an ideal objective of optimal decision-making, and it is more useful if applied within the real needs of users and library management activity.

5.3 COSTS AND BENEFITS

The costs of information systems are a matter of concern to many people today. The manager of even the smallest information unit has to be concerned with keeping costs down while maintaining efficient services to users. At a national level, technical institutions have to decide on how best to deploy their resources for providing information services to members. At the government level, decisions have to be taken on how best to direct the development of information services of national importance.

Cost-benefit analysis can provide a logical framework for the evaluation of one or more courses of action. It is also a comprehensive method for dealing with a number of factors, some of which may be highly conjectural in nature.

The main aim of a national economic policy should be to maximise human welfare. Obviously, the principal factors of production - land, labour and capital - can be obtained in various ways. The real objective, however, should be to assemble them in such a manner as to produce the greatest possible benefit for a given cost. Productivity can be increased in the process. Also the rest of the economy will benefit as these are the prerequisites to a maximum rate of economic growth.

Probably the greatest challenge which the modern decision-maker faces is the increasing complexity of the society in which he lives. Increased incomes are creating fresh demands, while technology, in turn, is providing mankind with new ways in which these demands may be satisfied.

Greater mechanisation frequently means that the latest projects become even more capital intensive. Being more durable, they often create benefits which will continue over a longer time. Meanwhile, developments in the transportation front are reducing the problem of distance. These developments give the consumer a wider range of choice and make it possible for individual projects to affect people in widely separated areas. It is apparent, therefore, that no technique for the selection of the most efficient course of action will be adequate unless it takes into account longer term, interregional or demand-related values.

Certain benefits, although generally recognised are not normally measured in terms of their monetary value. The same applies to costs to the extent that cost-benefit analysis is able to take these intangible factors into consideration.

Benefits are defined as advantageous effects (33). An estimate of the cost of any choice or decision implies an estimate of the benefits that result from that choice. But the use of this choice itself implies that other possible courses of action with their results in terms of costs and benefits have been examined and assessed against the overall benefits obtained with the choice finally made. Cost-benefit analysis purports to be a way of deciding what society prefers, and also should inform the decision-maker as to which option is the best course of action to be taken. Nevertheless use of cost-benefit analysis is consistent with the assumption that social objectives can be defined in terms of individual preferences, even though the process of aggregating individual preferences to obtain the total social preference presents some serious difficulties. And it seems however, that most private decisions are not concerned with the wider social effects, but with the effects on profits, sales or producer status (33).

The decision-maker aims to maximise the social benefits for a given cost, so that the choice rule is one of selecting policies which have the largest difference between them. The crucial problem that arises is the definition of social gain, a problem which has absorbed considerable attention in cost - benefit analysis and in welfare economics. Benefits and costs cannot be measured until it is known that it is being measured.

Direct benefits consist of the gains which accrue to those people who make use of the goods and services which can be provided by a given project (34). Theoretically, the real monetary value of these direct benefits is the maximum amount of money which consumers are willing to pay. The direct benefits of a hydro-power project, for instance, are represented by the market value of the electricity produced by the project. This can be established by multiplying the

the volume of energy delivered to consumers by the price the consumers would be willing to pay if the most economic alternative source were to provide the power. On the other hand, the direct benefits from an irrigation project may be determined by computing the increase in agricultural income which is directly attributable to the existence of the project. In other words social costs = benefits - forgone opportunities and economic or monetary costs = money - price of an alternative (35).

Indirect benefits stem from or are created by the project in question. If a sugar beet factory is set up as a result of the provision of irrigation water, this should be counted as a secondary benefit of the project. Although it is not the primary purpose of the project the existence of this new industry should properly be credited to the project (36).

Intangible benefits differ from other benefits to the extent that they are services not usually bought or sold at a price or fee, nor can their value be derived indirectly from the price of secondary products produced by using these services (35). They may, however, be measurable in monetary terms by procedures which attribute a value to them (37). It should be noted that there are direct and indirect intangible effects, see figure 13 in page 165.

A distinction should be made between intangible - not priced in a market, and not easily measured - not capable of quantification in monetary terms.

Direct costs consist of the goods and services which must be surrendered in order to construct and operate a given project. Not only do they include all the monetary expenditures, but provision must also be made for economic losses whether compensated or not.

Indirect costs comprise those costs involved in the production

of secondary or indirect benefits. For example in the case of a sugar beet factory whose establishment resulted from the development of an irrigation project, its income constitutes a secondary benefit of the project. The costs involved in the production of sugar at the factory are secondary costs of the project (36).

Associated costs are those costs which are incurred by the primary beneficiaries of a given project and which must be made in order to realise the full value of the benefits. For instance, in an irrigation project, the associated costs are the private costs incurred by farmers in preparing to use the irrigation water provided by a public authority. If they affect the magnitude of the cost-benefit ratio, those costs must be subtracted from the benefit numerator.

Intangible costs, like intangible benefits, are those values which are not usually priced in the market. One example might be the loss of a sports fishery as a result of the construction of a dam which interferes with the flow of a river. In this case a value for recreation may be determined (36).

Cost benefit analysis is based on the following principles:

a. the goods or services produced by a project have value only to the extent that there is or will be, demand for them;

b. in order to qualify as the best alternative for development a project must be the most economic means, whether public or private, for supplying the goods or services for which it is designed. The costs of proceeding with the next best alternative, meanwhile, establishes an upper limit to the value of the labour, materials and other resources which may be employed in its construction and operation;

c. the first-added, or most economic alternative should be that project which exhibits the highest cost benefit ratio;

d. in order to determine the scale on which the first-added project should be built, it is still necessary to maximise its economic effectiveness. The point at which its cost-benefit ratio reaches a maximum can only be determined by reference to its best alternative. For instance, a cost benefit analysis may show that projects A, B and C have ratios of 6:1, 5:1 and 4:1 respectively. The scale of project A may be increased so long as its cost benefit ratio does not fall below that of project B (37).

The optimum scale for a given project development occurs at the point where its net benefits are at a maximum. This is the point at which the benefits added by the last increment of scale have fallen to the point where they are just equal to the costs involved in adding this same increment. These increments cannot, of course, be less than the smallest physical additions of plant and equipment that are practical this is expressed in graphic terms (see figure 13). Three points are significant in the selection of the most economic scale of development of a project. The first (point X) is the scale at which the ratio of benefits to costs is the greatest. The second (point Y) is the scale at which the benefits exceed the costs by a maximum amount. The third (point Z) is the scale at which the benefits attributable to the project are equal to the costs involved. If the scale of project development were established at point X, the rate of benefit accrued per unit of cost would be at a maximum. This is not to say, however, that the full economic potential of the project would be realised at this point. The latter condition is, in fact, realised at point Y where the net benefits are a maximum.

At point Y, the cost of adding another increment to the scale of development is equal to the benefits added as a result of taking this step. Total benefits also exceed total costs by a maximum amount. Beyond point Y, incremental expenditures exceed the benefits added. The additional steps, therefore, cannot be justified in economic terms.

At each intermediate point between point Y and point Z the over-all ratio of benefits to costs in still greater than one. The benefits added however with each increase in the scale of the development are less than the costs involved in this expansion. It seems clear that increases in scale in this zone of negative net benefits is economically unsound.

The extent to which it is possible to move toward point Y is limited by the cost benefit ratio of the next best alternative. Under these circunstances optimisation rarely leads to a maximisation of net benefits. It should, nevertheless, ensure that the benefits attributed to the first added project are as large as they can be without, at the same time, reducing its cost benefit ratio to a level below that attainable by its next added alternative (37).

Traditionally, the CBA for the provisioning of goods and services by the public sector has fallen within the domain of public finance, where as the name suggests, analysis generally was not concerned with the actual production of these goods and services, but rather with the financial institutions which supported this production, and with the efficiency and welfare implications of the taxing process. This had led to the neglect of the study of an important part of the economy, namely, the production of local government goods and services. The bias which this has produced in an accurate economic analysis of the public sector has been recognised and within the last ten to thirteen years economic research efforts have been undergoing reorientation as the realisation spreads that both traditional and new forms of economic analysis can be fruitfully applied to governmentally provisioned and produced goods and services. Initially this research was directed to those areas which account for large percentages of local public expenditure, that is, education, labour and transportation. Research gradually extended to include economic analysis of other local services. Only very recently has information

activity been subject to this trend (30).

If we take this as a first approximation to the relative value the community and its authorities place on an SDI system, the position of the information centre budget is likely to be precarious due to pressure on local tax resources. This precariousness is underlaid by an incomplete understanding on the part of users and SDI officials concerning its contribution as a public institution to the economic and social welfare of the user community. This leads to an inability to sufficiently justify an SDI's role and its position relative to other goods and services produced. Education is one of the services to which an SDI service is an important contributor. Further underlying this lack of understanding is the lack of product or output measures by which an SDI service can be compared with the remainder of the public sector and with other SDI commercial services.

Information as an intangible commodity differs from goods like coal or wheat. Moreover, it is not used up in the process of consumption, so that unlike electricity, it can be passed from hand to hand without necessatily diminishing in value. Property in intangible commodities is to some degree protected by the patent and copyright laws; but there is probably little legal protection possible for such information services as information retrieval systems.

Prior to the application of cost-benefit analysis in the field of library and information science, the 1960's witnessed a rapid expansion in using this evaluation technique as a tool of the public sector investment appraisal. Cost-benefit techniques were specifically developed to take into account the social, rather than financial, criteria of government policy and to consider and evaluate large investment projects. This growth was partly the result of the increased government involvement in the economy during the post-war period (typified by the nationalisation of industry following the war and the

adoption of macro-economic policies), and partly because of the result of the increased size and complexity of investment decisions in the modern industrial state.

Much has been written about the theory and application of cost-benefit analysis. Early work in the United States (36) concentrated on water resource schemes, but its adoption in Brazil is not yet widely spread (38) (39) (40).

The basic idea of cost-benefit analysis is simple. To decide on the worth of a project involving public expenditure, it is necessary to weigh the advantages and disadvantages. The province of cost-benefit analysis is usually confined to public projects because the advantages and disadvantages are defined in terms of social gains and losses to society. It is assumed that most private decisions are not concerned with wider social effects, but with the effects on profits, sales or producer status.

Despite complaints about the lack of cost-benefit analysis literature, much literature is being produced. The purpose of the research is to introduce some current approaches to the application of cost-benefit analysis and to introduce a methodological approach to do so.

5.3.1 Methodological approach

The formulation of a series of questions will enable the researcher to analyse the general principles and methodology of cost-benefit analysis:

a. which costs and which benefits are to be included?

b. how are they to be valued?

c. at what interest rate are they to be discounted?

d. what are the relevant constraints?

In most cases the scope and nature of the project which are to be submitted to cost-benefit analysis will be clear. For the sake of completeness, however, we must make the point that if an authority is responsible for producing A goods and B goods, then in judging between A goods investment projects of different sizes, it must take into account the effect of producing more A goods on its output of B goods. There are all sorts of complications here: relationships between A goods and B goods may be on the supply or demand side, they may be direct in the sense of A influencing B or indirect in the sense A influencing A, which influences B and so on (33).

One illustration is the construction of a last motorway, which in itself speeds up traffic and reduces accidents, may lead to more congestion or more accidents on feeder roads if they are left unimproved. That is, where there are strong relationships on either the supply or the demand side, allowances must be made for these in cost-benefit calculations (33).

5.3.1.1 Externalities

Cost-benefit analysis differs from a commercial appraisal of a project or policy because it attempts to embrace all costs and benefits, whether they accrue to the investing agency or not. A basic difference between commercial and social returns consists of the external effects of the investment; hence the importance of these effects for cost-benefit analysis (41) (42).

An external effect will be said to exist whenever:

a. economic activity in the form of production or consumption affects the production or utility levels of other producers or consumers; and

b. the effect is unpriced or uncompensated.

Condition (a) is the interdependence condition, and (b) is the non-price condition. Both conditions must exist for an externality to emerge. If interdependence exists, but the effect is priced, then the externality is said to be internalised (41).

External effects may be either external benefits-economies-or external costs-diseconomies. If the economy is divided into two sectors - producers and consumers - there are four types of interdependence for benefits and costs respectively. These are:

a. producer-producer externalities. In this case, the output of one particular firm depends directly or indirectly on the output of another firm or firms and the effect is unpriced. The externality may be input or output-generated.

b. producer-consumer externalities. Whereas the interdependence condition for class (a) externalities requires the production or cost function of one producer to be partially dependent upon the output of another producer, producer-consumer interaction requires the consumer's utility function to be partly dependent upon the output of the donor producer. For an externality to exist, of course, it must be that no trade, exchange or compensation occurs between the two. This category of externality is perhaps the most noticeable, and would include aircraft and motorway noise, air water pollution, and many amenity losses.

c. consumer-producer externalities. It is less easy to find examples of this type of interdependence, and they are probably correctly regarded as being unimportant.

d. consumer-consumer externalities. This type of externality usually has a distinction made between 'envy' and 'non-envy' externalities. In the former case, the welfare loss arises

> because the consumer is envious of another consumer's income or his possession of a certain good or set of goods. In the latter case, the envy effect is absent and the interdependence is similar to that in the producer-producer case. There is some disagreement as to whether envy is a proper externality in that, although is clearly exists, some writers feel that on ethical grounds is should not be allowed to influence rules for allocating resources (33).

Externality relationships can be either 'technological' or 'pecuniary'. The essential points of distinction are that progenitors of public investment projects should take into account external effects of their actions in so far as they alter the physical production possibilities of other producers or the satisfactions that consumers can get from given resources. They should not take side-effects into account if the sole effect is via prices of products. One example of the first type is when the construction of a reservoir by the upstream authority of a river basin necessitates more dredging by the downstream authority. An example of the second type is when the improvement of a road leads to greater profitability of the garages and restaurants on that road, their employment of more labour, higher rent payments to the relevant landlords, etc. In general this will not be an additional benefit credited to the road investment, even if the extra profitability of the garages etc, on one road is not offset by lower profitability of garages on the other, which are not used less as a result of the traffic diversion. Any net difference in profitability and any net rise in rents and land values is simply a reflection of more journeys being undertaken than before, and it would be double counting if these were included. We measure costs and benefits on the assumption of a given set of prices and the incidental and consequential price changes of goods should be ignored (33).

The notion that some pecuniary spillovers are properly included

in benefits has a appeared in a particular guise in arguments about secondary benefits. Spill-over cost and benefits occur when the result of a transfer of information produces costs and benefits to people other than those who supply or use the information. The terms externalities or external costs and benefits, are sometimes used to express the same idea. Some spill-over effects may be monetary or marketable and some non-marketable or intangible (43). For example, monetary spill-over would arise if (a) a firm uses its information to produce a cheaper product and this cheaper product causes added benefits to consumers generally, or (b) a firm pays taxes to the government on profits made from new products derived from its information. For instance non-marketable spill-over would arise if (c) a researcher includes information in a paper which is widely read and used by other researchers or (d) information is used to market a product which has undesireable effects - say an undetectable method of producing heroin.

Estimation or length of like is clearly a highly subjective process depending on assessments of the physical length of life, technological changes, shifts in demand, emergence of competing products and so on. The effect of any error will depend on the rate of discount adopted; the higher it is, the less do errors of estimation matter.

5.3.1.2 Valuation of costs and benefits

So far it has been established that the objective of cost-benefit analysis is to guide the decision-maker in the choice of capital projects and expenditures which will maximise the gains to social welfare. Social welfare is related to some aggregation of individuals' preferences, and these in turn are represented by the individuals' willingness to pay for commodities. Market prices therefore play a central part in

the valuation of benefits, although substantial modifications have to be made to these links to allow for marked imperfections and for situations in which no market exists for the project's product. We shall consider Pareto optimality in situations where monopolistic elements or other imperfections in goods or factor markets are such as to turn relative outputs away from those which would prevail under competitive conditions.

Given that society's preferences for goods are relevant to the objective function of cost-benefit, it is necessary to see how the appropriate valuation of a benefit is obtained. Figure 14 shows a familiar downward-sloping demand curve for some product (35). Suppose that market forces set the price of the good at P and the quantity sold at Q. Consumers then pay out the amount PDQO- this is their effective payment for the good. It is not, however, a measure of their willingness to pay, and hence of their true preference for the good. It is usual to approximate the willingness to pay by adding to the effective payment the consumer's surplus triangle P" PD. Essentially, the argument is that there are some consumers who would have paid more than P for the product and their preferences are recorded on the demand curve above the ruling price.

The total willingness to pay is indicated by the large lightly-shaded area in figure P" DQO so that

$$\text{Total WTP} = P \cdot Q + S$$

that is the total willingness to pay for any good is equal to the purchase price multiplied by the amount purchased, plus the consumers' surplus.

Since the effects of an investment project usually alter the amount of the good already in existence, it is the change in WTP that is relevant. In other words, if quantity increases

from Q to Q' in figure 14, benefits are computed as the willingness to pay for this increased output. From the diagram it can be seen that this change is equal to

$$OQ'D'P'' - OQDP'' = QQ'D'D$$

which in turn is equal to the change in quantity multiplied by the new price, plus the triangle ED'D. Writing P for the change in price of A, and Q for the change in quantity, the change in willingness to pay becomes

$$\Delta WTP = \Delta Q.P' + \tfrac{1}{2}\Delta P.\Delta Q$$

where the last expression is the area of the heavily-shaded triangle ED'D.

This expression reduces to

$$\Delta WTP = \Delta Q = \Delta Q(P' + \tfrac{1}{2}\Delta P)$$

$$= \Delta Q = \Delta Q.\tfrac{1}{2}(2P' + P - P')$$

The appropriate valuation of benefits therefore becomes the change in physical quantity multiplied by a simple average of the price previous to the investment and the price after the investment.

If the investment alters prices only marginally, or not at all, then for valuation purposes, P = P' and the rule reduces to

$$\Delta WTP = \Delta Q.\ \frac{2P}{P} = \Delta Q.P$$

In other words the ruling market price can be an appropriate indication of the WTP per unit of output.

Since economic resources are limited, undertaking a public investment will divert resources from an alternative use,

perhaps another public investment, or an investment in the private sector. There is an opportunity cost in carrying out the expenditure. We are therefore interested in the benefits to be derived from the expenditure in question compared with the benefits that would have been obtained if the money had been used elsewhere. Since cost benefit analysis is to reflect the structure of society's preferences, it follows that the chosen ranking function should reflect the difference between the benefits obtained from a given project x, and the benefits that would have been obtained from the forgone project w. Essentially then, we require a measure of the willingness to pay for the forgone project. Faced with several projects x, y and z, the choice of any of which would mean going without w, the ranking function becomes

$$WTP\ (i) - WTP\ (w), \qquad i = x, y, z$$

If this difference is higher for x, than for y or z, for example, then x is the most preferred project. WTP (w) is properly regarded as the cost of project i.

The problem is to obtain a measure of the WTP for the forgone project w, or the "social opportunity cost". If the resources used in x had been used in y, they would have produced a certain physical output Qd, which would sell at price Pd. Ignoring consumers' surplus and subject to the modification of accounting prices to be discussed later, Pd must reflect the marginal social benefit of w. Hence, Pd. Qd is the willingness to pay for w. The resources displaced by x, however, are represented by the money cost of x, and this money cost would appear in turn to be equal to Pd. Qd. Subject to some qualifications to be shortly made, it follows that WTP for the forgone project is equal to the money cost of the chosen project.

To compute the net benefits of any project to society it is therefore necessary to estimate

$$\text{net } B = b \,.\, p - C$$

where b is the [illegible] benefit, p the product price and C the costs of supplying the product. Since the amount supplied can be varied - the investment can vary in size, or scale, it is useful to write each of these variables as a function of size, so that the ranking function becomes

$$\text{net } B\ (x) = b\ (x)\ .\ p\ (x) - j\ (x)\ .\ w\ (x)$$

where b (x), for example, simply means the physical benefits which result from some chosen scale x; j (x) is the amount of physical resources used in the project; and w is the market price of these resources. This in turn reduces to

$$\text{net } B\ (x) = B\ (x) - C\ (x)$$

As yet time has not been introduced into the picture. The benefits and costs will be distributed over the 'life' of the project. To complete the formula for the ranking function it is necessary to write Bt (x) for the benefits in year t, with a similar notation for costs. It will then be necessary to add the benefits over the time periods, so that

$\sum_{t=0}^{n}$ Bt simply means 'the sum of all the benefits in each of the years from 0 to n', where the nth year is the year in which the project terminates its 'life'. Again for completness, we introduce the discount factor dt, which allows for the fact that £1 of the benefit or costs in later years is not to be regarded as being as large as the £1 of the benefit or cost now. The rationale of 'discounting' is discussed later. The discount factor will become larger as time passes that is,(i.e. dt will get smaller), so that dt will vary with time. The <u>final formula</u> becomes

$$\text{net } B\ (x) = \sum_{t=0}^{n} Bt\ (x)\ .\ dt - \sum_{t=0}^{n} Ct\ (x)\ .\ dt$$

$$= \sum_{t=0}^{n} (Bt\ (x) - Ct\ (x))\ .\ dt.$$

Under certain circumstances market prices are inadequate representations of marginal social valuations in the case of benefits. The same problem arises with costs, since these are readily translated into WTP for the forgone project. There are two general reasons for supposing that price of the resources used in the chosen project will be an adequate guide to the true opportunity cost of the project:

a. resource prices may rise because of the transfer of resources from one sector to another in which the project is to take place, that is from w to x or y or z in the example given.

b. the resources may come from sectors which have imperfecty competitive resources markets.

