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5th Floor, Hunt Library
Carnegie Mellon University
4909 Frew Street
Pittsburgh, PA 15213-3890
Telephone: 412-268-2434
Email: huntinst@andrew.cmu.edu
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The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

18 April 1969

Dr. I. C. Kaufman
Department of Psychiatry
University of Colorado Medical Center
Denver

Dear Dr. Kaufman:

Enclosed is the Taximetrics Laboratory suggested involvement with the Program for Human and Primate Studies, to be included in your NIH grant.

I hope that there is sufficient information included.

Attached is a memo from Mr. Hersh estimating your line budget needs to accomplish what has been outlined in the enclosed work program.

These are estimated, however; we have little information to make them more than guesses at this time.

Good luck!

Sincerely,

David J. Rogers
Professor of Biology

DJR:gm

Introduction: The Problem

A dialog between the Program for Human and Primate Studies (PHUPS) and the Taximetric Laboratory (TaxLab) began in February 1969 when each became aware of the other. The TaxLab, an administrative unit of the University of Colorado (now in the process of becoming an Institute of the Graduate School) has an active interest in information systems development and implementation, systems analysis of scientific research groups, and research in the construction of theoretical models for information synthesis (see Appendix 1 for full description). Some of the problems posed by PHUPS are of interest to the members of the TaxLab; some of the systems developed by the TaxLab are of interest to PHUPS - especially in that they are operational and that the TaxLab is willing and able to implement them for PHUPS's use.

Subsequent dialogs disclosed the following major areas with respect to PHUPS's research problems which the TaxLab can address effectively and within certain cost-time constraints.

1. PHUPS research design (experiments) will generate a great deal of information (data in the form of observations); therefore, a comprehensive system must be designed and implemented which will allow for the effective flow of data from initial observations, through a fast computer-assisted information system providing efficient storage and selective retrieval capacities. The system must be flexible enough to adapt to different data problems, be integrated into the PHUPS program design, operate within defined time-cost constraints; and provide for the training of operators and users at all levels of competence.

2. Data from previous work (now on magnetic tape) requires conversion for entry into the information system.

3. Programs for data manipulation (analytic and synthetic) are required by the PHUPS researchers to make meaningful their research findings. Certain analytic programs (such as statistical packages) have been used satisfactorily; however, there are expressed needs for synthesis programs (based on non-analytic mathematical models, see Appendix 2). Training in the use of these programs must be provided for the research staff.

4. The information systems and data manipulating programs must be made available as soon as possible inorder to produce results so that the researchers may evaluate their experimental designs and publication can be begun.

5. It is necessary to determine the costs of running such programs and systems of their effectiveness in handling these types of data.

PLAN

a. Taximetrics Laboratory Resources

Under National Science Foundation Grant GN 656, entitled "Development of a Biological Information Retrieval System" the Taximetrics Laboratory has built and demonstrated a system known as TAXIR. The TAXIR system is a currently operative, computer-assisted information storage retrieval system comprised of several related but independent modules, each specifically designed to serve a particular function in information retrieval. One such module is the TAXIR Accessioner. Its task is to accept any Boolean expressions (logical combinations of search criteris) for a collection of items and respond with the list of items which meet the conditions of that Boolean expression.

The system stores the Data Bank (records of descriptor state membership for each item) as base characteristic functions. This technique enables vast amounts of information to be stored in relatively little space. Boolean operands can be reconstructed by a simple calculation with these base

characteristic functions. Further, the ease and flexibility with which any logical combination of search criteria may be implicated, through execution with base characteristic functions, makes feasible the presently uncommon practice of actively using any conceivable criterion, instead of just the three or four most obvious ones.

For queries with moderately sophisticated logical combinations of search criteria (operands [such as, in the Boolean query language of TAXIR, Query - List items with (flower color, red OR pink OR NOT leaf venation, pinnate) AND month of flowering, From April to June AND geographical location, Maryland*] the TAXIR Accessioner operates with considerable efficiency since calculation largely replaces the traditional file searching.

The TAXIR system is being installed by several collaborators (see Appendix 3).

b. Implementation

1. The TaxLab will assist in integrating the TAXIR system (including al all aspects of information flows, operator training, cost/effectiveness analysis of the operating system and continued service on the system) into the PHUPS research design.

The current TAXIR system can be implement early in the project. Certain modifications and new modules can be made during the first 12 - 18 months of the project to assure proper Information Systems service.