In case (a) the resource cost of the chosen project could be measured as the resource prices before change or after change. The actual loss of welfare from the project that would otherwise have been undertaken, however, is not measured by either valuation. Figure 15 demonstrated this point.

The supply and demand curves are shown for the forgone project w. The effect of the chosen investment is to raise factor prices so that the product supply curve is shifted from SS to S'S'. The total loss of WTP in project w is therefore shown by the shaded area EFBD, and it is this area which is the proper valuation of the 'opportunity cost' of the chosen project.

In practice, however, the use of market prices for resources will entail a valuation equal to the area EFBG, so that there is a 'bias' equal to the lost consumers' surplus DHB and the lost 'producers' surplus HBG.

Case (b) is shown in figure 16 . The forgone output would have ocurred in an imperfectly competitive context, so that the

appropriate marginal revenue curve, as well as the demand curve, should be considered. In figure 16 the diversion of resources from project w is assumed to raise resource prices so that the marginal cost curve shifts upward from MC to MC'. The change in the profit maximising price is from P to P'. The loss in WTP is shown by the shaded area, whereas the usual valuation, based on market prices of resources, would compute only the area Q'QCD. There is, therefore, an understatement of the true WTP by the area DCPP', which can be thought of as two areas: BCD, the effect of bidding up the resource prices, and BCPP', the effect of withdrawing resources from an imperfectly competitive context.

A ranking function should measure the difference between the WTP for the project in question and the WTP for the output forgone. Only under simplified conditions will the money cost of the chosen project, based on revealed market prices of resources, represent the forgone benefits. In practice there is likely to be at least one source of bias.

5.3.1.3 Pareto Optimality

Departures from Pareto-optimum situations arise when monopolistic elements or other imperfections in goods or factor markets are such to turn relative outputs away from those which would prevail under competitive conditions. In cases of this kind, investment decisions based on valuations of costs and benefits at market prices may not be appropriate. Failure to correct for these distortions is likely to lead to misallocations of investment projects among different enterprises.

The Pareto * rule says that if everyone prefers x to y, x

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* Vilfredo Pareto was an Italian sociologist and economist at the end of the 19 th century and beginning of the 20 th century. His manual of Political Economy was first published in Italian in 1906.

is a socially acceptable policy. Its scope is widened a little in that policy x is also held to be socially preferred if a number of individuals are indifferent between x and y, and some individuals prefer x to y. If some people prefer x to y, and others prefer y to x, the Pareto rule offers no guidance: it does not permit the 'counting of votes' to see if the majority prefer one state rather than another. The reason for this is that Pareto welfare theory denies the possibility of interpersonal comparisons of utility. Hence, if some gain and some lose in respect to a policy change, there is no way to discover whether the extra utility of the gainers exceeds the extra utility of the losers.

The concept of Pareto optimality lies in the heart of cost-benefit analysis. The choosing of policies, which maximise the difference between benefits and costs, is prima facie equivalent to moving the overall state of the economy towards a Pareto optimum. The essential problem is that cost-benefit analysis is specifically designed to deal with the fact that policies to involve losses for some people. In consequence the Pareto unanimity rule needs revision.

The Paretian social welfare function tells us that a policy is acceptable (that is, is in accord with the basic individualist ethic) if at least one member of society prefers the new state and no one disprefers it. But projects tend to involve gains to some and losses to others - that is, there will usually be at least one person who rejects the policy. The Pareto rule needs refinement to allow for this obvious fact of life.

The most celebrated attempt to allow for non-unanimity while retaining the concept of Pareto optimality was the compensation principle formulated in slightly different ways by Kaldor (44) and Hicks (42). In simple terms, the Kaldor-Hicks principle declares a social state y 'socially preferable' to an existing social state x if those who gain from the move to y

can compensate those who lose and still have social gains left over. In this way, the idea of 'Pareto optimality' appears to be preserved because the compensation paid to the losers is defined so that it leaves the losers no worse off than they were before in state x. If the gainers can pay this compensation and still have something left over, then there is a net social gain in that some people will prefer y, while losers having been fully compensated must be indifferent between x and y.

It is just this principle which underlies cost-benefit analysis. If the monetary value of benefits exceeds the monetary value of costs, then the gainers - those who receive the benefits, can hypothetically compensate the losers - those who bear the costs, and still have some gains left over. The excess of gains over required compensation is equal to the net benefits of the project.

5.3.1.4 Social Welfare function

Cost-benefit analysis is a means of identifying policies which society prefers. The difficulty lies in deciding precisely what is meant by 'society prefers'. In this context for cost-benefit analysis, saying 'society prefers' x to y constitutes in effect a recommendation that X be adopted. Hence no definition of social preference can be value free. The discussion is based on the value judgement that individual preferences should count. This implies that social preference is interpreted as an aggregate constructed from individual preferences.

The problem of social choice can be discussed rationally in terms of the postulated welfare function for society that was

first suggested by Bergson (45). Its implications for welfare economics were further explored by Samuelson (46). Indeed, the Bergson concept of a social welfare function is frequently referred to as the Bergson-Samuelson concept.

Bergson defined a social welfare function as a real-valued function SW, 'the value of which is understood to depend on all the variables that might be considered as affecting welfare. In principle then SW is regarded as being defined over all social alternatives.

First he distinguishes between economic and non-economic variables. Both sets of variables affect welfare. He assumes however that while the non-economic variables can affect economic variables, they are not affected by them. Bergson concedes that this assumption may not always hold. Political change, for example, may not influence only economic factors but may itself depend on such factors. However, Bergson argues that for relatively small changes in economic variables 'other elements of welfare' will not be significantly affected. To the extent that this is so, it is his view that a partial analysis will be possible.

According to Bergson, the shape of the function is determined by specific decisions on ends that are introduced into the analysis. But this does not tell us who provides these decisions on ends.

One answer to the question is provided by Little (47), who regards decisions on ends as given by the individual ethical observer. Little argues that decisions on ends involve value judgements, that a value judgement is necessarily a judgement by an individual and hence that the social welfare function postulated by welfare economics must be interpreted as such.

In this view the social welfare function is not to be regarded in any sense as an ordering by society as a whole, but rather

as the opinion of a particular individual. This is one possible answer, however, there are others.

Arrow's (26) contribution to the theory of social choice consists essentially in attempting to get another answer to the question: how should the Bergson social welfare function be determined? The social welfare function, according to Arrow, is to be regarded as a social decision process. Specifically, it is a method, a 'collective choice rule' for deriving a social ordering from individual preferences. What Arrow is concerned with . . is that a collective choice rule satisfying conditions that are normally thought to be reasonable, do not usually exist.

Arrow's definition of a social welfare function is as follows. Suppose a certain society consists of n individuals. Each individual i is assumed to have a weak preference (i.e. preference or indifference) ordering Ri of available alternatives which determines his choice between them. Arrow then defines a social welfare function to be a process or rule for which each such set of individual orderings $R_1, \ldots\ldots R_n$ of alternatives - one ordering for each individual, states a corresponding social ordering of alternatives R.

The logic of Arrow's approach may be stated as follows. The concept of a social welfare function was introduced into theoretical welfare economics as a device for expanding its range beyond the Pareto optimality criterion which is very restrictive. When it exists, the social welfare function allows the ordering of any social state, including the Pareto optimal.

In the Bergson-Samuelson discussion of social welfare functions, function tends to be used in its strict sense. On the other hand, Arrow's concept of a social welfare function is really based on the concept of a social ordering rather than of a function. Indeed, for the purpose of choosing

between alternative policies, it is not really necessary that such a real-valued function should exist. A complete social ordering (ranking) is sufficient.

5.3.1.5 Shadow prices

Government expenditures are group decisions and they are choices that affect many persons. Choices are made by individuals and in the case of government, they are made by individual senators, officials, employees, organisation members, voters and so on. In making his decision each person takes into account the wishes expressed, rewards offered, and possible penalties. Thus individuals make decisions, yet those choices are by no means independent of other persons' views.

Choices for government expenditures, therefore, are group choices for which there is no correct preference function or choices whose preferredness cannot be subject to ultimate test. A corollary to the proposition that group choices cannot be subjected to any ultimate test is that there is no correct set of prices or trade-off ratios. If a dictator establishes a set of trade-offs, it will be appropriate for him. If another dictator sets other criteria, then a different set is correct for him. If it is agreed to abide by the results of a majority rule, whatever preference function this implies would call for another set of exchange ratios. If it is accepted the results of voluntary exchange starting with a given wealth distribution, still another set of prices will be correct. There is always an inherent uncertainity about the preferences implied by a collective decision-making process. These include the preferences of any subaudience to which an analysis might be directed, constraints that are given and those that are negotiable, technological facts and substitution-possibilities, and so on (48). Whatever preference surfaces and shadow prices are used, it should be

kept in mind that prices play a pervasive role in the economic analysis of federal expenditure programmes. Their general function is to provide appropriate substitution rates enabling an economy to achieve efficiency, but prices perform this function at all stages of analysis - not merely in whatever final exhibits are presented to higher officials.

When prices are explicity for the free exchange of items, they are called market prices. When the prices are implicit in exchanges that should be made to maximise a particular objective function or to minimise a cost function, they are called shadow prices. This exchange relation emerges from the shadows if one minimises the cost of providing a specified number of goods. A sequence of shadow prices emerges if one traces out a combined production-possibility schedule - maximum Y for each amount of X to be produced - from individual production-possibility sets (49).

Market prices of final outputs indicate the proper valuation of benefits, while and market prices of resources give the proper valuation of costs. Valued in this way the maximum of benefits minus costs, satisfies the requirements for a ranking function which orders alternative projects in terms of their social preferredness. The extent to which these prices do comprise a proper valuation must now be discussed.

Given that resources are limited, their use in one project will entail an opportunity cost or the benefit they would have yielded in an alternative use. Whatever the objective function, there will be a cost involved in meeting that objective by the use of resources in one project rather than in another. The ratio of the two WTPs for these alternative uses is given the term shadow or accounting price (30).

The adjective shadow is a useful one, since shadow prices are not necessarily observed, Health, education and information are 'outputs' but they are not always sold in the market. There is

no observable price, but there is a 'shadow' price, since each must have an opportunity cost in terms of some forgone alternative (50).

Actual market prices may or may not aproximate these shadow prices. In general the marginal cost of a final good can be expected to indicate society's valuation of that good, as the marginal cost reflects consumers' willingness to pay for resources for that use. As a first approach then, shadow prices are indicated by marginal costs.

The divergence of private and social costs and benefits may occur for a number of reasons. Market imperfections, or the imposition of constraints that interfere with the working of markets, are possible causes. Private and social costs may also diverge when external economies or diseconomies exist (e.g. smoke produced by a factory), or when characteristics for the public good are exhibited; that is when it is impossible or expensive to exclude someone who has not paid for a good or service (e.g. defence) from receiving benefits from it. To take the market price for an innoculation, therefore, would be to understate its social value. Not only does one man get the benefit of freedom from a disease when he is vaccinated, but his vaccination also reduces the rest of society's chances of catching the disease (51).

When no market price exists, the analyst can attempt to place a monetary value on a wide variety of costs or benefits, ranging from commuters' time-saving benefits resulting from the construction of a new road, to the costs associated with aircraft noise. The first and perhaps most obvious point is that external effects must be allowed for. Second, having noted their existence and the form they take, the decision-maker must decide whether to adjust his shadow prices or to assess separately the social valuation of the externality. Third and most important, as externalities are characterised by the absence of markets, there will also be an absence of

observable prices with which the cost-benefit analyst can work. Many external effects problems therefore reduce to the issue of valuing 'intangibles'.

The valuation of intangible benefits and costs presents perhaps the most serious and most controversial problem in cost-benefit analysis. Three procedures exist. First, surrogate prices can be sought by finding - out what the consumer would be willing to pay if there were a market for the intangible good. Where the intangible relates to a cost, the surrogate value will be the compensation required by the person who suffers in putting up with the nuisance. Thus in order to shorten a road journey or an air journey, it is possible to conduct a survey of passengers and ask what they would be willing to pay to save an extra thirty minutes travel time. Samples must be carefully chosen, questions carefully phrased and subsequent questions must be incorporated which serve as a check on the crucial answers.

A second approach does not require the use of subjective responses. Surrogate prices may be implicit in the behaviour of economic agents. In this case, for example, it may be possible to observe how a passenger behaves when confronted with two modes of travel such as a bus, taxi, train or tube. If he chooses the faster, more expensive mode of travel, it could be argued that he implicitly values the savings in time at the difference in cost between the two modes. A number of analyses of this kind have been conducted (52), but their results are not sufficiently in agreement for a clear result to be obtained.

A third approach abandons the attempt to put money values on intangibles. It may be that methods of measurement exist conceptually but cannot be put into practice. This is most likely to be the case with a reduction in the rate of juvenile delinquency or an improvement in the health of a severely subnormal patient in a mental hospital. Technically, society

can be thought of as expressing some price that it is willing to pay for these changes. In practice it is difficult to see how these prices can be obtained. If the list of benefits and costs contains only one intangible item, it is still possible to formulate a meaningful rule for the decision-maker. If the non-monetary benefits are measurerable in terms of physical units - e.g. a reduced crime rate, it should be possible to present each project in terms of net costs or benefits and in the size of physical benefits. Project A may have net costs of £ 2 $\frac{1}{2}$ million and reduces the crime rate by 1000 crimes per year. Project B has net costs of £2 million and reduces the crime rate by 600 per year, and project C has corresponding values of £ $\frac{1}{2}$ million and a crime rate reduction of 50. The decision-maker can still decide if any project is worthwhile and should be able to decide if an improvement in the crime rate of 400 per year is worth £ 1/2 million, etc. Once two or more intangibles exist, however, no clear decision rule is implied. If project A has a reduced crime rate of 1000, but increases hospital admission by 50, while B has a reduced crime rate of 500 and no increase in hospital admissions, the decision-maker must now trade off health against crime, and money against both (53).

Another problem of evaluating intangibles arises with the estimation of the shadow prices for public goods. Public goods exhibit two characteristics: they yield significant external benefits and they are in joint supply. Joint supply means that their provisions to any one individual entails their provision to other individuals. Unlike private goods, an increase in the supply of a public good to individual A will not reduce the consumption of the good by individual B. In short, the principle of exclusion does not apply. While it is difficult to find goods which are completely excludable in the strict sense, goods such as defense, radio and television signals and the open countryside contain large elements of publicness. In each case some pricing mechanism could perhaps be devised such as 'unwillingness to pay for a radio license could result in

signals being scrambled, but only with immense difficulty or cost. One problem with public goods is that they generate a "free rider" problem. Attempts to price the good will, if consumers are rational in their strategies, cause some consumers to understate their preference for a good, thinking that if others get it, they will to. For that reason a pricing system based on recorded preferences would understate total benefits.

In practice public goods are normally provided on a non-discriminatory basis and poll taxes are used to generate the revenue necessary - as in the case of radio licenses or taxation to cover defence expenditures. Of course, no set of true prices exists by which the cost-benefit analyst can compute gross benefits. The strategies open to him are identical to those discussed under the heading of intangibles(51).

5.3.1.6 Marginal cost and willingness to pay

The marginal cost of any final output reflects the appropriate shadow price. In a perfectly competitive economy market prices equal marginal costs, so that market prices are themselves adequate shadow prices.

It may be useful to relate marginal cost pricing to the idea of maximising the difference between benefits and costs as measured by willingness to pay. Figure 17 shows a demand curve for a product together with the relevant marginal and average cost curves. Price will be BE if marginal cost pricing is adopted, and total willingness to pay will be ABEO. The net willingness to pay (benefits minus costs) will be ABG = ABEO - OEBG, where OEBG, the area under the marginal cost up to the selected output OE, is the total cost of providing the output OE.

By setting price equal to marginal cost, the shadow price implicit in the Pareto optimality condition, the net

willingness to pay should be maximised. That is, any other pricing policy would not result in a 'total surplus' greater than ABG. If price was set equal to average cost, for example, the total willingness to pay would be ACDO, but the net willingness to pay would be ACF, an area which, upon inspection, is seen to be smaller that ABG. If the reader can imagine a marginal revenue curve to the left of the demand curve, the profit maximising price would be H. In other words, marginal cost pricing will maximise the net willingness to pay (35).

5.3.1.7 The social discount rate

Investment in capital projects involves the sacrifice of present benefits in favour of future benefits. The sacrifice of present consumption would not be worthwhile unless the gains in future consumption are greater. Essentially an investment is worthwhile if the future gains in consumption are regarded as being in excess of the current sacrifice of consumption from the point of view of the chosen social welfare function. It is important to define the meaning of future gains in consumption carefully. These gains will be distributed over the lifetime of the project. One simple procedure would be to add up all consumption benefits regardless of when they occur. But such a procedure would ignore the existence of social time preference - a preference which society supposedly exhibits for present benefits over future benefits (54).

If individuals prefer £1 of consumption benefits now to £1 of consumption benefits in the future, the principle of consumers' sovereignty, which the researcher noted was fundamental to most cost-benefit procedures, requires that the present-year 1, benefit be weighted more heavily than the future benefit, calculating the social value of a project. Let the relevant weight, yet to be derived, on year 1 consumption benefit be w, and let consumption benefit on years 1 and 2 be C1 and C2. Then the worth from the standpoint of present society of the two

consumption flows is

$$C_0 = w \cdot C_1 + C_2$$

where C_0 is the weighted sum of consumption benefits.

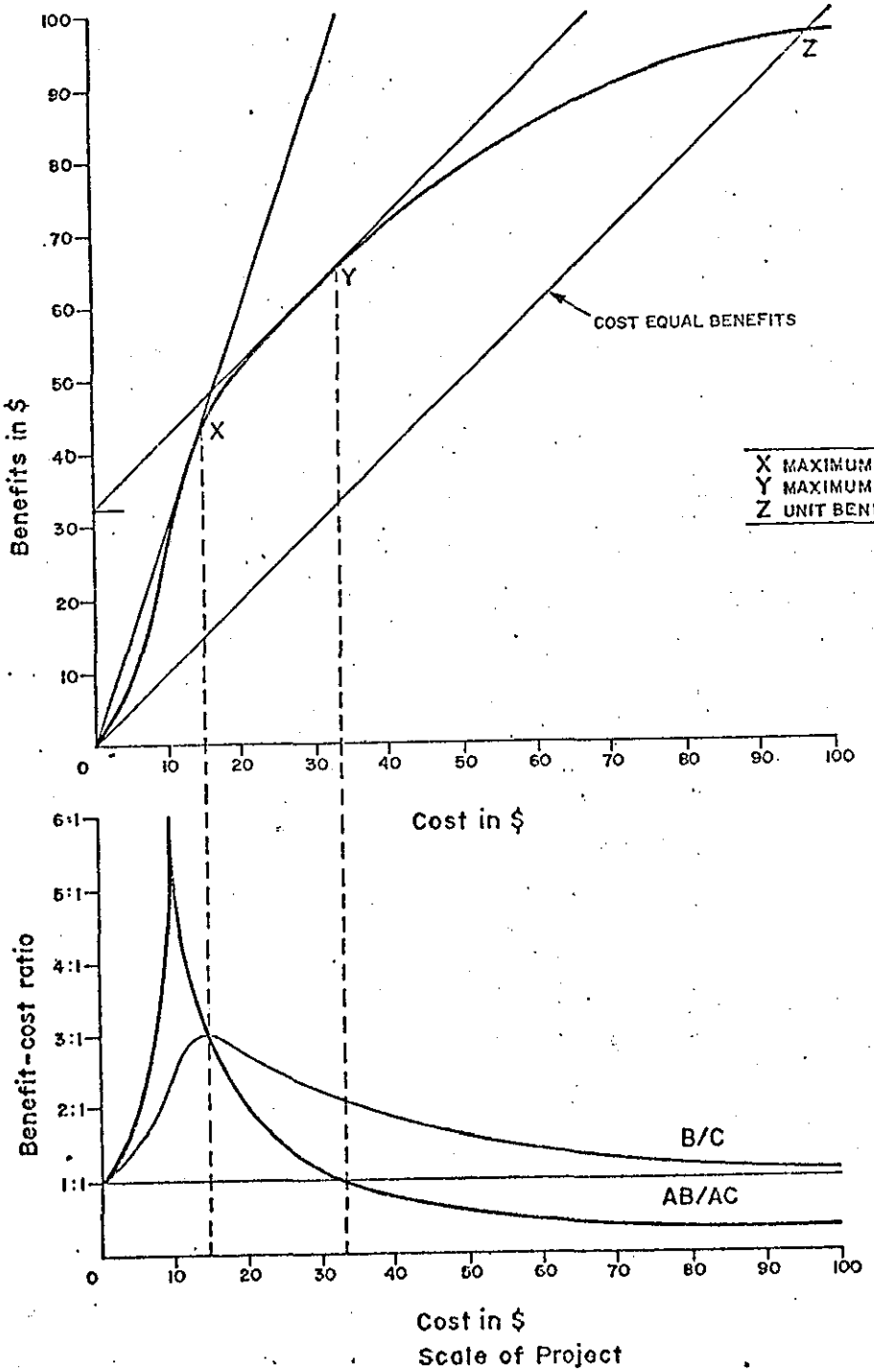
Essentially, if C_2 is regarded as 'numeraire', then w is the weight by which C_1 must be multiplied in order that C_1 and C_2 can be added together to give the measure of social benefit. If the present benefit is to count more heavily that the future benefit, then w must be greater than unity. In fact what we have is the 'accounting price' of present benefits as compared with future benefits: w can be constructed as the price which reflects society's 'trade-off' between the present and the future.

The equation above could also have been written

$$\frac{C_0}{w} = PV\ (C) = C_1 + \frac{C_2}{w}$$

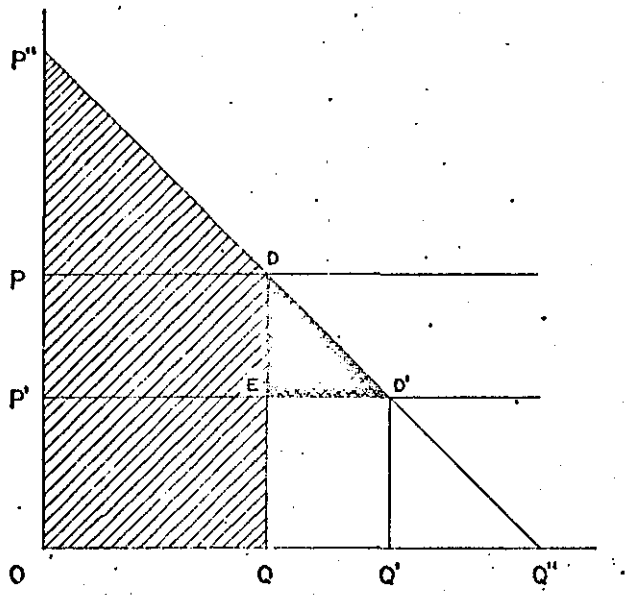
where PV (C) now reads the 'present value' of consumption benefits - i.e. the value to society from its present standpoint. The weight w is now divided into C_2 so that 1/w becomes a 'discount factor'. In general it will be found that w 1, so that 1/w 1. The problems of deciding upon the appropriate value of w is a problem argued by various economists (35).

Figure: 13 Cost-benefit relationships for various scales of development



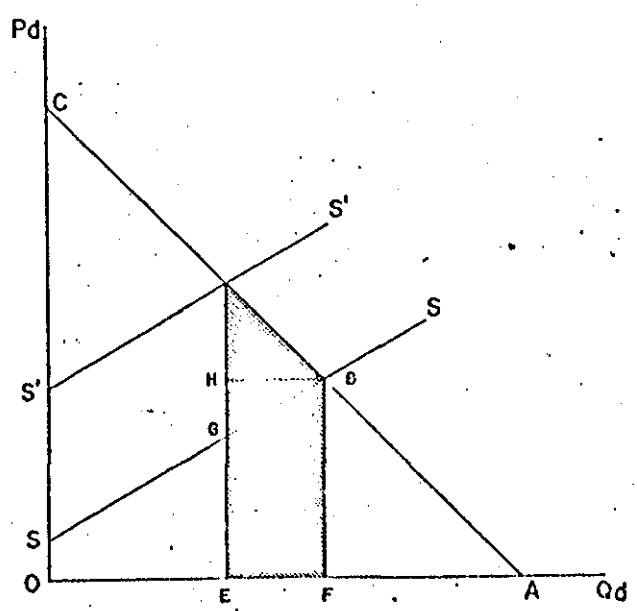
Source: HILL, M.A. A goals achievement matrix for evaluating alternative plans. Journal of the American Institute of Planning. 19 – 29, Jan, 1968

Figure: 14 Demand Curve



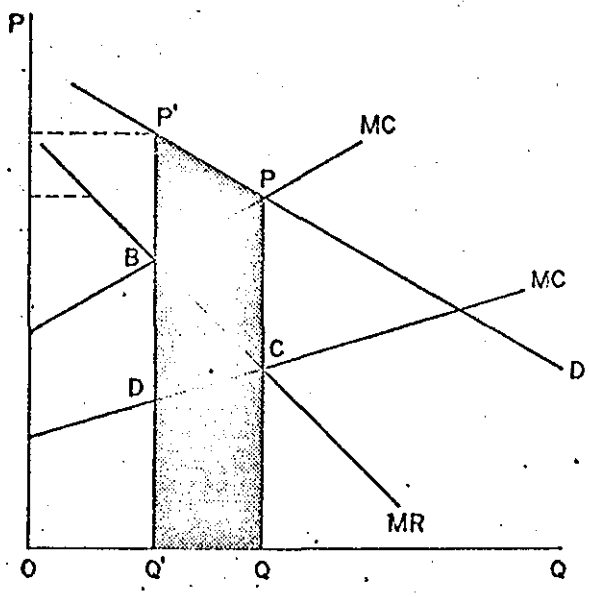
Source: DASGUPTA, A. K. and PEARCE, D.W. Cost-benefit analysis. 1972.

Figure: 15 Demand and Supply



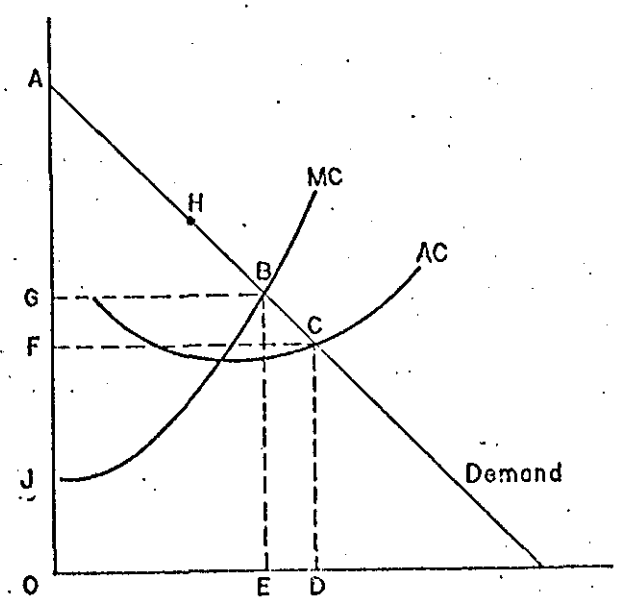
Source: DASGUPTA, A.K. and PEARCE, D.W. Cost-benefit analysis. 1972

Figure: 16 Marginal Revenue



Source: DASGUPTA, A. K. and PEARCE, D.W
Cost-benefit analysis. 1972

Figure: 17 Marginal Average Cost Curve



Source: DASGUPTA, A. K. and PEARCE, D.W.
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6. RESULTS AND DISCUSSION

The purpose of this chapter is to present the results obtained with the research based on the methodologies stated in chapter one and the theoretical approaches explored in chapter five. All the data showed in the tables and in the figures have been compiled by the researcher during 1979 and 1980. The statements not supported by statistical analysis are restricted to data obtained in the sample. The researcher uses the term nuclear scientist and user as synonymous within the scope of this study.

The user population surveyed falls within the priority areas of Nuclear Research in Brazil and these subject areas have been transformed into descriptors of the INIS Thesaurus once users of the SONAR/SDI are indexed by these subject areas, as may be seen in table 21.

These areas of interest were selected as prioritary according to the National Development Plan of Brazil as mentioned in Chapter 1 and used as a criteria to sample users of SONAR/SDI from CIN/CNEN.

6.1 DESCRIPTIVE STATISTICS

One of the large problems of the information scene in Brazil, particularly within the scientific field, is the difficulty in obtaining documents such as theses. In this sample, the researcher observed that it is not difficult to obtain documents in general as shown in table 10.

The difficulty to proceed with a bibliographic search is estimated in this sample as being 83% and mainly in obtaining a thesis. The percentage of respondents having difficulty in obtaining a particular sort of document of the 123 users sampled is high due to problems of lack of information infra-structure and also to lack of library use tradition in Brazil as shown in table 11. There are other kinds of difficultties facing CIN users. It seems that writing is a great problem. This aspect is probably due to the lack of library use and reading habit tradition that are poor in Brazil, see table 12.

The results obtained in the sample showed that users believe and use the SONAR/SDI from CIN/CNEN as a way of gathering information. This observation may be seen in table 22.

The 111 frequency distribution in table 23 for using information services of CIN/CNEN justifies also users' preferred way of receiving information once SONAR/SDI provides titles of publications with abstracts, as may be seen in table 13.

Table 24 shows the information service characteristics preferred by user in the context of this research. It may be observed that the preferred characteristics of information service are higher for the SONAR/SDI of CIN/CNEN and within this source, information presentation, accessibility, relevance to the user's need have rates above 50%, one might have thought that cost and satisfaction characteristics would be preferred. The results shows that users have a clear idea about what they want. Their preferences and the value given to information services are mainly in terms of speed, coverage, relevance of information to their needs and accessibility mostly to SONAR/SDI, library within the organisation and periodicals.

The preferred sources when the user from CIN/CNEN is seeking

for information are a library, the SONAR/SDI, talking to a colleague and searching his personal file, as shown in table 14.

CIN/CNEN users are not dependent upon the use of information sources other than SONAR/SDI. The preferences of 111 users of SONAR/SDI had a dependence ranking as follows:

Library within organisation	4
Periodicals subscribed by organisation	3
Not specified source	3
Library outside organisation	2
Periodicals subscribed personnaly	2
Government publications	2
Personal contact	2
Contact by letter	2

User evaluation of SONAR/SDI in terms of keeping abreast of new knowledge is not very high as may be seen in table 15. The users of SONAR/SDI do not use other sources of information such as indexes or abstracts, which may be observed through table 16. The main source of information that CIN/CNEN users are aware of is the SONAR/SDI. This service has been evaluated having a fair performance by 41.0% of respondents, see table 17.

Users evaluate SONAR/SDI as having a fair performance although 78% of all information they request comes from CIN/CNEN. To give a better score to the SONAR/SDI performance, users have suggested in 46% of respondent cases that an orientation or training in how to proceed a bibliographic search would be desirable. In addition to this suggestion they have also mentioned as difficulties with SONAR/SDI these shown in table 18. The 25% of respondents that answered for unfamiliar languages is not surprising since the knowledge of foreign languages is not very common in Brazil. The percentage of Brazilian population that knows a foreign language is only 12% (1).

The way user knew about the SONAR/SDI in 38% of respondents was through advertising from CIN/CNEN and only in 13% of the cases was it from information given by a specialised library, as can observed in table 19. User's have suggested that the best way of advertising SONAR/SDI is through informal speeches in institutions that use the service. The following data has been observed in Table 20. It is clear that users prefer to receive a technical visit from CIN/CNEN official to explain how the centre works and what the SONAR/SDI System is. At this point it may be observed that ease of use is one of user's preferences. This finding confirms that of several other studies (2) (3) (4) which is that accessibility and ease of use are primary criteria for selection of information service. The obvious implication for the information service is to make the information more accessible and easy to use.

Users from CIN/CNEN many times share the information received with 1 to 3 other colleagues in at least 33% of respondent cases, which means that one product is serving more than one user at the same time.

A common problem encountered in an SDI service is the lack of feedback from users. Some SDI services provide their users with a printout duplication on which they may note references pointing out whether such references are relevant or not. This information is used to implement profiles and generally continues for several months or even a year. As an alternative, SDI services can send questionnaires for evaluation of the service being offered.

Unfortunately, the percentage of users who provide feedback to the service is low. Sometimes users stop using the service without giving any explanation considering it inadequate, however, this lack of communication prevents the service from improving.

Users must decide whether the printouts are relevant or not and the SDI service can contact them by letter or telephone (5). Relevancy or accuracy and recall are subjects widely discussed in literature concerning SDI by Barker (6), Brown (5), Cleverdon (7), Clough & Bramwell (8), Dutton & Gibney (9), Gaffney (10), Housman (11), Leggate (12), Miller (13), Nuggent (14), Olive (15), Rowlands (16), Scheffler (17), and Wolters & Brown (18).

Precision can be defined as the ratio of relevant references in relation to the total number of retrieved items. Recall is the ratio of relevant references in relation to the total number of relevant items in the data base.

These two measures are inversely related since the greater the accuracy, the smaller the recall and vice-versa (19).

As mentioned previously, the only person who can decide whether the printout is relevant or not, whether precision is more important than recall or vice-versa, is the user himself. Whenever users stop giving the system feedback there is always the risk that the service lacks efficiency and a decrease in the number of users can be expected.

Reading habits have not been analysed in the scope of this research although the researcher has collected data to observe in which field these 123 respondent users sampled are reading more. It may be observed through table 25 that those users in pure research and teaching are all expending at least 20% of average work time in reading and the consumption is between 6 to 10 papers per month in 43.5% and 42.5% of cases respectively. Users devoted to applied research expend more than 20% of their working time in reading in 17.4% of the cases. Users involved in project activities are also very much concerned with reading. In 78.1%, of cases they expend almost 20% of their working time in reading. As in pure research activities there are also 43.5% of users in technical supervision with a reading average of 6 to 10 papers, who devote almost 20% of their working time to reading. User's in field work activities are also expending almost 20% of their working time to read in 43.5% of the cases for an average of 6 to 10 papers per month.

It is observed that SONAR/SDI users do expend an average of more than 20% of their working time to read, regardless of the area of activity, and at least 43.5% of the majority of the 123 users read between 6 to 10 papers per month. CIN users read an average of 28.67 hours per month which means almost 1.30 (one hour and thirty minutes) per day (Table 26). According to Allen (20) engineers do not spend more than 3 to 4 hours/week in reading. It seems that users from CIN are reading above these averages. There is also

the question of the lack of an information infra-structure. Brazil is still having problems in organising information facilities throughout the country and it seems that libraries are not much used. Unfortunately there is no available data to verify the amount of reading. Nevertheless, libraries are built without considering users as Carvalho (21) stated in her work that there is 6 cm^2 per user on the average at Brazilian libraries according to her statistical analysis done in 1982.

Now certain findings concerning salary, age and distribution or working time of the scientists sampled will be examined. The results concerning salaries should perhaps be given special note since the salary is one of the chief constituents of the formula used to analyse time-saving benefits. Those CIN users receiving the SONAR/SDI Service still spend a mean of 13.5 hours per month with information search (Table 27).

The monthly average time spent to organise printouts received from SONAR/SDI, that is , to use them is 4.236 hours (Table 28). If users had to search information for themselves they said they would need an average of 19.812 hours monthly only for information search (Table 29 and Figure 18). CIN users have a mean equal to 211.7 total working hours per month (Table 30 and Figure 19). From this total CIN users would have to work in addition a mean of 37.3 hours per month in R & D work if they had to search information for themselves. So, it may be observed that there is an extra cost to especifically search for information and a cost for R & D work as well (Table 31 and Figure 20). The time saving benefit obtained from SONAR/ADI is 132 hours per user or 16.5 days per year, which would be equal to a total of 25,870 hours saved for all the users or the equivalent of Cr$ 7.285.000,00 * in money terms.

The total costs for CIN users to keep up to date, having the same amount of R&D output, is equivalent to a mean of 56.494 hours per month or Cr$ 15.906,00 *. If compared with real costs incurred to produce SONAR/SDI it may be observed that the average variable cost per user is Cr$ 626,44.

The respondents had a mean salary of Cr$ 48.829,00 in salary per month and a mean of 32 years of age. (see Tables 32 and 33 and Figures 21-22(. If compared with salaries of all scientists in the nuclear field it may be observed that the difference is not significant since the average salary of all nuclear scientists in Brazil is equal to Cr$ 50.000,00. The total technical nuclear community in Brazil is 2.197 according to Mendonça (22) (23). From those almost 40% (1562) are using SONAR/SDI.

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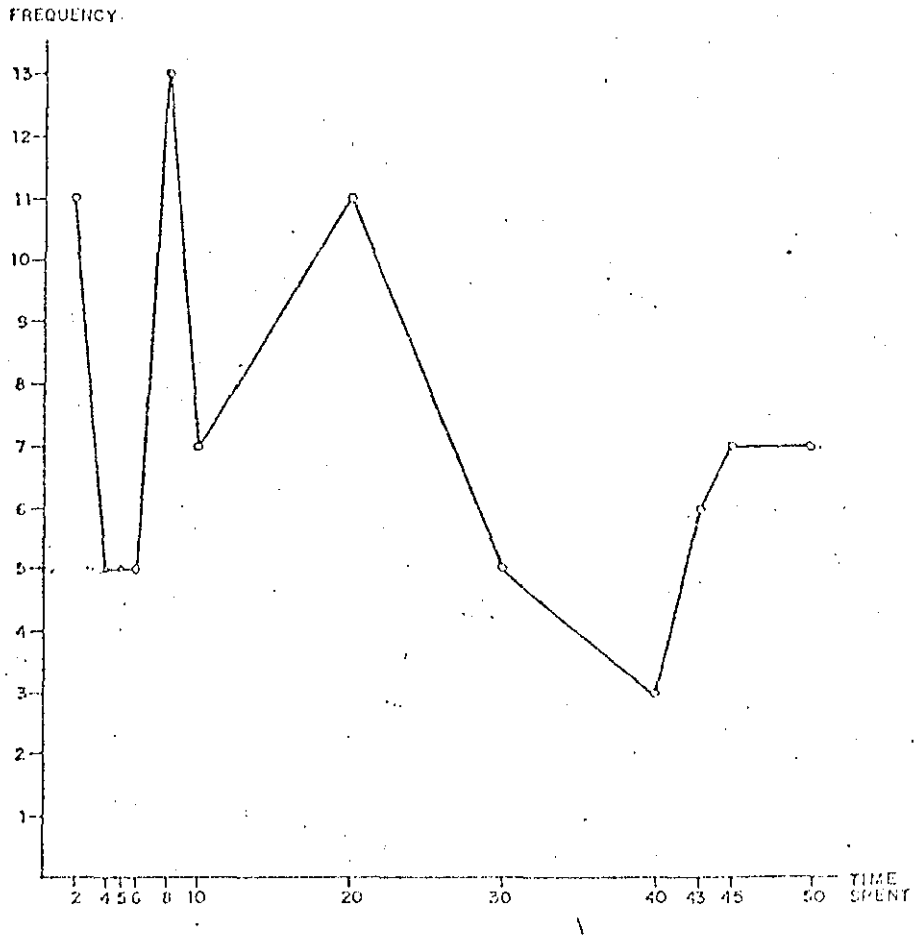
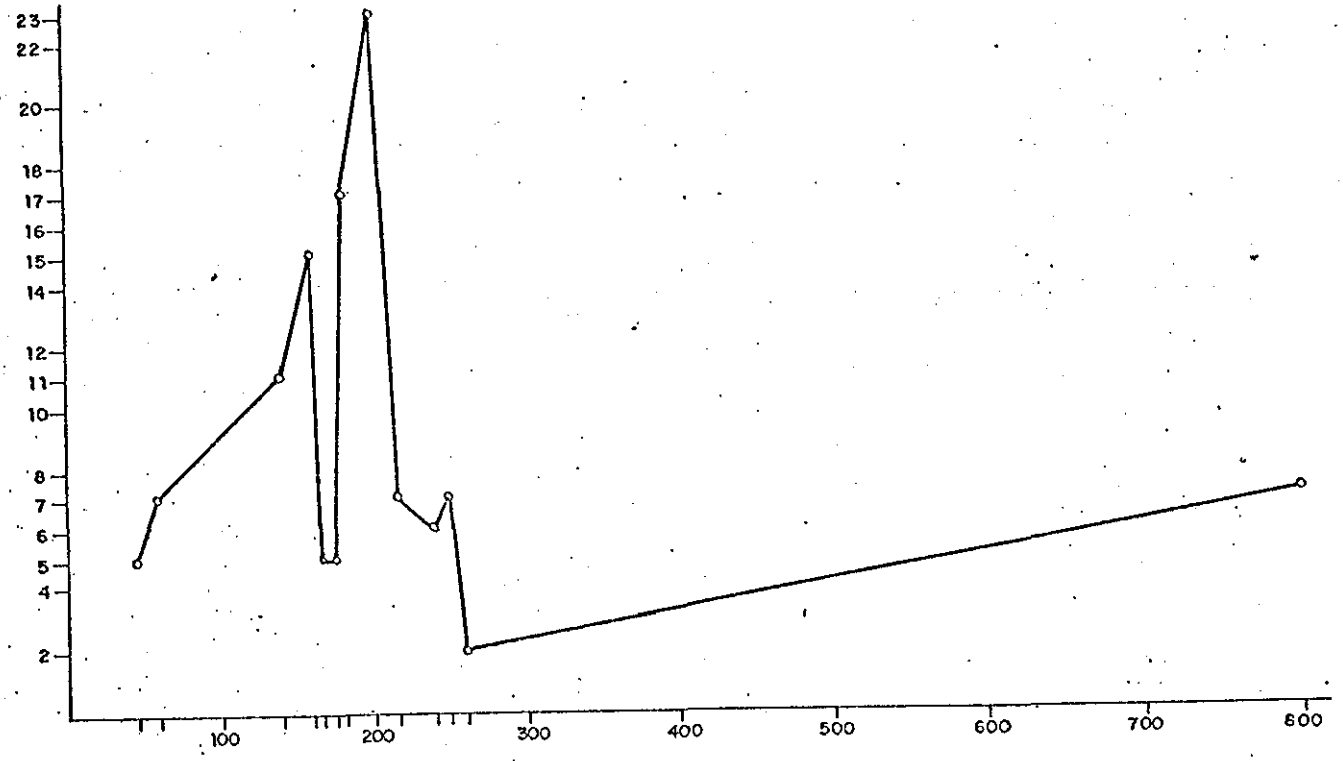
* £1 = Cr$ 101.78 in 1979.