2. From the current dialogs with PHUPS it appears that certain operational data synthesis models developed by the TaxLab (see Appendix 4) might be useful in the general research desing: in the description and classification of data.

Other discussions between Dr. Styne and Dr. Estabrook (research biomathematician on the TaxLab staff) have posed several possible model formulations which could be of great value in the PHUPS research. These models might be build and made operational during the first 24 months of the project.

3. The TaxLab is prepared to make a full cost/effectiveness analysis of all systems used for further evaluation and implementation. Further the TaxLab will be available to the PHUPS staff in a continuous and intensive dialog concerning these problems, systems installation, etc.

It is suggested that the Taximetrics Laboratory be employed as contract consultants to implement systems which will address the aforementioned problems. For these services for the first year the fee will be $50,000; the second $25,000, and the subsequent years $5,000.

For a complete breakdown of the work the Taximetrics Laboratory proposes to do for the Program for Human and Primate Studies, and the man-time estimated to carry out each sub-project, please see the following work program.

II. Work Program

About fifteen man-days of the Taximetrics Laboratory time has been spent in dialogs with PHUPS to date. The discussions have been very fruitful and indicate a very profitable collaboration.

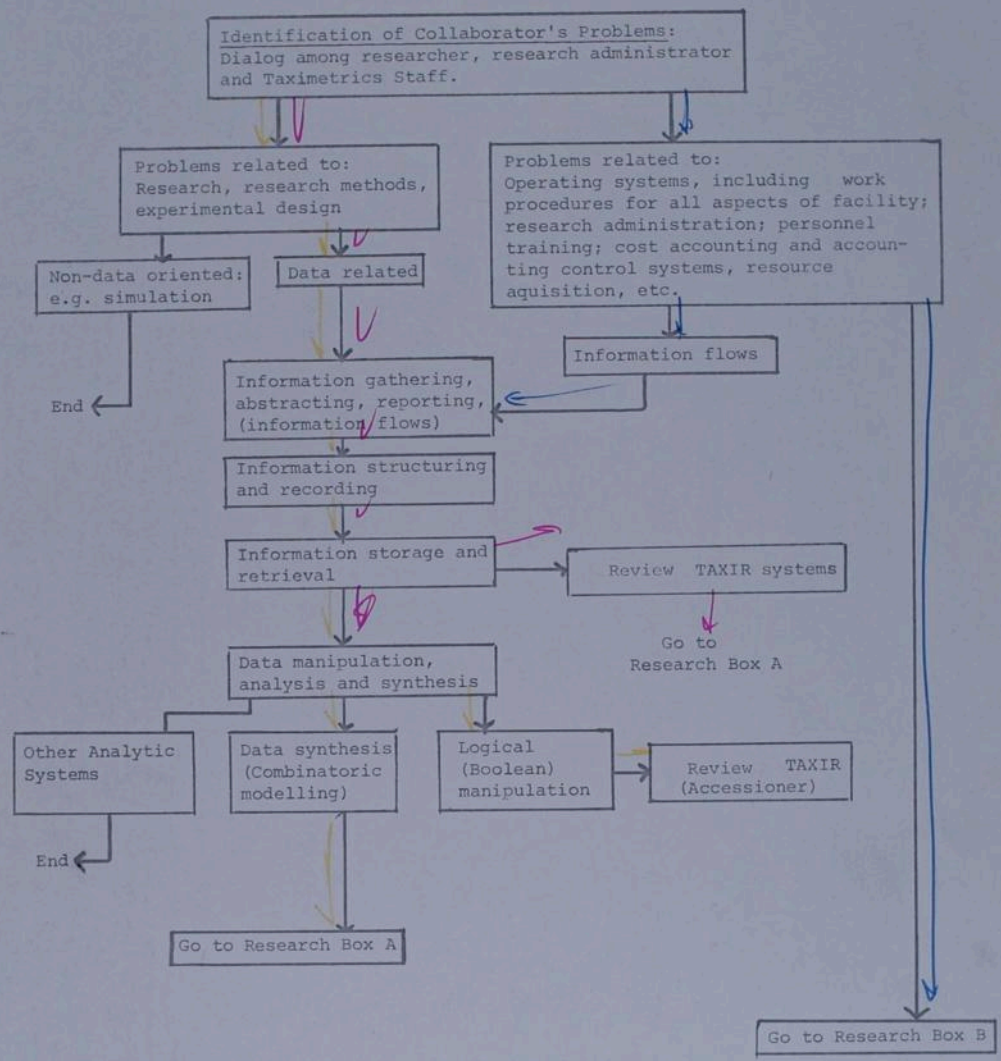
The following is a flow chart delineating the tasks to be done by the Taximetrics Laboratory for aid with PHUPS and constitutes the work-program diagram. The various paths to these tasks are color-coded.