FIGURE: 18 FREQUENCY DISTRIBUTION OF ESTIMATED MONTHLY AVERAGE HOURS WHICH WOULD BE DEVOTED TO INFORMATION SEARCH IF SONAR/SDI IS NOT AVAILABLE.



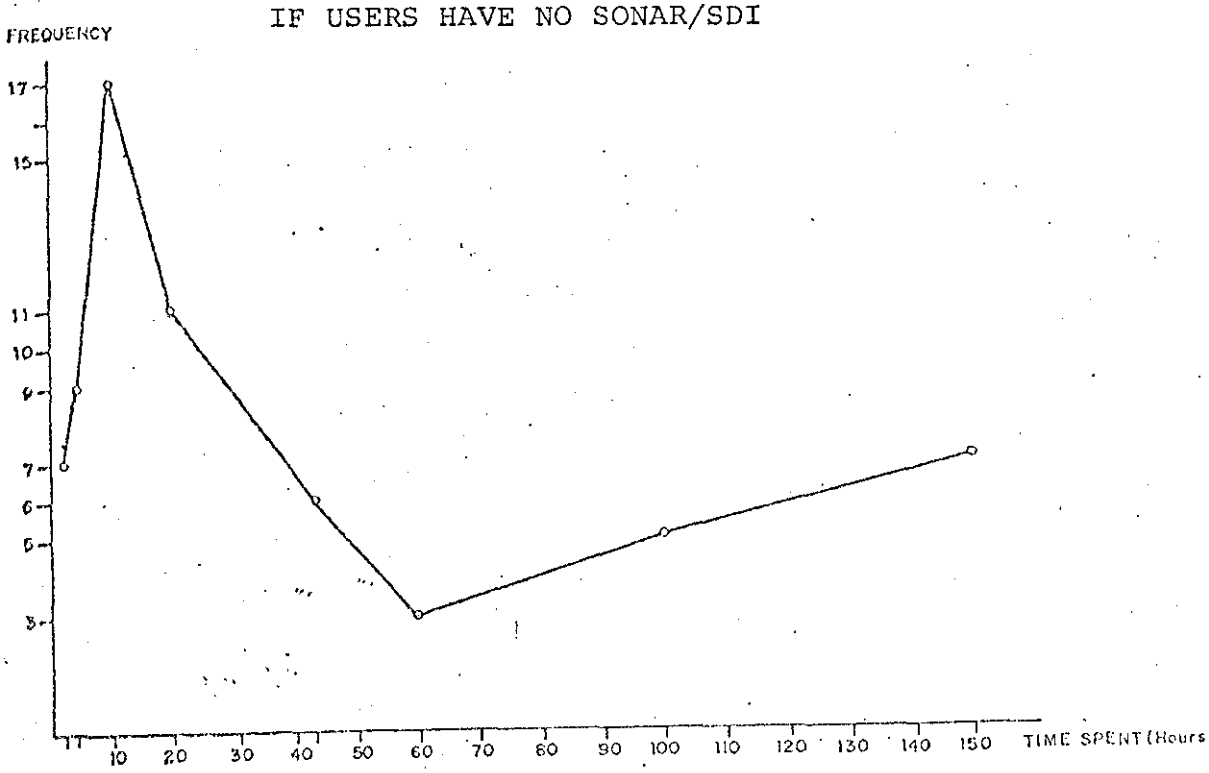
Source: Data collected by the researcher in Brazil, 1979
Note: Includes 85 observations (38 missing cases)

FIGURE: 19 FREQUENCY DISTRIBUITION OF TOTAL MONTHLY AVERAGE WORKING HOURS HAVING SONAR/SDI



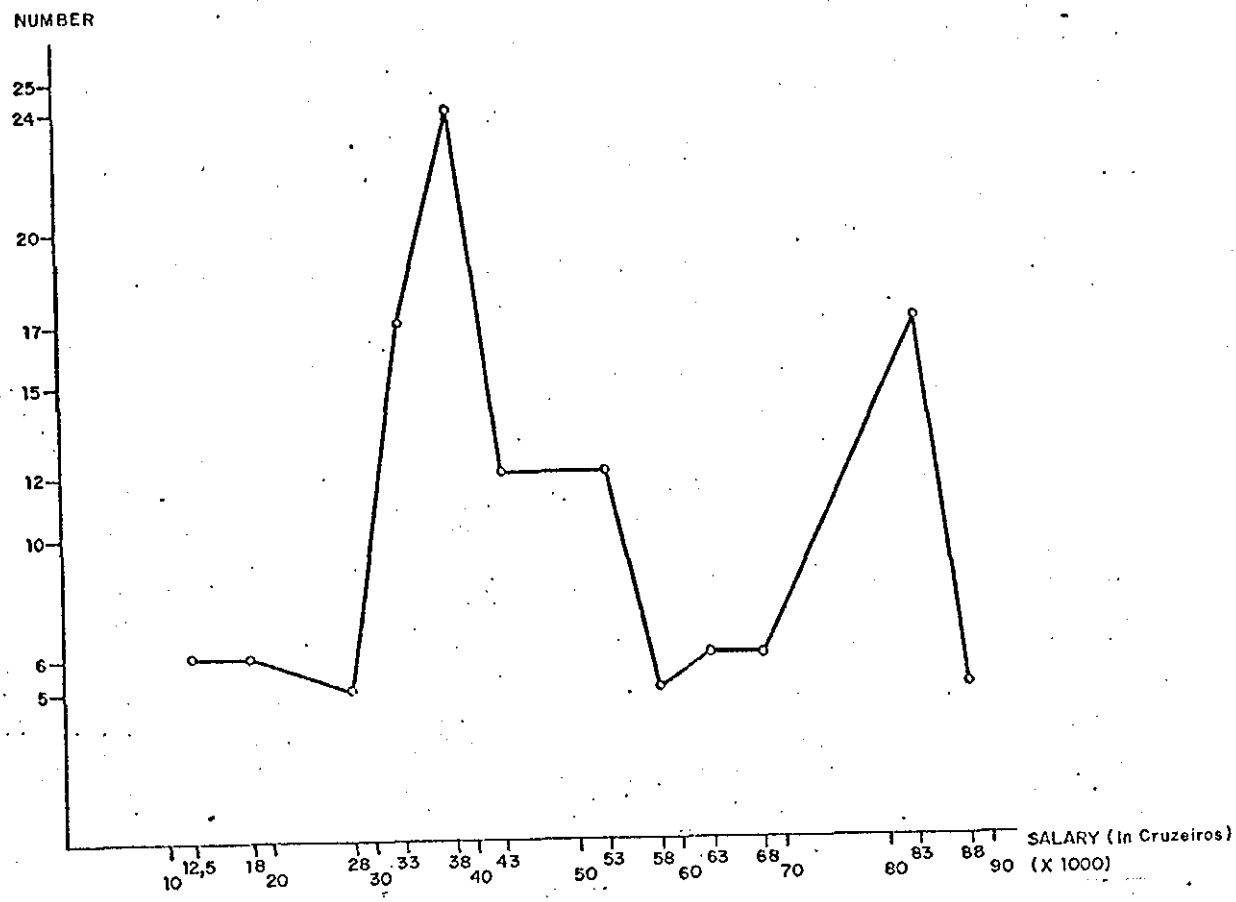
Source: Data collected by the researcher in Brazil, 1979
Note: Includes 117 observations (6 missing cases)

FIGURE: 20 FREQUENCY DISTRIBUTION OF ESTIMATED MONTHLY AVERAGE HOURS INCREASE IN TOTAL R & D WORK IF USERS HAVE NO SONAR/SDI



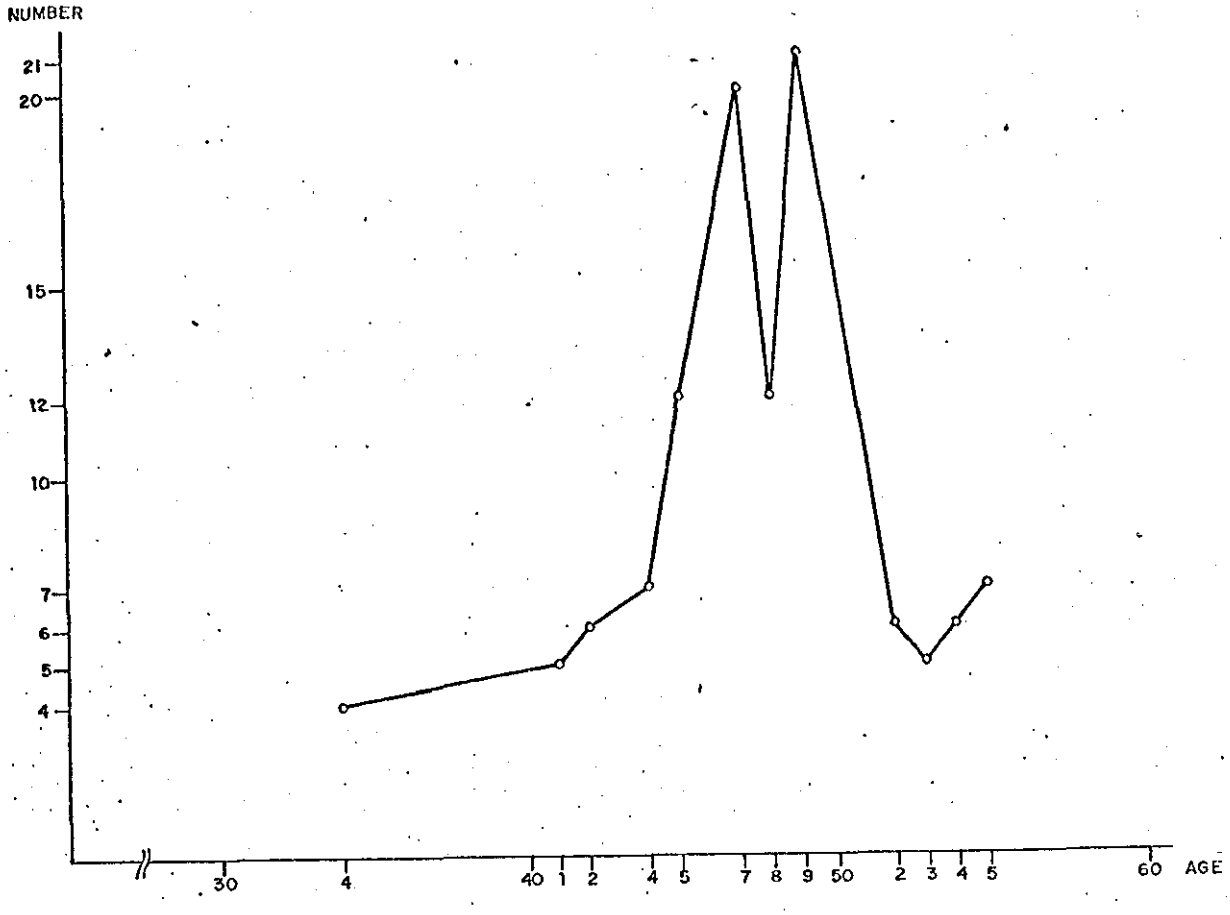
Source: Data collected by the researcher in Brazil, 1979
Note: Includes 65 observations (58 missing cases)

FIGURE: 21 DISTRIBUITION OF SALARY



Source: Data collected by the researcher in Brazil, 1979

FIGURE: 22 AGE OF RESPONDENTS



Source: Data collected by the researcher in Brazil, 1979

TABLE 10: PERCENTAGE OF RESPONDENTS BY DIFFICULTY OF OBTAINING DOCUMENTS

LEVEL OF DIFFICULTY	PERCENTAGE OF RESPONDENTS TOTAL (123) %
WITHOUT DIFFICULT	22.0
SOME DIFFICULTY	57.0
FAIRLY DIFFICULT	17.0
VERY DIFFICULT	4.0

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 11: PERCENTAGE OF RESPONDENTS BY DIFFICULTY OF OBTAINING SOME SORT OF DOCUMENTS

	TOTAL (123)	
	T	%
THESIS	80	65.0
TECHNICAL REPORT	55	43.9
PERIODICAL ARTICLES	48	39.0
BOOKS	35	28.5

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 12: PERCENTAGE OF RESPONDENTS HAVING ALL SORT OF DIFFICULTIES AT WORK

	TOTAL (123)	
	T	%
PREPARING REPORT OR ARTICLE	75	61.0
PREPARING FIGURES AND TABLES	27	22.0
PROBLEM SOLVING	59	48.0
CRITICISM OF OWN WORK	59	48.0

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 13: PERCENTAGE OF RESPONDENTS OF PREFERRED WAY OF RECEIVING INFORMATION

	PERCENTAGE OF RESPONDENTS TOTAL	
	T	%
NEW TITLES LIST	32	26.0
ALERTING SERVICE	24	19.5
SONAR/SDI	25	20.3
ABSTRACTING SERVICE ONLY	25	20.3
ABSTRACTING IN SCIENTIFIC ASSOCIATION BULLETINS	18	14.6

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 14: PERCENTAGE OF RESPONDENTS OF PREFERRED SOURCES OF INFORMATION USED

SOURCES OF INFORMATION USED	PERCENTAGE OF RESPONDENTS TOTAL (123)	
	T	%
LIBRARIES	119	96.7
SONAR/SDI	112	91.1
COLLEAGUES WITHIN ORGANISATION	96	78.0
PERSONAL FILE	91	74.0
OTHER PROFISSIONALS OUTSIDE ORGANISATION	64	52.0
PHONE CALL OR WRITING	64	52.0

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 15: PERCENTAGE OF RESPONDENTS THAT KEEPS UP-TO-DATE THROUGH THE USE OF SONAR/SDI

KEEPS UP-TO-DATE	PERCENTAGE OF RESPONDENTS TOTAL (123)	
	T	%
IN PART	32	26.0
COMPLETELY	27	22.0
NOT INFORMED	64	52.0

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 16: PERCENTAGE OF RESPONDENTS USING OTHER SOURCES OF INFORMATION

SOURCES	DO NOT USE TOTAL (123)	
	T	%
EXCERPTA MEDICA	123	100
INDEX MEDICUS	119	96
PHYSICS ABSTRACTS	96	78
CHEMICAL ABSTRACTS	75	61
ENGINEERING INDEX	75	61
PERIODICAL INDEXES IN A MANUAL FORM	70	56.9

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 17: PERCENTAGE OF RESPONDENTS EVALUATING SONAR/SDI PERFORMANCE

	TOTAL (123)
BAD PERFORMANCE	5.0
NOT BAD PERFORMANCE	14.0
MEAN PERFORMANCE	18.0
FAIR PERFORMANCE	41.0
GOOD PERFORMANCE	22.0
TOTAL	100.0

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 18: PERCENTAGE OF RESPONDENTS HAVING DIFFICULTIES WITH SONAR/SDI

DIFFICULTIES WITH THE SONAR/SDI	PERCENTAGE OF RESPODENTS TOTAL (123) %
LANGUAGE OF PAPERS QUITE UNFAMILIAR	25
DIFFICULTY IN GETTING DOCUMENTS REFERENCED BY THE SERVICE	16
TOO SMALL NUMBER OF REFERENCES RECEIVED	16
OTHER PROBLEMS NOT IDENTIFIED	16
DIFFICULTY WHEN FILLING OUT USER'S PROFILE FORM	17
RECEIVING REFERENCES WITHOUT INTEREST	3
DIFFICULTY WHEN FILLING AN ANSWER CARD	5
RECEIVED TOO MUCH REFERENCES	2

SOURCES: Data collected by the researcher in Brazil, 1979.

TABLE 19: PERCENTAGE OF RESPONDENTS WITH WAY KNEW SONAR/SDI

WAY KNEW SONAR/SDI		PERCENTAGE OF RESPONDENTS TOTAL (123) %
THROUGH	CIN/CNEN PUBLICITY	38
THROUGH	OTHER COLLEAGUES	36
THROUGH	SPECIALISED LIBRARIES	13
THROUGH	ANOTHER INFORMATION CENTRE	9
THROUGH	ANOTHER UNIDENTIFIED SOURCE	4

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 20: PERCENTAGE OF RESPONDENTS IN WAYS OF ADVERTISING SONAR/SDI

BEST WAYS ADVERTISING SONAR/SDI ACCORDING TO USERS' OPINION	PERCENTAGE OF RESPONDENTS TOTAL (123) %
SPEECHES IN ALL INSTITUTIONS THAT USE THE SERVICE	34
ADVERTISING IN SCIENTIFIC BULLETINS	31
STANDS IN SCIENTIFIC CONFERENCES	10
SPEECHES IN CIN/CNEN	12
OTHER WAYS NOT INDENFIED	9
ANNOUNCEMENTS IN SCIENTIFIC NEWSPAPER	4

SOURCE: Data collected by the researcher in Brazilm 1979.

TABLE 21: PERCENTAGE OF RESPONDENTS BY CATEGORY LABEL OF INIS THESAURUS

CATEGORY LABEL	TOTAL (1562) %
B 31 LAND	26.6
B 16 FUEL PROCESSING AND REPRODUCTION	17.0
E 22 REACTOR COMPONENTS	16.0
E 11 THERMODINAMICS OF FLUIDS	15.0
E 23 REACTOR OF FUELS	13.0
E 13 STRUCTURE EQUIPMENTS	13.0

SOURCE: Data collected by researcher in Brazil, 1979.

TABLE 22: WAYS OF GATHERING INFORMATION

	PERCENTAGE OF RESPONDENTS ANSWERING VERY USEFUL	
	TOTAL (123)	
	T	%
USING SONAR/SDI FROM CIN/CNEN	96	78.0
CITATION IN PERIODICAL ARTICLES	91	74.0
USING AN SPECIALISED BIBLIOGRAPHY	89	72.4
USING BOOKS AND MONOGRAPHIES	64	52.0
WRITING TO OTHER PROFESSIONALS	48	39.0
USING A PERSONAL FILE	48	39.0
USING LIBRARY WITHING ORGANISATION	48	39.0
READING PUBLIC REPORTS FROM OWN ORGANISATION	48	39.0
USING INFORMAL COMMUNICATION	37	30.0
INDICATIONS FROM THE LIBRARIAN	37	30.0
USING ABSTRACT PERIODICALS	32	26.0
USING PERIODICAL INDEXES	32	26.0
INDICATIONS FROM AN INFORMATION SPECIALIST	21	17.0
USING TRADE LETERATURE	21	17.0

SOURCE: Date collected by researcher in Brazil, 1979.

TABLE 23: FREQUENCY DISTRIBUITION OF PREFERRED ALTERNATIVE WAYS OF GATHERING INFORMATION

PREFERENCE	FREQUENCY
CIN/CNEN INFORMATION SERVICE	111
LIBRARY WHITIN ORGANISATION	107
PERIODICALS SUBSCRIBED BY ORGANISATION	88
LIBRARY OUTSIDE ORGANISATION	71
CORRESPONDENCE	67
PERSONAL AND TELEPHONE CONTACT	59
ATOMINDEX	51
GOVERNMENTAL PUBLICATIONS	24
OTHER ALTERNATIVE	19

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 24: INFORMATION SERVICE CHARACTERISTICS IN RELATION TO SCIENTISTS' SATISFACTION

CHARACTERISTIC	PERCENTAGE OF RESPONDENTS ANSWERING VERY IMPORTANT													
	TOTAL (123)													
	SONAR/SDI		LIBRARY IN		LIBRARY OUT		PERIODICALS		GOVERNMENT PUB.		PERSONAL COMMUN.		CORRESPONDENCE	
	T	%	T	%	T	%	T	%	T	%	T	%	T	%
SPEED	59	48.0	76	61.8	22	17.9	32	26.0	87	7.0	54	43.9	34	27.6
COVERAGE	50	40.7	78	63.4	33	26.8	82	66.7	87	7.0	23	18.7	55	44.7
RELEVANCE TO NEED	86	69.9	76	61.8	49	39.8	89	72.4	17	13.8	20	16.3	27	22.0
ADDITIONAL SERVICES	16	13.0	55	44.7	25	20.3	15	12.2	18	14.6	18	14.6	69	5.6
COST	48	39.0	50	40.7	54	43.9	34	27.6	23	18.7	32	26.0	69	5.6
SATISFACTION INFORM. RECEIVED	43	35.0	64	52.0	33	26.8	34	27.6	18	14.6	54	43.9	53	4.3
ACCESSIBILITY	82	66.7	11	89.0	16	13.0	40	32.5	18	14.6	54	43.9	117	95.1
INFORMATION PRESENTATION	67	54.5	65	52.8	33	26.8	55	44.7	87	7.0	55	44.7	55	44.7

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 25: NUMBER OF PAPERS MONTHLY READ DISTRIBUTED BY PERCENTAGE OF WORK TIME ACTIVITY (PART I)

N. OF PAPERS	PURE RESEARCH % 0-20	% 21-40	TOTAL (123) %	APPLIED RESEARCH % 0-20	% 21-40	% 41-60	TOTAL (123) %	TEACHING % 0-20	% 21-40	% 41-60	TOTAL (123) %	ADMINISTRATIVE % 0-20	% 21-40	% 41-60	TOTAL (123) %
0-5	21.7	8.8	30.5	21.7	4.5	4.5	30.5	21.7	9.9	-	31.5	26.2	-	4.3	30.5
6-10	43.5	-	43.5	17.4	13.0	13.0	43.5	34.8	7.6	0.1	42.5	34.8	8.7	-	43.5
11-15	21.7	-	21.7	13.0	8.7	-	21.7	21.7	-	-	21.7	21.7	-	-	21.7
more than 30	4.3	-	4.3	-	4.3	-	4.3	4.3	-	-	4.3	4.3	-	-	4.3
MISSING OBSERVATIONS	8.8	91.2	-	52.1	30.3	17.6	-	17.5	82.5	-	-	13.0	91.3	95.7	-

SOURCE: Data colleted by the researcher in Brazil, 1979.

TABLE 25: (PART II)

N. OF PAPERS BY RANGE	PROJECT % 0-20	% 21-40	% 41-60	% 81-100	TOTAL (123) %	TECHNICAL % 0-20	SUPERVISION % 21-40	TOTAL (123) %	FIELD WORK % 0-20	% 21-40	% 41-60	% 61-80	% 81-100	TOTAL (123) %	OTHER % 0-20	% 41-60	TOTAL (123) %
0-5	30.4	-	-	-	30.4	26.1	4.3	30.4	13.3	4.3	4.3	4.3	4.3	30.5	30.4	-	30.4
6-10	34.8	4.3	4.3	-	43.4	43.5	-	43.5	34.8	8.7	-	-	-	43.5	43.5	-	43.5
11-15	8.7	8.7	-	4.3	21.7	17.4	4.3	21.7	21.7	-	-	-	-	21.7	17.4	8.7	26.1
MORE THAN 30	4.2	-	-	-	4.3	4.4	-	4.4	4.3	-	-	-	-	4.3	4.3	-	-
MISSING OBSERVATIONS	21.9	87.0	95.7	95.7		8.6	91.4	25.9	99.8						4.4		

TABLE 26: FREQUENCY DISTRIBUTION OF AVERAGE TIME SPENT MONTHLY IN READING

TIME SPENT	FREQUENCY
2	5
4	2
5	6
8	5
10	25
12	7
15	6
20	15
30	14
33	5
40	5
45	6
50	9
70	7
120	6
TOTAL	123

MEAN	28.675	SKEWNESS	1.909
MODE	10.000	MAXIMUM	120.000
KURTOSIS	3.793	MEDIAN	19.867
MINIMUM	2.000	VARIANCE	751.139
STD ERR	2.471	RANGE	118.000
STD DEV	27.407		

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 27: FREQUENCY DISTRIBUTION OF AVERAGE HOURS DEVOTED MONTHLY TO INFORMATION SEARCH WITH SONAR/SDI

TIME SPENT	FREQUENCY
2	7
4	5
5	38
8	6
10	25
12	7
20	9
24	6
30	13
50	7
TOTAL	123

MEAN	13.577	SKEWNESS	1.618
MODE	5.000	MAXIMUM	50.000
KURTOSIS	2.050	MEDIAN	9.720
MINIMUM	2.000	VARIANCE	151.902
STD ERR	1.111	RANGE	48.000
STD DEV	12.325		

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 28: FREQUENCY DISTRIBUTION OF AVERAGE TIME SPENT MONTHLY TO ORGANISE INFORMATION RECEIVED FROM SONAR/SDI - CIN/CNEN

TIME SPENT	FREQUENCY
1	21
2	42
4	12
5	20
8	6
10	22
TOTAL	123

MEAN	4.236	SKEWNESS	0.846
MODE	2.000	MAXIMUM	10.000
KURTOSIS	-0.740	MEDIAN	2.464
MINIMUM	1.000	VARIANCE	10.313
STD ERR	0.290	RANGE	9.000
STD DEV	3.211		

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 29: FREQUENCY DISTRIBUTION OF ESTIMATED MONTHLY AVERAGE HOURS WHICH WOULD BE DEVOTED TO INFORMATION SEARCH IF SONAR/SDI IF NOT AVAILABLE.

TIME SPENT	FREQUENCY
2	11
4	5
5	5
6	5
8	13
10	7
20	11
30	5
40	3
43	6
45	7
50	7
0	38
TOTAL	123

MEAN	19.812	SKEWNESS	0.638
MODE	8.000	MAXIMUM	50.000
KURTOSIS	-1.232	MEDIAN	10.000
MINIMUM	2.000	VARIANCE	298.417
STD ERR	1.874	RANGE	48.000
STD DEV	17.275		

SOURCE: Data collected by the research in Brazil, 1979

NOTE: Includes 85 observations (38 missing cases).

TABLE 30: FREQUENCY DISTRIBUTION OF ESTIMATED TOTAL MONTHLY AVERAGE WORKING HOURS

CODE	FREQUENCY
45	5
60	7
140	11
160	15
165	5
176	5
180	17
200	23
216	7
240	6
250	7
260	2
800	7
TOTAL	117

MEAN	211.726	SKEWNESS	3.078
MODE	200.000	MAXIMUM	800.000
KURTOSIS	9.414	MEDIAN	180.471
MINIMUM	45.000	VARIANCE	24799.425
STD ERR	14.559	RANGE	755.000
STD DEV	157.478		

SOURCE: Data collected by the researcher in Brazil, 1979.

NOTE: Includes 117 observations (6 missing cases)

TABLE 31: FREQUENCY DISTRIBUTION OF ESTIMATED MONTHLY AVERAGE HOURS INCREASE IN TOTAL R & D WORK IF USERS HAVE NO SONAR/SDI

TIME SPENT	FREQUENCY
2	7
4	9
10	17
20	11
43	6
60	3
100	5
150	7
TOTAL	65

MEAN	37.354	SKEWNESS	1.529
MODE	10.000	MAXIMUM	150.000
KURTOSIS	0.993	MEDIAN	10.941
MINIMUM	2.000	VARIANCE	2265.170
STD ERR	5.903	RANGE	148.000
STD DEV	47.594		

SOURCE: Data collected by the researcher in Brazil, 1979.

NOTE: Includes 65 observations (58 missing cases).

TABLE 32: SALARY OF RESPONDENTS

CODE	FREQUENCY
12500	6
18000	6
28000	5
33000	17
38000	24
43000	12
53000	12
58000	5
63000	7
68000	7
83000	17
88000	5
TOTAL	123

MEAN	48829.268	SKEWNESS	0.382
MODE	38000.000	MAXIMUM	88000.000
KURTOSIS	-0.802	MEDIAN	41958.333
MINIMUM	12500.000	VARIANCE	*********
STD ERR	1921.454	RANGE	75500.000
STD DEV	21309.952		

SOURCE: Data collected by the researcher in Brazil, 1979

TABLE 33: AGE OF RESPONDENTS

CODE	FREQUENCY
34	4
41	5
42	6
44	7
45	12
47	20
48	12
49	21
52	6
53	5
54	6
55	7
0	12
TOTAL	111

MEAN	47.495	SKEWNESS	-0.659
MODE	49.000	MAXIMUM	55.000
KURTOSIS	1.216	MEDIAN	47.625
MINIMUM	34.000	VARIANCE	20.525
STD ERR	0.430	RANGE	21.000
STD DEV	4.530		

SOURCE: Data collected by the researcher in Brazil, 1979.

6.2 STATISTICAL ANALYSIS

The researcher considered the existence of functional relations among variables as hypothesis, to be modeled and analysed from the point of view of the linear regression model. The results obtained will be discussed below.

Variables studied:

. Salary and years of experience

. Years of experience and age

. Supply and demand

. Willingness to pay and supply

. Willingness to pay with years of experience and age

. Willingness to pay with salary and age

The hypothesis that salary is dependent upon years of experience is supported. The correlation coeficient between the variable V60 salary and the variable V59 years of experience is 0.77997. The variation of V60 is explained in 60% through V59. Salary shows a positive dependency in relation to years of experience. These results are explained by the adoption of some of the employment policies of Brazilian enterprises in recent years. These policies are based on parameters such as fixation of salary level according to the academic background and professional experience. Actually, it is largely assumed the need to have a post-graduate course and previous experience in order to obtain a good job in Brazil.

The regression equation is:

$$V60 = 23613.58 + 2483.804\ V\ 59 \qquad R^2 = 0.60835$$

The regression conducted for the hypothesis that the number of years of experience among CIN users is dependent upon

age was shown to be unsupported. The correlation coeficient was 0.60640 and the coeficient of determination was very low. The establishment of a linear model to explain the relation was not possible because $R^2 = 0.36772$. As it may be observed there is no correlation between age and years of experience. This results is probably due to a mean of 32 years of age with no correspondence of salary increase with age.

The correlation coeficient between the variable V61 supply and the variable V62 demand is 0.89234. The supply of information is a function of the demand, so that V61 is explained in 79% through V62 as has been proved with the linear model designed by the researcher, where the coeficient of determination is $R^2 = 0.79628$, indicating that the variation observed in the supply of information is highly significant in relation to the demand for information. The regression equation is V61 = 3.346528 + 0.693659 V62.

These results show that the supply of information is dependent on the demand for information. The above results allows the researcher to assure that the SONAR/SDI system responds very well to the demand for information. In the cases where the demand increases the regressive model shows the correspondent behaviour for the supply of information. That is to say that when the demand increases, the supply increases too.

The hypothesis that the supply of information is dependent upon the demand for it shows that dependency is perfectly supported.

The hypothesis that the willingness to pay is dependent upon the supply follows. The correlation coeficient between the variable V52 and the variable V61 is 0.75901. The supply of information as a function of the consumer willingness

to pay is explained in 57%, indicating that the linear model exists as may be shown in the following regression equation:

$$V52 = -1570.000 + 233.7500\ V61 \qquad R^2 = 0.57609$$

In 75% of cases the WTP maybe explained through the supply of information. These results means that the guarantee in the supply of information causes the WTP among nuclear researchers.

Two other regressions were conducted for the hypothesis that the willingness to pay is dependent upon years of experience and age on one side and upon salary and age on other hand.

The first regression was conducted for the hypothesis that the WTP is dependent upon years of experience and age. The results showed such a hypothesis to be unsupported: the correlation and the coeficient of determination were low. The variation of V52 is explained in only .06% when used with a simple linear model with V59. When used in the multiple linear model with V59 and V58, V52 is explained in 18% through V58 and V59.

If the multiple correlation of the WTP is considered it shows a coeficient equal to 0.42. The establishment of a linear model to explain the relation has not been possible since $R^2 = 0.18176$ in the multiple regression.

The second regression was conducted for the hypothesis that the WTP is dependent upon salary and age. The results

showed such a hypothesis also to be unsupported: the correlation coeficient and the coeficient of determination were low. The variation of V52 is explained only in 0.06%. When used in a simple linear model with V60. When used in a multiple linear model with V60 and V58, V52 is explained in 12% through V60 and V58. The non-existent dependence among WTP, years of experience, age and salary is probably due to the lack of information infrastructure, library use tradition in the country and academic background and professional experience of nuclear researchers in Brazil. There is a trend with the Brazilian researcher to have their own private library once they do not know or trust other libraries; they do not have the notion of information costing, except for private book acquisition. The idea of information as an indirect salary is never thought of and it causes a misjudgement of the role of a library within an organisation.

If the multiple correlation of the WTP is considered it shows a coeficient equal to 0.34.

The establishment of a linear model to explain the relation was not possible since $R^2 = 0.12154$ in the multiple regression. The researcher tested the independence among some variables.

The Chi-square text was used to determine the existence, or not, of dependence among variables (V52, V58, V59, V60, V61, V62).

The tests applied showed that there was no dependence among the referred variables at any level of significance. (see tables 34-42).

The test has been applied to variables Custoso (cost of using SONAR/SDI) and Custnv (cost of searching information by own means). The results showed that the hypotheses Ho) $M_1 = M_2$ i.e. that Custuso = Custnv is unsupported at any level of significance once the t value = 6.27. So, Custnv is on the average significantly greater than Custuso. It may be concluded that the cost to search information without SONAR/SDI was much greater for CIN users. The number of hours saved monthly was estimated to be equal to 10h 58 minutes which is equivalent to 132 yearly hours saved. This time saved is equal to 16.5 days per year and approximately Cr$ 4.630,00 per user.

As it was not possible to create a supply curve in relation to a market price for SONAR/SDI Services, the researcher made an analysis of the mean X average values of the variables V61, V62 and V52 in relation to the cost to run the system.

The regression analysis of the function V52 = f (V62) showed the existence of some degree of explanation through the coeficient of determination R^2 = 0.57609 i.e., the variable V52 has its variation explained in 57% through the variable V61.

The effort to establish a supply function is limited because of the non-existent market price to be taken as a variable associated to CIN users.

6.3 COST ANALYSIS

It is usually very frustrating to know that something very important actually exists and it is out of reach. This is one of the serious problems SDI service users face when they

receive their printouts and are aware of the existence of important material in their subject areas without being able to get photocopies, or even the document they want to read.

For SDI services to be efficient it is necessary to provide a good document supply service to inform users about current material in their interest areas while simultaneously providing the users access to those documents (24)

Document supply can be obtained from different sources even if the SDI centre does not have the collection. At this point, the researcher refers again to one of the stages in the dissemination process that is the efficiency of the library. There is a serious inability of a great number of libraries to supply documents corresponding to listings present in SDI service printouts. When the library itself can not supply the information it should make use of loan systems among libraries in order to have the material available for researchers (25). Another source of bibliographic material is the British Library Lending Division - BLLD, Boston Spa, England, that was designed for the purpose of supplying photocopies of material of interest to other libraries. Thirty percent of this service is utilised by subscribers from countries outside of Europe. Other countries, like the United States for instance, have been undertaking studies aiming at developing this same kind of service that will perform the same functions either through a national centre or through several local centres.

Libraries or even individual users should try the national libraries in several countries such as the Library of Congress, the National Agricultural Library - NAL, the National Library of Medicine in the United States - NLM and the British Library among others in order to get the needed information.

Another resource would be to count on intitutions that can supply the information, but only in microform; this however, will depend on the users' attitude regarding the use of this kind of material since all studies done until today have revealed a number of controversies and opinions for and against the use of microforms. Nevertheless if there are microform readers and printers of good quality and in quantity enough to allow a number of people to make use of them, there are several advantages to using microforms. These include completing collections saving space for storage, lowering acquisition cost as microforms are cheaper than printed material and more easily reproduced.

If users are unable to get the desired material after having tried all possible ways, they may feel frustracted and probably think it useless to be aware of important material when it is not possible to acquire it.

The researcher set up data on the supply of documents to CIN/CNEN users in Brazil and abroad obtaining the data shown in tables 43 and 44.

The 65.9% of requests supplied from England may be explained by the level of importance given to information in that country as well as to the existence of a centralised system such the one in Boston SPa, the BLLD. On the other hand the 11.5% from Germany may be explained by the existing German-Brazilian Nuclear Agreement and the 11.6% from Austria is due to the headquaters of INIS system being in the IAEA in Viena.

The average answering rate of Brazil is 35.8 days, for foreign countries is 76.5 days. These rates must decrease once there is a project to provide periodical acquisition for the titles with a higher request frequency in the CIN. Those titles with less demand will still be requested from other information centres or libraries through the use of union catalogues.

The supply of information received through SONAR/SDI is 9.45 papers per month on the average while the demand is for an average of 9.09 papers per month; the supply is greater than demand (tables 45-46). The number of hardcopies per title request demanded by users was 37.290 in 1979 resulting in a real individual demand equal to 23.8 papers per month

considering that CIN has 1562 users and 1.01 requested papers per printout.

A rather important consideration when operating a SDI service is its cost distribution. This consideration can be approached in several ways by the different current services (26). Some persons think that as the SDI is an extension of library reference services it should be free for users; others think it is important to put aside any ideas about sales being not welcome and thus SDI services should be commercialised (27).

The fact is that SDI services normally are sold in the form of yearly subscriptions. One difference among SDI services is that some are supported by governmental agreements or belong to the government, and so are not designed to be profit making. Other services belong to private institutions which are naturally profit oriented, charging more for their services than governmental organisations do.

SDI services charge users in different ways. Some charge a fixed yearly fee, limiting the number of references the users receive and most of them charge according to the number of data bases the users want. Still others charge according to the number of keywords or terms in the profiles, and some accept a number of terms requested by users.

Another approach takes into consideration the various types of costs the service operation has as well as to what extent it is possible to maintain an SDI service, or to take part in such a service.

In an SDI service, costs can be divided into several components. Such costs include the cost of magnetic tape producing or leasing; of their reformulation; of computer time searching; of printing documents: of personnel salaries; of profile maintenance; of material and mail delivery and so on (26) (28).

The establishment of an SDI service should only be considered feasible and economical when the number of profiles is above 50 or when the terms used are above 600 (29). Even so, this will depend on the type of available computer facilities, as well as on ease of access to such facilities.

In discussing SDI services all points that make them successful, as well as their cost should be considered. When we consider the exponential development of world literature, the decrease in computer prices and the increase of manpower cost, the time saved by scientists when reading literature existing in their research fields, the wide coverage inherent to any data base, we can state that total cost decrease is probably the dominant factor causing the high acceptance of SDI services on the part of users.

Considering all the SDI service advantages already mentioned, it may be inferred that such type of service is justifiable both in terms of real cost and effective cost. This is true when beginning with a solid profile construction, an accurate choice of data bases and a good search program. Cost-effectiveness of the service then becomes inherent since the final result will answer the users' needs in the best possible way (30).

After establishing SDI services utilisation and effectiveness, there still exist some factors that will reduce their cost. In addition to individual profiles, almost all SDI services provide profiles stardardised in the subject areas considered important by the centres. Users can participate in this kind of alert service which is cheaper then individual profiles since it is a pre-established operation and users don't take part in the profile elaboration process (12). A similar way of reducing costs is to make group profiles which are normally formed by a number of scientists in the same researcher area. This makes the profile consistent to the

scientists' interest. In addition the users share the cost of only one profile.

Taking into account all the aspects of SDI service costs, it seems clear that such services have already proven to be cost-effective (31). However only a minority of the world's scientists take advantage of such services (24).

A detailed theoretical approach on costs and benefits was examined in Chapter 5 taking into account that:

a. The objective of cost-benefit analysis is to guide the decision maker in the choice of capital projects and expenditures which maximise the gains for social welfare;

b. social welfare is related to some aggregation of individual preferences, represented by the individuals willingness to pay - WTP for commodities;

c. market prices play a central part in the valuation of benefits.

The researcher therefore was unable to apply a rigorous cost-benefit analysis in the study. The private sector of the economy in Brazil did not produce an SDI system in nuclear energy. As a result the government took the initiative and created the SDI service of the CIN/CNEN. Therefore the SDI service of the CIN/CNEN is a case of an externality which is subject to government intervention.

Considering that information is an output that is not always sold in the market, there is no observable price, but there is a shadow price since each must have an opportunity cost

in terms of some foregone alternative. As there is no market price for the SDI service of the CIN/CNEN, the researcher attempted to place a monetary value on the CIN users time taking part of the scientist's salary attributable to R & D work, and use of information as an appropriate measure. Nevertheless, since there was an absence of observable prices, many external effects problems arose such as the issue of placing a value on intangibles, which is one of the most controversial matter in cost-benefit analysis. The researcher adopted surrogate prices by finding out what users would be willing to pay for the SDI service of the CIN/CNEN.

In the following pages the researcher will treat the results obtained from the above approach.

The WTP for SONAR/SDI has a mean of Cr$ 1.387,50 * cruzeiros per month which would mean Cr$ 16.650,00 per year (see table 47).

The WTP of Cr$ 16.650,00 is 412% greater than the average cost/user per year in terms of 1562 users at the CIN/CNEN. (see table 49)

The mean of Cr$ 585,42 cruzeiros per month is the amount of money that users withdrawn from SONAR/SDI would feel compensated for this loss (table 48). This amount compared with the real cost shows that at a production level of 36.888 printouts per year, user unit cost p.a. would be between Cr$ 227,73 and Cr$ 189,78.

The researcher studied costs in order to demonstrate the cost behaviour of SONAR/SDI of CIN/CNEN based on cost concepts stated in chapter 1 and 5. The cost aspects under consideration are total cost and unit cost in relation to the 1562 users receiving SONAR SDI from CIN/CNEN.

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* £1 = Cr$ 101,78 in December 1979.

Summarising cost behaviour it may be demonstrated in table 49 and through values of columns (2), (3) and (4) of the same table 49 the figure 23 illustrating the main conclusions that will follow. This figure allows the researcher to visualise the behaviour of cost curves according to the variation of the number of users per year. It may be seen that there is a great distance between fixed costs and variable costs determined by the characteristics of producing the SONAR/SDI and by the production structure adopted in CIN/CNEN in order to provide this information service.

Table 49 shows the simplified Total cost for each different level of users in the SONAR/SDI. Columns (1) and (4) are the crucial ones, showing that Total costs increase. This is normal because it takes more labour and factor inputs to produce more of a good, and these extra factors involve an extra money cost. It costs Cr$ 939.960,00 to provide the SONAR/SDI service to 1500 users who receive 3.000 printouts, 2000 users who receive 4000 printouts, and so forth.

Columns (2) and (3) break down Total cost into two components: total fixed costs and total variable costs. Fixed costs being the cost that is incurred independently of the output, it continues even with less than 300 users. According to Zais (32) fixed costs accounted for between 20% and 61% of total costs if a centre had more than 300 users.

In the period studied the SONAR/SDI from CIN/CNEN had 1562 users and the identified values may be seen at points A, A', A'' of figure 23 where A refers to the total cost of Cr$ 5.077.976,40, A' refers to the fixed cost of Cr$ 4.099.164,70 and A" refers to the variable cost of Cr$ 978.811,70. This variable cost is shown in column (3) of table 49. By definition variable cost begins at zero when quantity q is zero. It is the part of Total cost that

grows with output; indeed the jump in Total cost between any two outputs is the same as the jump in variable cost. This is due to fixed costs that remain constant at Cr$ 4.099.164,70 throughout and cancels out in any such comparison. At this level of service, fixed cost is 81% and variable cost is 19% of total costs.

In column (6) of table 49 average cost per user is given which is the total costs divided by the number of users.

$$\text{Average cost/user} = \frac{\text{Total cost}}{\text{output (users)}} = \frac{TC}{q} = AC$$

Note that average total cost falls lower and lower as the number of users increases. Average total costs is broken down into its two components, fixed and variable costs which were obtained by dividing each of the last (two) by the number of users, so average fixed cost, $AFC = \frac{FC}{n \text{ users}}$ and average variable cost $AVC = \frac{VC}{n \text{ users}}$.

Since total fixed cost is a constant, dividing it by n users gives a steadily falling average fixed cost curve in column (5) except for the AVC of column (6) that has a constant rate.

The behaviour of the rates observed in tables 50 and 51 allows the researcher to plot figure 24 with the various levels of rates studied in relation to the point of 300 users adopted in accord with the Zaiss (32) Statement mentioned in Chapter 5 on fixed cost and variable cost rates.

Table 50 presents cost variation rates observed from table 49 and from which may be inferred the rated at which the increase of users will cause a decreasing rate in total cost.

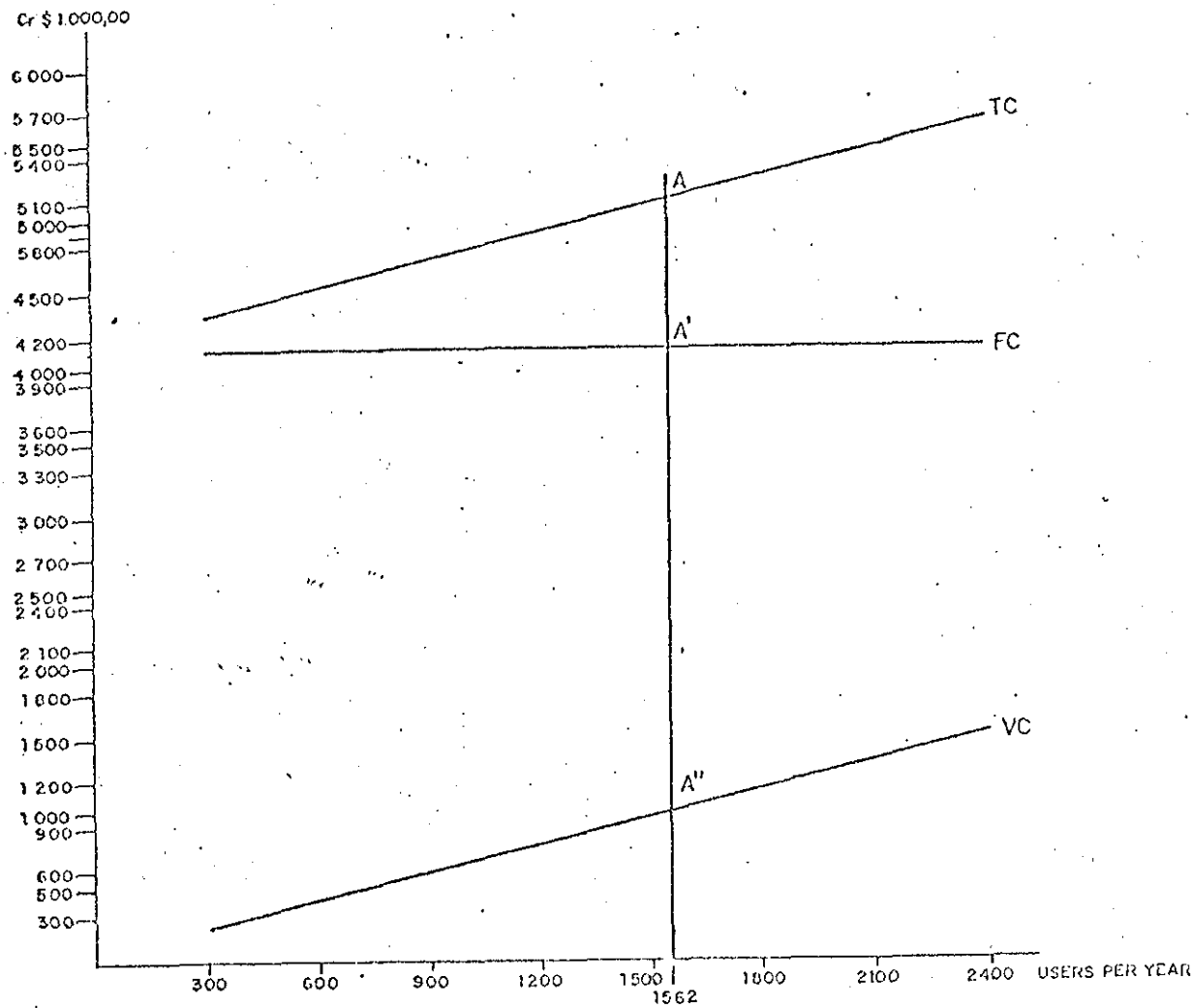
On the other hand the average fixed cost and the average total cost have their cost dilution rates indicating a cost decreasing behaviour and a trend to have a constant by decreasing rate as shown in table 51 and figure 25.

Fixed costs are high in relation to the total costs. This is due to the production structure of the CIN/CNEN that was designed to allow for a large increase of users. It is a purpose that this structure will allow the CIN/CNEN to obtain gains on a scale that will permit a large dilution of fixed costs. In figure 26 it may be observed that at the average point B of service, fixed costs represent 81% of total costs against 96% and 73% at points A and C of the scale. The relative weight of fixed costs in the production structure of the SONAR/SDI service decreases in relation to the total costs, as shown by a curve behaviour with an accentuated descending angle in figure 26. The 81% of total costs may be attributable to the 17% of system re-design, programming and operation. If this category of costs is not included, fixed cost would be approximately 64%. The variable costs appear to be increasing at a variable rate as the number of users and profiles in the SONAR/SDI system increase and are proportionally inferior to this increased rate, although its relative weight is rising when compared with total cost. The decline of the increasing rate of variable cost is very accentuated at the beginning of the scale and diminishes when there is an increment in the number of users, as shown in figure 27.

It is useful to break down Total cost into its fixed and variable cost components. Fixed costs cancel out of all decisions relevant to the period for which it is truly fixed. If long run planning is adopted and all fixed cost commitments terminated then CIN/CNEN will be able to feel free for the best choice for each level of output.

The results of the cost analysis are an attempt to provide practical help in the costing system. Most of this writing has been empirical in nature. As a result, not much of what has been published has been of real use for the cost analysis in the researcher's effort to learn what it really costs to run a selective dissemination system.

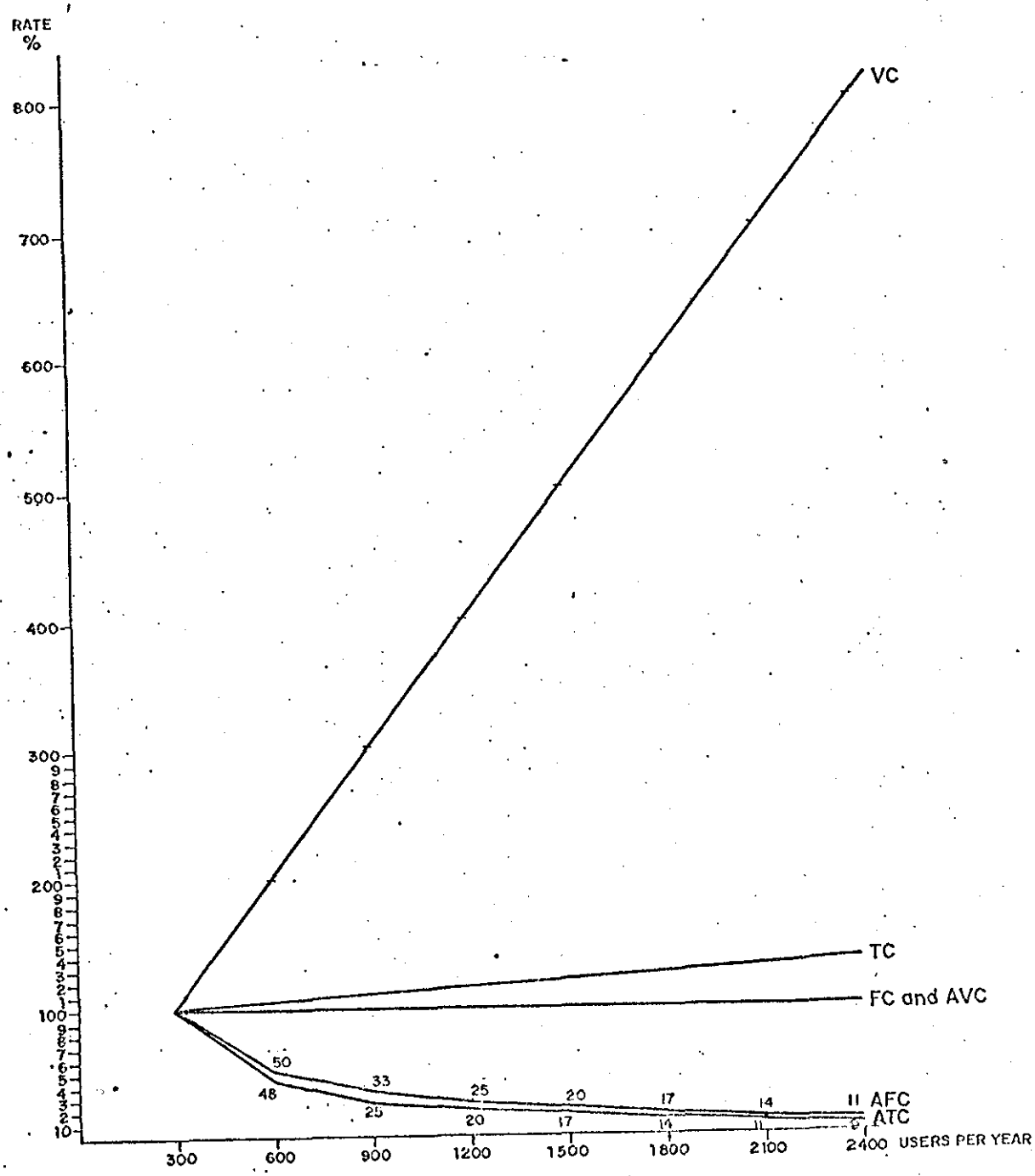
FIGURE 23 - TOTAL, FIXED AND VARIABLE COST



Source: Compiled by the researcher in Brazil, 1980

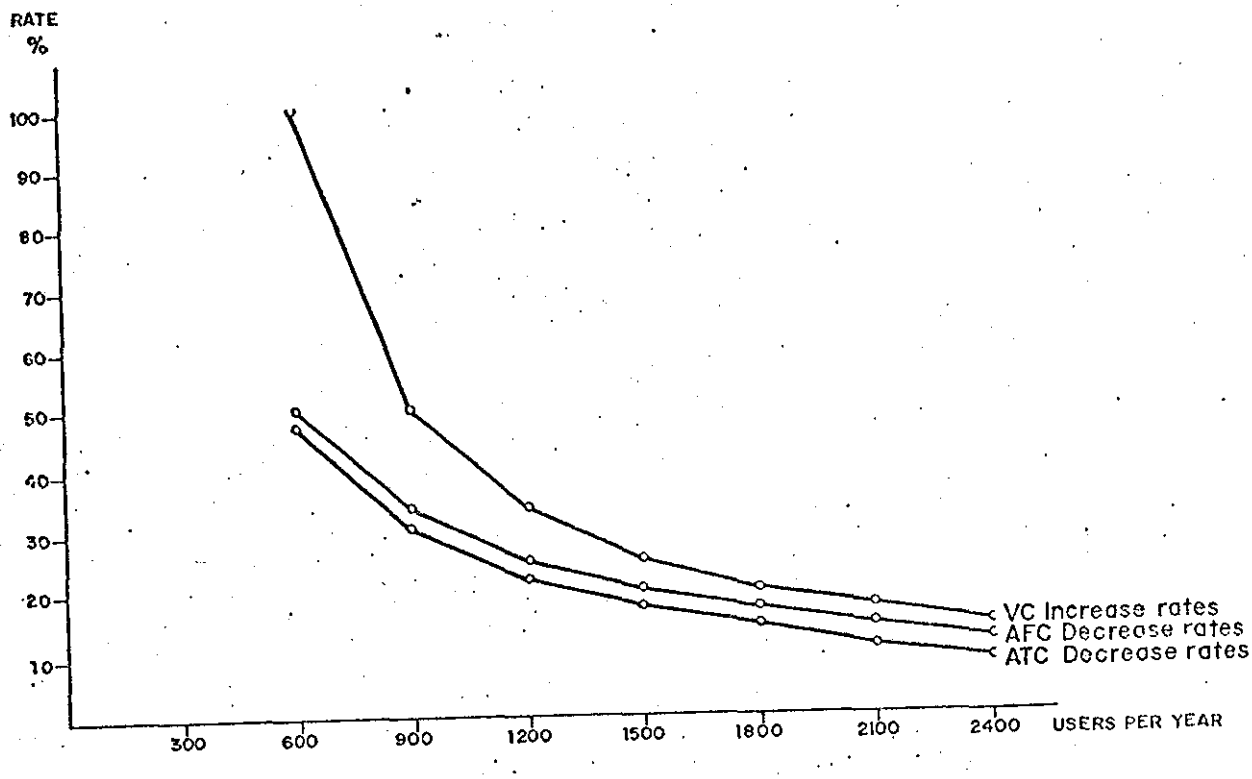
NOTE: See page 94 for information on system study.

FIGURE: 24 TOTAL COST, VARIABLE COST, FIXED COST AND AVERAGE COST RATES



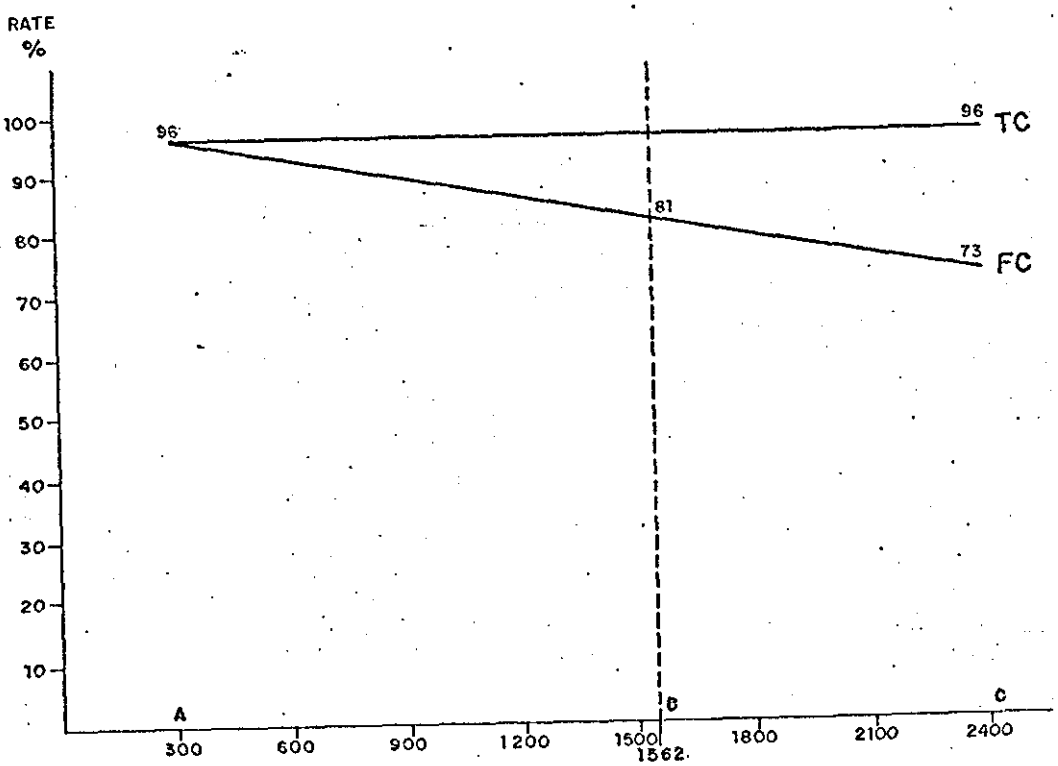
Source: Compiled by the researcher in Brazil, 1980

FIGURE: 25 INCREASE/DECREASE RATES OF AVERAGE COST



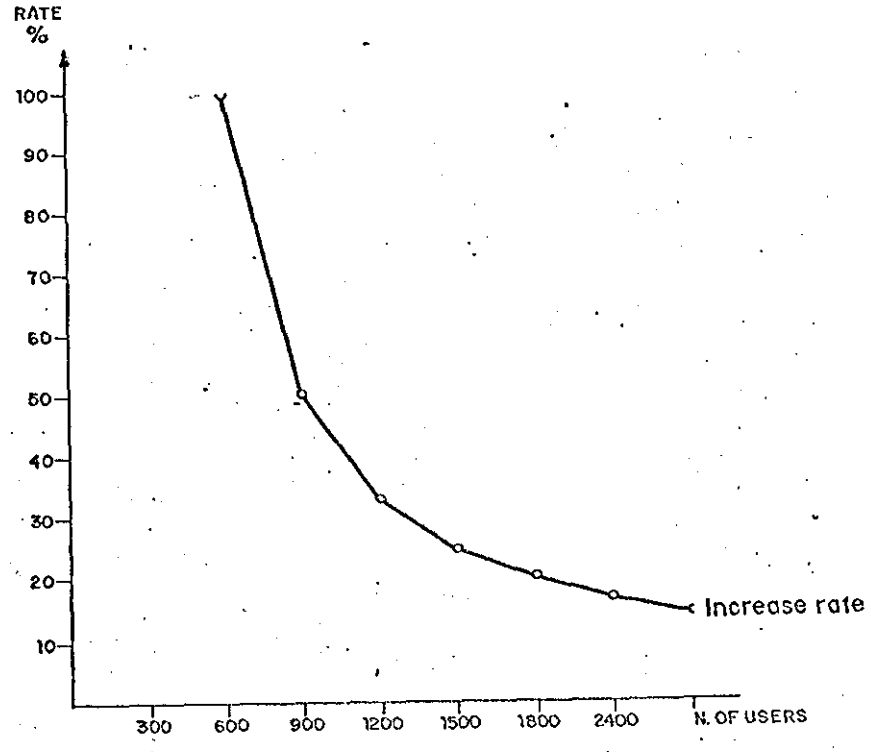
Source: Compiled by the researcher in Brazil, 1980

FIGURE: 26 TOTAL COST AND FIXED COST RATES



Source: Compiled by the researcher in Brazil, 1980

FIGURE: 27 INCREASE RATE OF VARIABLE COST



Source: Compiled by the researcher in Brazil, 1980

TABLE 34: CHI-SQUARE TEST - DEMAND FOR INFORMATION IN RELATION TO YEARS OF EXPERIENCE

	COUNT / % ROW / % COL / % TOT	V59 YEARS OF EXPERIENCE 4	8	13	19	ROW TOTAL
V62 DEMAND	3	25	0	5	0	30
		83.3	0.0	16.7	0.0	24.4
		47.2	0.0	20.8	0.0	
		20.3	0.0	4.1	0.0	
	8	10	23	19	5	57
		17.5	40.4	33.3	8.8	46.3
		18.9	62.2	79.2	55.6	
		8.1	18.7	15.4	4.1	
	13	12	14	0	4	30
		40.0	46.7	0.0	13.3	24.4
		22.8	37.8	0.0	44.4	
		9.8	11.4	0.0	3.3	
	33	6	0	0	0	6
		100.0	0.0	0.0	0.0	4.9
		11.3	0.0	0.0	0.0	
		4.9	0.0	0.0	0.0	
	COLUMN	53	37	24	9	123
	TOTAL	43.1	30.1	19.5	7.3	100.0

CHI SQUARE = 57.06790 WITH 9 DEGREES OF FREEDOM SIGNIFICANCE = 0.0000

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 35: CHI-SQUARE TEST - DEMAND FOR INFORMATION IN RELATION TO AGE

	COUNT % ROW % COL % TOT	V58 AGE 28	34	42	81	ROW TOTAL
V62 DEMAND	3	13 43.3 54.2 10.6	6 20.0 9.2 4.9	5 16.7 22.7 4.1	6 20.0 50.0 4.9	30 24.4
	8	5 8.8 20.8 4.1	33 57.9 50.8 26.8	13 22.8 59.1 10.6	6 10.5 50.0 4.9	57 46.3
	13	0 0.0 0.0 0.0	26 86.7 40.0 21.1	4 13.3 18.2 3.3	0 0.0 0.0 0.0	30 24.4
	33	6 100.0 25.0 4.9	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	6 4.9
	COLUMN TOTAL	24 19.5	65 52.8	22 17.9	12 9.8	123 100.0

CHI-SQUARE = 62.92359 WITH 9 DEGREES OF FREEDOM SIGNIFICANCE = 0.0000

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 36 : CHI-SQUARE TEST - DEMAND FOR INFORMATION IN RELATION TO WILLINGNESS TO PAY

	COUNT % ROW % COL % TOT	V52 WILLINGNESS TO PAY 700	 2750	 5000	ROW TOTAL
V62 DEMAND	3	24 96.0 29.8 22.2	0 0.0 0.0 0.0	1 4.0 8.3 0.9	25 23.1
	8	31 66.0 38.3 28.7	11 23.4 73.3 10.2	5 10.6 41.7 4.6	47 43.5
	13	26 86.7 32.1 24.1	4 13.3 26.7 3.7	0 0.0 0.0 0.0	30 27.8
	33	0 0.0 0.0 0.0	0 0.0 0.0 0.0	6 100.0 50.0 5.6	6 5.6
	COLUMN TOTAL	81 75.0	15 13.9	12 11.1	108 100.0

CHI-SQUARE = 61.55026 WITH 6 DEGREES OF FREEDOM SIGNIFICANCE = 0.0000

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 37 : CHI-SQUARE TEST - SUPPLY OF INFORMATION IN RELATION TO AGE

	COUNT % ROW % COL % TOT	V58 AGE 28	 34	 42	 81	ROW TOTAL
V61 SUPPLY	3	13 59.1 54.2 10.6	3 13.6 4.6 2.4	0 0.0 0.0 0.0	6 27.3 50.0 4.9	22 17.9
	8	5 7.7 20.8 4.1	36 55.4 55.4 29.3	18 27.7 81.8 14.6	6 9.2 50.0 4.9	65 52.8
	13	0 0.0 0.0 0.0	26 86.7 40.0 21.1	4 13.3 18.2 3.3	0 0.0 0.0 0.0	30 24.4
	33	6 100.0 25.0 4.9	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	6 4.9
	COLUMN TOTAL	24 19.5	65 52.8	22 17.9	12 9.8	123 100.0

CHI SQUARE = 83.53430 WITH 9 DEGREES OF FREEDOM SIGNIFICANCE = 0.0000

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 38 : CHI-SQUARE TEST - SUPPLY OF INFORMATION IN RELATION TO YEARS OF EXPERIENCE

	COUNT % ROW % COL % TOT	V59 YEARS OF EXPERIENCE 4	 8	 13	 19	ROW TOTAL
V61 SUPPLY	3	22 100.0 41.5 17.9	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	22 17.9
	8	13 20.0 24.5 10.6	23 35.4 62.2 18.7	24 36.9 100.0 19.5	5 7.7 55.6 4.1	65 52.8
	13	12 40.0 22.6 9.8	14 46.7 37.8 11.4	0 0.0 0.0 0.0	4 13.3 44.4 3.3	30 24.4
	33	8 100.0 11.3 4.9	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	6 4.9
	COLUMN TOTAL	53 43.1	37 30.1	24 19.5	9 7.3	123 100.0

CHI-SQUARE = 65.88921 WITH 9 DEGREES OF FREEDOM SIGNIFICANCE = 0.0000

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 39: CHI-SQUARE TEST - SALARY IN RELATION TO YEARS OF EXPERIENCE

	COUNT % ROW % COL % TOT	V59 YEARS OF EXPERIENCE 4	 8	 13	 19	ROW TOTAL
V60 SALARY	18000	17 100.0 32.1 13.8	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	17 13.8
	45500	36 55.4 67.9 29.3	11 16.9 29.7 8.9	13 20.0 54.2 10.6	5 7.7 55.6 4.1	65 52.8
	63000	0 0.0 0.0 0.0	19 100.0 51.4 15.4	0 0.0 0.0 0.0	0 0.0 0.0 0.0	19 15.4
	85000	0 0.0 0.0 0.0	7 31.8 18.9 5.7	11 50.0 45.8 8.9	4 18.2 44.4 3.3	22 17.9
	COLUMN TOTAL	53 43.1	37 30.1	24 19.5	9 7.3	123 100.0

CHI-SQUARE = 96.18811 WITH 9 DEGREES OF FREEDOM SIGNIFICANCE = 0.0000

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 40: CHI-SQUARE TEST - SUPPLY OF INFORMATION IN RELATION TO WILLINGNESS TO PAY

	COUNT % ROW % COL % TOT	V52 WILLINGNESS TO PAY 700	 2750	 5000	ROW TOTAL
V61 SUPPLY	3	21 95.5 25.9 19.4	0 0.0 0.0 0.0	1 4.5 8.3 0.9	22 20.4
	8	34 68.0 42.0 31.5	11 22.0 73.3 10.2	5 10.0 41.7 4.6	50 46.3
	13	26 86.7 32.1 24.1	4 13.3 26.7 3.7	0 0.0 0.0 0.0	30 27.8
	33	0 0.0 0.0 0.0	0 0.0 0.0 0.0	6 100.0 50.0 5.6	6 5.6
	COLUMN TOTAL	81 75.0	15 13.9	12 11.1	108 100.0

CHI SQUARE = 59.77147 WITH 6 DEGREES OF FREEDOM SIGNIFICANCE = 0.0000

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 41 : CHI-SQUARE TEST - SALARY IN RELATION TO AGE

	COUNT % ROW % COL % TOT	V58 AGE 28	 34	 42	 81	ROW TOTAL
V60 SALARY	18000	5 29.4 20.8 4.1	6 35.3 9.2 4.9	0 0.0 0.0 0.0	6 35.3 50.0 4.9	17 13.8
	45500	19 29.2 79.2 15.4	33 50.8 50.8 26.8	7 10.8 31.8 5.7	6 9.2 50.0 4.9	65 52.8
	63000	0 0.0 0.0 0.0	19 100.0 29.2 15.4	0 0.0 0.0 0.0	0 0.0 0.0 0.0	19 15.4
	85000	0 0.0 0.0 0.0	7 31.8 10.8 5.7	15 68.2 68.2 12.2	0 0.0 0.0 0.0	22 17.9
	COLUMN TOTAL	24 19.5	65 52.8	22 17.9	12 9.8	123 100.0

CHI-SQUARE = 77.65667 WITH 9 DEGREES OF FREEDOM SIGNIFICANCE = 0.0000

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 42: CHI-SQUARE TEST - SALARY IN RELATION TO WILLINGNESS TO PAY

	COUNT % ROW % COL % TOT	V52 WILLINGNESS TO PAY 700	 2750	 5000	ROW TOTAL
V60 SALARY	18000	11 64.7 13.6 10.2	0 0.0 0.0 0.0	6 35.3 50.0 5.6	17 15.7
	45500	38 69.1 46.9 35.2	11 20.0 73.3 10.2	6 10.9 50.0 5.6	55 50.9
	63000	19 100.0 23.5 17.6	0 0.0 0.0 0.0	0 0.0 0.0 0.0	19 17.6
	85000	13 76.5 16.0 12.0	4 23.5 26.7 3.7	0 0.0 0.0 0.0	17 15.7
	COLUMN TOTAL	81 75.0	15 13.9	12 11.1	108 100.0

CHI SQUARE = 22.65070 WITH 6 DEGREES OF FREEDOM SIGNIFICANCE = 0.0009

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 43: PERCENTAGE OF REQUESTS SUPPLIED TO CIN USERS IN BRAZIL

	PERCENTAGE OF REQUESTS SUPPLIED TOTAL (37.290) %
BRAZILIAN STATES	
RIO DE JANEIRO	90.6
SÃO PAULO	6.2
MINAS GERAIS	1.5
OTHERS	1.7
TOTAL	100.0

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 44: PERCENTAGE OF REQUESTS SUPPLIED FROM ABROAD

ABROAD	%
ENGLAND	65.9
AUSTRIA	11.6
GERMANY	11.5
INDIA	4.5
JAPAN	1.8
FRANCE	1.7
SOUTH AMERICA	1.6
AUSTRALIA	0.6
CZECHOSLOVAKA	0.3
OTHERS	0.5
TOTAL	100.0

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 45: NUMBER OF PAPERS PER MONTH SUPPLIED BY SONAR/SDI

No. SUPPLIED	FREQUENCY
0 - 5	22
6 - 10	65
11 - 15	30
16 - 30	-
more than 30	6
TOTAL	123

MEAN	9.455
MINIMUM	2.5
MAXIMUM	33
STANDARD DEVIATION	6.341
MEDIAN	8.538
MODE	8

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 46: DEMAND FOR SONAR/SDI IN NUMBER OF PAPERS PER MONTH

DEMAND	FREQUENCY
0 - 5	30
6 - 10	57
11 - 15	30
16 - 30	-
more than 30	6
TOTAL	123

MEAN	9.098
MINIMUM	2.5
MAXIMUM	33
STANDARD DEVIATION	6.566
MEDIAN	8.263
MODE	8

SOURCE: Data collected by the researcher in Brazil, 1979.

TABLE 47: FREQUENCY DISTRIBUTION OF WILLINGNESS TO PAY FOR THE SONAR/SDI

Cr$ 1,00	FREQUENCY
300	37
750	31
1250	13
1750	5
2750	4
3250	6
4750	6
5250	6
TOTAL	108

MEAN	1387.500	SKEWNESS	1.580
MODE	300.000	MAXIMUM	5250.000
KURTOSIS	1.223	MEDIAN	771.774
MINIMUM	300.000	VARIANCE	2269632.009
STD ERR	144.966	RANGE	4950.000
STD DEV	1506.530		

SOURCE: Data collected by the researcher in Brazil, 1979.

NOTE: Includes 108 observations (15 missing cases),

TABLE 48: FREQUENCY DISTRIBUTION OF USERS COMPENSATION IF SONAR/SDI IS WITHDRAWN

Cr$ 1,00	FRRQUENCY
50	9
100	7
200	13
300	7
500	18
748	5
1000	18
2000	6
0	40
TOTAL	83

MEAN	585.422	SKEWNESS	1.357
MODE	500.000	MAXIMUM	2000.000
KURTOSIS	1.590	MEDIAN	490.278
MINIMUM	50.000	VARIANCE	269443.661
STD ERR	56.976	RANGE	1950.000
STD DEV	519.080		

SOURCE: Data collected by the researcher in Brazil, 1979.

NOTE: includes 83 observations (40 missing cases).

TABLE 49: TOTAL, FIXED, VARIABLE AND AVERAGE COSTS PER YEAR

(1) USERS PER YEAR n	(2) FIXED COST FC	(3) VARIABLE COST VC	(4) TOTAL COST TC=FC+VC	(5) AVERAGE FIXED COST/USER AFC = $\frac{FC}{n}$	(6) AVERAGE VARIABLE COST AVC = $\frac{VC}{n}$	(7) AVERAGE TOTAL COST/USER AC = $\frac{TC}{n}$
300	4.099.164,70	187.992,00	4.287.156,70	13.663,88	626,64	14.290,52
600	4.099.164,70	375.924,00	4.475.148,70	6.831,94	626,64	7.458,58
900	4.099.164,70	563.976,00	4.663.140,70	4.554,63	626,64	5.181,27
1200	4.099.164,70	751.968,00	4.851.132,70	3.415,97	626,64	4.042,61
1500	4.099.164,70	939.960,00	5.039.124,70	2.732,78	626,64	3.359,42
1800	4.099.164,70	1.127.952,00	5.227.116,70	2.277,31	626,64	2.903,95
2100	4.099.164,70	1.315.944,00	5.415.108,70	1.951,98	626,64	2.578,62
2400	4.099.164,70	1.503.936,00	5.603.100,70	1.707,99	626,64	2.334,63

SOURCE: Compiled by the researcher in Brazil, 1980.

TABLE 50: VARIABLE COST INCREASE RATE

N. OF USERS PER YEAR	INCREASE RATE %
300	-
600	100
900	50
1200	33
1500	25
1800	20
2100	17
2400	14

SOURCE: Data collected by the researcher in Brazil, 1980.

TABLE 51: INCREASE/DECREASING RATES OF AVERAGE COST

N. OF USERS PER YEAR	INCREASE RATE OF TOTAL COST %	DECREASING RATE OF AFC	DECREASING RATE OF ATC
300	-	-	-
600	4.4	50.0	48.0
900	4.2	33.0	31.0
1200	4.0	25.0	22.0
1500	3.9	20.0	17.0
1800	3.7	17.0	14.0
2100	3.6	14.0	11.0
2400	3.5	12.0	9.0

SOURCE: Compiled by the researcher in Brazil, 1980.

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7. CONCLUSIONS

This Chapter was prepared to provide an overview of the research results and to state the main points concluded as well as to Sketch some guidelines to further research in the future.

7.1 OVERVIEW OF RESEARCH RESULTS

The main results obtained in this case study may be summarised as follows:

a. preferred sources for seeking information are to be found in a library, the SONAR/SDI, in talking to a colleague, and/or in searching a personal file;

b. users' preferences in valuing the SONAR/SDI service are mainly given in terms of its speed, coverage, relevance of information to their needs and accessibility;

c. SONAR/SDI is used by CIN users to keep them abreast of new knowledge; but they would prefer to receive informal visits from the centre in order to be aware of the facilities that can be provided for document requests;

d. SONAR/SDI users expend an average of 20% of their working time in reading, regardless of the area of interest; the average hours of reading per day is 1.30;

e. there would be an extra cost for searching information if SONAR/SDI was not available to CIN users; the estimated time saving benefits per user are equal to 16.5 days per year i.e. 7% of CIN users' time;

f. in money terms this time saving benefit is equal to Cr$ 7.285,000,00 for all users, per year;

g. the WTP is greater than the real costs incurred to produce SONAR/SDI by Cr$ 30,074,200 p.a.;

h. the WTP of CIN users is greater than average cost/user per year;

i. Average fixed cost and average total cost/user of CIN/CNEN shows a trend to have a constant decreasing behaviour;

j. variable cost /user increases at a variable rate as the number of CIN users increase;

k. the behaviour of cost curves for the CIN/CNEN demonstrates that cost relation characteristics are a function of the production structure adopted in the Centre;

l. willingness to pay is dependent on the supply of information and the supply of information is a function of the demand for it in the SONAR/SDI;

m. cost of CIN users searching information by their own means is much greater than if CIN users utilise the SONAR/SDI;

n. the demand for information among CIN users is 23.8 papers per month which are mainly supplied from England (65.9%);

o. salary of CIN users is dependent upon years of experience;

It has been the researcher's intention to apply an economic calculus to a variety of aspects approached such as economic choice without price constraint, not usually treated by economists. Therefore, the researcher relied upon the reports rather than actions of the users studied. The researcher believes that the way is open to help government to establish the range of options in terms of new investments and particularly concerning difficulties in the distribution of the volume of production in SDI services, with consequent variation in technology, cost, factor incomes, and total production. It is a characteristic of the approach adopted by the researcher that attention is focused on the cost analysis of the procuction of the SDI service from CIN/CNEN and on the value of such service to users, mainly in relation to its supply of and demand for information.

It appears practical to develop a technique for evaluating the relative value of SDI systems from the approach used in the case of the CIN/CNEN. The statistical analysis used was essential to help conclude that the use of the SDI system from CIN/CNEN is less costly to users when compared with the cost of users searching information by their own means. This

approach, if taken by the government when setting up investment projects, would reduce the range of difficulties that arise in the distribution of services and productivity.

One point worth careful thought in relation to future investment projects is that of utilising the linear models established by the researcher where the supply of and demand for information fall into a functional relation, although there is not a market price to be considered to give a value to information. On the other hand the willingness to pay for such an SDI service of CIN/CNEN is a function of the supply of this service. Therefore, if the private sector makes investments there on, they will probably have a profit. There is a great demand for such services in Brazil and there is a shortage in their supply. The printouts in CIN/CNEN have a consumption level of 1.01 for the supply of one printout each 15 days. It is worthwhile to point out that the opportunity cost of this investment may be considered to be as high as the cost of other government projects viewed as more important than information. Nevertheless, if one computes the individual time saving benefit to be had with the SDI service from CIN/CNEN and the total time saving benefit in the remainder of the public economy, it would probably be possible to generate higher benefits if correctly estimated. It should also be possible to reduce costs that would be passed on in the form of reduced prices for the service involved. The extent to which these hypothetical prices may alter the number of those who are able to make use of the information would also be of benefit to the public at large.

It would therefore be necessary to estimate the sensitivity of prices to costs, and the elasticity of demand for the service with consequent effects on prices and demand.

7.2 RECOMMENDATIONS FOR FURTHER RESEARCH WORK

Aphorisms such as information is power, information is a resource, the pursuit of profit has become the pursuit of knowledge, which influence modern society's current cultural and political concepts are a basic, but not easily discernible factor. Ignorance has become commonplace in the information conscious society, as well as among the large majority in the less developed societies, who live in the hope that information can bring material improvement to their lives. Although there is an emerging awareness that information is a key to socio-economic change, the full significance of the structural changes that are taking place due to the information revolution has not yet been fully understood. It is not unusual for planners, policy makers, and administrators therefore to think of information as an extra, a luxury, and not a basic resource. As a result, answers to key questions have not yet been sought. For example:

- What are the guidelines and criteria for allocating national resources among the nuclear information activities on the one hand and the other sectors - science and technology, agriculture, energy, etc. on the other?

- How to weight different modes of nuclear information transfer - e.g. library and documentation services, mass media, satellite communication, etc., and what are their complementary relations?

- In the interest of maximal benefit to society, how do we distribute the flow of nuclear information since several participants may be involved in the whole process - the author, the recorder, the collector, the distributor, the researcher, etc.?

- What kinds of information services are necessary for nuclear scientists?

- What are the consequences of making the provision of information an instrument of nuclear state policy?

. Is there a real market price for a nuclear SDI service?

. Given that different scientific communities or segments of a community have different information assimilation and utilisation capacity,, would equal access to information contribute to equal sharing of benefits?

A lack of factual data and information on nuclear and scientific information activities in general combined with the basic conceptual difficulties inhibit efforts to measure and understand the role of information in scientific, technological and cultural development. As a consequence the formulation of an adequate national information policy is necessary as well as is the persuasion of development planners and policy makers as to the basic role of information in national development.

7.3 CHANGES TOWARD A NEW SOCIETY

For several centuries man has been in a dependent situation for most of his needs. The level of production, therefore, was determined by the level of consumption. The situation is changing with the application of technology to development. One of the characteristics of this change is the increasing proportion of returns to a given effort and more subtly a shift in the direction of economics from a supply-base to a demand-base (1). What people now want affects the level of production and determines the different kind of items to be produced. This is becoming increasingly visible in the information industry as well.

A second characteristic of the change is the breakdown of segmentation and enlargement of the boundaries of society - the creation of the mass society (1). Communication has brought about an increase in social interactions. The number of social contacts per unit of time or the number of different individuals one meets, has increased considerably. The increase in interaction leads to competition as well as to cooperation.

These may lead to specialisation for achieving efficiency, differentiation in function, and interdependence (2). In the area of work, intellectual and other, man becomes a smaller part of a larger whole, In culture, this situation is reversed. In the traditional society, the ideas one has, the beliefs one accepts and the arts one sees are all within a bounded space. Modernity has broken down the boundaries. Almost everything is now demanded and available.

Another important feature of these changes is the change of scale. While a change in quantities is a change in quality, a change in scale is a change in institutional form (1). Technological revolution makes available large amounts of energy at lower cost, more control of the circumstances of production and more rapid communication. Each development increases the efficiency of the other two. All three together increase the speed of large-scale operations, that is, such operations may therefore be performed in less time. Transformation and communication bind the world. The major socio-economic problem is the question of what would happen if the segmentation of society decreases and an increase in human interaction takes place? Many problems of modern society arise from its increasing complexity, that is, multiple interactions and interdependence. The resolution of the problem is two-fold: to create political and administrative structures that are responsive to the new scales and to develop a more comprehensive and coherent creed that diverse people can share.

Limits to growth arise from resource limitations, however, expansion of knowledge and information is limited only by human intelligence capacity. In the long run, the gathering and handling of knowledge may be the only industry to grow. To make use of and to make enjoyment of that knowledge possible, technology must play its other great role: lifting the burden of mindless toil, and permitting that Norbert Wiener called:

'the human use of human beings' (3).

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APPENDIX 1: THE QUESTIONNAIRE TRANSLATION INTO ENGLISH

THE FOLLOWING QUESTIONS ARE AIMED AT VERIFYING WHAT KIND OF INFORMATION YOU NEED MOST AND HOW YOU USE IT

1 - Do you experience any difficulty in keeping up to date with new work as it is published?

Check your answer with 'X', 1 being absence of difficulty and 5, maximum difficulty.

1	2	3	4	5
☐	☐	☐	☐	☐

2 - Check with 'X' the stages when you have already experienced or still experience difficulty in obtaining information

a) bibliographic research concerning journal articles and/or books and/or theses and/or technical scientific reports:

☐ No, I don't experience any difficulty

☐ Yes, I experience some difficulty

☐ Thesis?

☐ Technical report?

☐ Articles?

☐ Books?

b) when working on a technical report or an essay

☐ No, I don't experience any difficulty ☐ Yes, I experience some difficulty

c) when working on tables and charts

☐ No, I don't experience any difficulty ☐ Yes, I experience some difficulty

d) when solving practical problems in the technical scientific field

☐ No, I don't experience any difficulty ☐ Yes, I experience some difficulty

e) when evaluating and reviewing your own work

☐ No, I don't experience any difficulty ☐ Yes, I experience some difficulty

3 - This is a list of possible ways of gathering information. When available, how useful do you think each methods is to you? Check your answer with - 'X'

	very useful	not very useful	fairly useful	not relevant in my work
gathering bibliographic references from conversation with other workers in the field (personally or on the telephone)	☐	☐	☐	☐
Gathering bibliographic references from correspondence	☐	☐	☐	☐
gathering references quoted inpapers relevant in your work field	☐	☐	☐	☐
using abstract journals	☐	☐	☐	☐
using journal indexes	☐	☐	☐	☐
using personal index	☐	☐	☐	☐
using services of information officer in your work field	☐	☐	☐	☐
asking information to your organisation librarian	☐	☐	☐	☐
using library collection in your organisation	☐	☐	☐	☐
using subject bibliography	☐	☐	☐	☐
consulting reports issued by your organisation	☐	☐	☐	☐
using books and monographs of yours	☐	☐	☐	☐
using literature issued by manufacturers	☐	☐	☐	☐
using CIN/CNEN services	☐	☐	☐	☐

4) Which alternatives would you use to meet your information needs?

Check your answer with 'X'

- ☐ atomindex
- ☐ library in your organisation
- ☐ library outside your organisation
- ☐ journals you subscribe
- ☐ journals your organisation subscribes
- ☐ governmental publications
- ☐ personal or on the telephone contact
- ☐ contact through correspondence
- ☐ CIN/CNEN
- ☐ others, specifying .....

.....

5 - Assign values from 1 to 5 to the following sources of information as an indication of relative value in your research and development activities. 5 is the highest value. Check your answer with X

SOURCES OF INFORMATION

	1	2	3	4	5
a) SONAR/SDI of CIN/CNEN	☐	☐	☐	☐	☐
b) any other information service	☐	☐	☐	☐	☐
c) contacts within your organisation	☐	☐	☐	☐	☐
d) contacts out of your organisation	☐	☐	☐	☐	☐
e) library within your organisation	☐	☐	☐	☐	☐
f) library out of your organisation	☐	☐	☐	☐	☐
g) Atomindex	☐	☐	☐	☐	☐
h) journals you subscribe	☐	☐	☐	☐	☐
i) journals subscribed by your organisation	☐	☐	☐	☐	☐
j) governmental publications	☐	☐	☐	☐	☐

THE FOLLOWING QUESTIONS ARE AIMED AT VERIFYING HOW YOUR WORK TIME IS ALLOTTED

6 - Write down in the boxes the average proportion of your total time spent in the activities described from 'a' to 'f'.

ACTIVITIES	YOUR TIME %
(a) working on a project, including development	
(b) working on a technical report	
(c) working on a paper or essay	
(d) administrative work requirements	
(e) revising previous work	
(f) others	
	100 %

7 - a) How many hours a month do you spend, in average, in research and development? _____

b) From such hours a month, how many do you spend seeking information? _____

c) From such hours a month, how many do you spend reading information gathered? _____

8 - How many hours a month, in average, do you spend organizing material received from CIN/CNEN service of selective dissemination of information?

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9 - Check with X the YES or NO boxes, and write down average time (hours) spent monthly in situations described below.

SITUATIONS	/SUCH ACTIVITY IS RELEVANT/ YES	NO	AVERAGE HOURS A MONTH
using SONAR/SDI of CIN/CNEN	☐	☐	----------
using Atomindex	☐	☐	----------
talking to other technologists within your organisation	☐	☐	----------
talking to professionals out of your organisation	☐	☐	----------
using your organisation library	☐	☐	----------
using libraries out of your organisation	☐	☐	----------
using journals you subscribe	☐	☐	----------
using journals your organisation subscribes	☐	☐	----------
using publications from governmental agencies	☐	☐	----------

THE FOLLOWING QUESTIONS ARE AIMED AT VERIFIYING THE IMPORTANCE YOU GIVE TO BIBLIOGRAPHIC INFORMATION SERVICES

10 - In order to indicate the relative value of every information service you use, assign from 1 to 5 points to the services listed below when '5' is the highest value. Check your answer with X in the boxes below.

SERVICE NAME	RELATIVE VALUE				
	1	2	3	4	5
abstracting service	☐	☐	☐	☐	☐
alert service	☐	☐	☐	☐	☐
abstracts in primary journals	☐	☐	☐	☐	☐
new titles list	☐	☐	☐	☐	☐
SDI/SONAR of CIN/CNEN	☐	☐	☐	☐	☐
others, specify	☐	☐	☐	☐	☐

11 - Imagine having to choose an information source meeting your information needs. Such choice would certainly be influenced by some characteristics of the service. The check sheet below supplies some examples. There may be others you can think as important; in such case, specify. According to each source point out characteristics you "imagine" being important to meet your information needs. Check your answer, making use of a scale from 1 to 5. Mark 5 implies that such characteristic is essential, from your point of view.

CHARACTERISTIC	INFORMATION SOURCE					
	SONAR/SDI of CIN/CNEN	other information service	library within your organisation	library out of your organisation	journals	government publications (not journals)
speed in the reply	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
coverage of work field	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
relevance to your needs	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
supply of extra services	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
cost	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
fulfillment information obtained	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
accessibility	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
information presenting	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

12 - Indicate on a scale from 1 to 5 how satisfied you were regarding each characteristic below related to the information source you make most use of (specified in question 5).
5 points represent the "most satisfied" value. Check your answer with X in the boxes below.

CHARACTERISTICS	INFORMATION SOURCE	1	2	3	4	5
speed in the reply	----------					
coverage of work field	----------					
relevance to your needs	----------					
supply of extra services	----------					
cost	----------					
fulfillment as to information obtained	----------					
accessibility	----------					
information presentation	----------					
others, specify	----------					

THE FOLLOWING QUESTIONS ARE AIMED AT EVALUATING THE RELATION COST/INFORMATION SERVICE BENEFIT.

13 - (a) Check your answer with X, assigning scores from 1 to 5, being the highest value in the "services" column.

(b) If you were to allocate funds to pay for the works mentioned below, what proportion would you allocate to each service? (allocate proportion in the "fund % allocation").

VALUES 2 3 4 5	(a) SERVICES	(b) FUND % ALLOCATION
☐☐☐☐	Atomindex	----------
☐☐☐☐	Library in your organisation	----------
☐☐☐☐	Library out of your organisation	----------
☐☐☐☐	Journals subscribed by your organisation	----------
☐☐☐☐	Governmental agencies publications (not journals)	----------
☐☐☐☐	SONAR/SDI of CIN/CNEN	----------

14 - (a) Which would be the minimum and maximum amount of money (in cruzeiros a month in 1979) you would be willing to pay in order to use the following services. Check your answer in the boxes below.

SERVICES	Minimum average amount a month	Maximum average amount a month
SONAR/SDI of CIN/CNEN	----------	----------
Atomindex	----------	----------
Library in your organisation	----------	----------
Library our of your organisation	----------	----------
Journals you subscribe	----------	----------
Governmental Agencies Publications (not journals)	----------	----------
Other service, specify	----------	----------

(b) Which would be the minimum and maximum amount of money (in cruzeiros a month in 1979) you would recommend to your organization to pay the following services:

SERVICES	Minimum average amount a month	Maximum average amount a month
SONAR/SDI of CIN/CNEN	----------	----------
Atomindex	----------	----------
Library in your organisation	----------	----------
Library out of your organisation	----------	----------
Journals your organisation subscribe	----------	----------
Governmental agencies publications	----------	----------
Other service, specify	----------	----------

15 - Which would be the minimum amount of money (cruzeiros 1979) that would compensate you in case you were deprived of SONAR/SDI service from CIN/CNEN and had to obtain some information on your own?

- - - - - - - month average

16 - The following question concern a hypothetical situation and are aimed at finding an indication of the value you put on the information service you use now.

Compare the current situation in which your colleagues and you have access to SONAR/SDI service of information to the hypothetical situation in which "such service is not available to you".

- If you were to choose between keeping your job with SONAR/SDI information service on the same salary level and a job without SONAR/SDI INFORATION SERVICE but with a salary raise, which would the monthly sum of salary raise that you would ask? Check your answer with X.

Cr$ 100 a 500 de aumento		☐
Cr$ 500 a 1000	"	☐
1000 a 1500	"	☐
1500 a 2000	"	☐
2000 a 2500	"	☐
2500 a 3000	"	☐
3000 a 3500	"	☐
3500 a 4000	"	☐
4000 a 4500	"	☐
4500 a 5000	"	☐

If above Cr$ 5.000.00, please specify

17 - In a same hypothetical situation, if SONAR/SDI service were not available to you, the problem would be choosing between:

(a) spending more time in doing your own information research;

(b) adjusting to the situation in some other way.

In the first hypothesis (a), please indicate the average nunber of hours increase you would have to work monthly

monthly average hours

(i) research and development ----------

(ii) bibliographic research to meet information needs ----------

(iii) others, please specify. ----------

hour total ----------

THE NEXT QUESTIONS ARE EXTREMELY NECESSARY WHEN ANALYZING AND CORRELATING THE PREVIOUS QUESTIONS. RESULTS WILL BE MEASURED BY AVERAGE AGGREGATION AND NO INDIVIDUAL DATA WILL BE MEASURED IN THE FINAL RESULT. SUCH INFORMATION WILL BE CONFIDENTIAL AND ONLY DEALT WITHIN MY DOCTORATE RESEARCH CONTEXT.

8 - Please indicate how many average hours you work a month

---------- average hours a month

9 - If will be extremely useful if you supply the following data:

(a) year of birth ----------

(b) number of years in your profession ----------

(c) your current salary level

Check your answer with X in the boxes below

below	Cr$ 10.000,00		
between	10.000,00 e 15.000,00		☐
	16.000,00 e 20.000,00		☐
	21.000,00 e 25.000,00		☐
	26.000,00 e 30.000,00		☐

31.000,00 e 35.000,00 ☐
36.000,00 e 40.000,00 ☐
41.000,00 e 45.000,00 ☐
46.000,00 e 50.000,00 ☐
51.000,00 e 55.000,00 ☐
56.000,00 e 60.000,00 ☐
61.000,00 e 65.000,00 ☐
66.000,00 e 70.000,00 ☐
71.000,00 e 75.000,00 ☐
76.000,00 e 80.000,00 ☐
81.000,00 e 85.000,00 ☐
86.000,00 e 90.000,00 ☐
91.000,00 e 95.000,00 ☐
96.000,00 e 100.000,00 ☐
above Cr$100.000,00 ☐

please specify ----------

20 - Please check, on a scale from 1 to 5, how important information sources are for you in your research and development work. 5 represents a situation of complete dependence. Check your answer with X in the boxes.

SOURCES	1	2	3	4	5
Atomindex	☐	☐	☐	☐	☐
✓ Library in your organisation	☐	☐	☐	☐	☐
✓ Library out of your organisation	☐	☐	☐	☐	☐
✓ Journals you subscribe	☐	☐	☐	☐	☐
✓ Journals subscribed by your organi ation	☐	☐	☐	☐	☐
✓ Governmental Agencies publications (not journals)	☐	☐	☐	☐	☐
✓ Personal or on the telephone contacts	☐	☐	☐	☐	☐
Contacts by correspondence	☐	☐	☐	☐	☐
✓ Others, please specify	☐	☐	☐	☐	☐

21 - (a) How many full texts (articles, reports, projects, books, etc) reach you monthly, due to requests made to information systems (libraries, SONAR/SDI and others)?

Check with X the chosen answer.

- ☐ 0 a 5 a month
- ☐ 6 a 10 a month
- ☐ 11 a 15 a month
- ☐ 16 a 20 a month
- ☐ 21 a 25 a month
- ☐ 26 a 30 a month
- ☐ above 30 a month

(b) Among those, how many do you read, even partially?

- ☐ 0 a 5 a month
- ☐ 6 a 10 a month
- ☐ 11 a 15 a month
- ☐ 16 a 20 a month
- ☐ 21 a 25 a month
- ☐ 26 a 30 a month
- ☐ above 30 a month

(c) Which is such text proportion reaching you through bibliographies supplied by the Nuclear Information Center?

- ☐ 5%
- ☐ 10%
- ☐ 20%
- ☐ 30%
- ☐ 40%
- ☐ 50%
- ☐ 60%
- ☐ 70%
- ☐ 80%

22 - Check with X which information sources you have already used

- ☐ Engineering Abstracts
- ☐ Physics Abstracts
- ☐ Chemical Abstracts
- ☐ Index Medicus
- ☐ Excerpta Medica
- ☐ Current Contents
- ☐

23 - On a scale from 1 to 5 (5 corresponds to optimal performance) how do you evaluate SONAR/SDI service?

Check your answer with X ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

24 - Information from Abstracts supplied by SONAR/SDI has been sufficient to keep you updated?

☐ YES ☐ NO

25 - In case you worked out papers in 1978, how many were published in Brazil and how many abroad?

NUMBER OF PAPERS IN BRAZIL	NUMBER OF PAPERS ABROAD

26 - (a) existence in and/or out of Brazil of research works similar to yours is (check with X boxes below):

In Brazil:	Out of Brazil
☐ very frequent	☐ very frequent
☐ frequent	☐ frequent
☐ almost none	☐ almost none
☐ none	☐ none
☐ I do not know	☐ I do not know

(b) SONAR/SDI service has been helpful as a first step to establish direct contacts with people performing work similar to yours, in or out of Brazil?

Check you answer with X

In Brazil?		Out of Brazil?	
YES	NO	YES	NO
☐	☐	☐	☐

Difficulty in getting documents referenced by the service

Receiving too small number of bibliographic reference

Difficulty when filling out answer Card from SONAR/SDI

Other problems. Please identify

---

31 - Allocate in a monthly average proportion time spent in your professional activities (in and out of your office).

Activities	%
Pure research	_____
Applied research	_____
Teaching	_____
Project development	_____
Administration	_____
Technical Supervision	_____
Field work	_____
Others (specify)	_____
TOTAL	100%

27 - Check with X the source or sources you use when seeking information:

- ☐ Libraries
- ☐ SONAR/SDI service in CIN/CNEN
- ☐ Personal Index
- ☐ Talking to technologist colleagues in my organisation
- ☐ Talking to professionals out of my organisation
- ☐ Contact by correspondence or on the telephone
- ☐ Others, please specify ----------

28 - Check with X to what degree you obtained information required from SONAR/SDI service

- ☐ Totally
- ☐ Partially
- ☐ Not obtained
- ☐ Still in search process

29 - How important would an orientation in bibliographic and/or for training to use some information service be? Check with X a box below:

- ☐ Very important
- ☐ Important
- ☐ Fairly important
- ☐ Not important

30 - What kind of problems have you found when using SONAR/SDI of CIN/CNEN? Check with X the box below:

- ☐ Difficulty when filling out User's Profile form
- ☐ Receiving too great number of bibliographic references.
- ☐ Information in languages quite unfamiliar

32 - How have you become aware of SONAR/SDI service existence?

Check with X boxes below (non-excluding choice)

- [ ] Libraries
- [ ] Colleagues aware of the service
- [ ] Nuclear Information Center
- [ ] Other Information Centers
- [ ] Other source (specify) _____

33 - Which divulgation means mentioned below would you choose in order to promote SONAR/SDI use?

- [ ] Newspaper advertising
- [ ] Conferences in different organisations
- [ ] Conferences at the Nuclear Information Center
- [ ] Stands in national wide conferences
- [ ] Others, specify _____

34 - On a time saving basis how useful has SONAR/SDI system been?

Check with X the box below.

- [ ] Useful
- [ ] Not very useful
- [ ] Occasionally useful
- [ ] Frequently useful
- [ ] More useful than conventional sources (library)

35 - (a) Besides yourself, how many people consult your "sanfona" (printed paper distributed by SONAR/SDI):

- ☐ none
- ☐ 1 a 3
- ☐ 4 a 6
- ☐ 7 a 10
- ☐ 10 a 13
- ☐ above 13

(b) How many of such persons are SONAR/SDI users?

Check with X one of the following questions:

- ☐ None
- ☐ 1 a 3
- ☐ 4 a 6
- ☐ 7 a 10
- ☐ 10 a 13
- ☐ above 13

36 - (a) In case you have ever had a paper published, explain what usually has happened after its publishing.

☐ I kept working in the same field, developing another paper

☐ I moved to another field, on a temporary basis, returning afterwards.

☐ I am not working in the same field at present.

(b) Check with X the reasons of changing field occurred after the latest publication:

☐ I changed job

☐ More interest on other field

☐ Work was on field peripheral to my main interest

☐ Work was the final stage of a project

☐ A recent paper exhausted field potentialiaty

☐ The department or organization I work for has changed its interst area

☐ Lack of financial support

☐ Lack of time to be concentrated on a new paper development

☐ Any other reason, please specify ----------

(c) Which was the date of your latest publication?

month ----------

year ----------