The work program summary and notes indicate the estimated amount of time needed to accomplish these tasks and the estimated time periods during which various tasks will be faced.

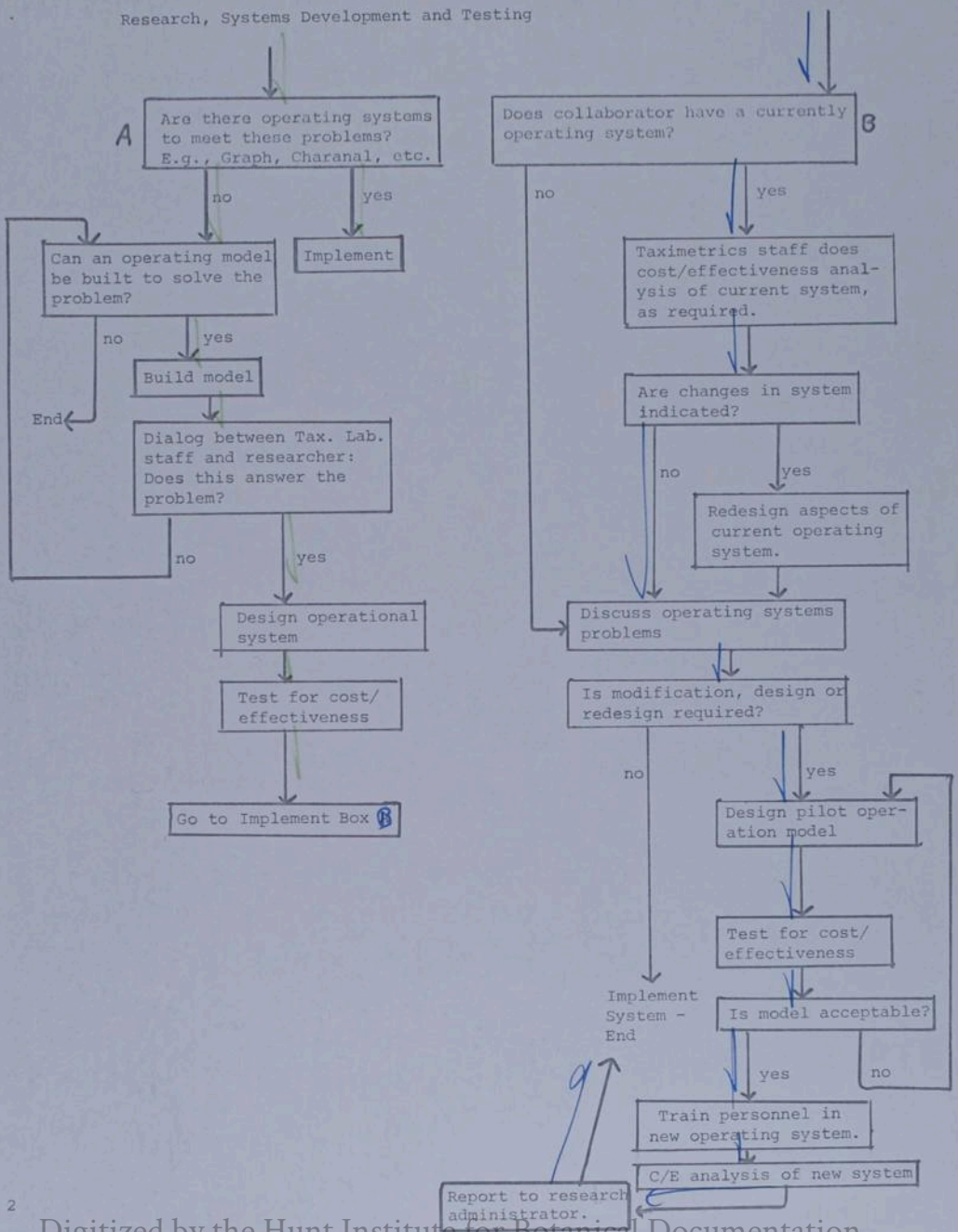
The Budget follows, indicating roughly from the work program the amount of money needed to accomplish the various tasks and how payment is requested.

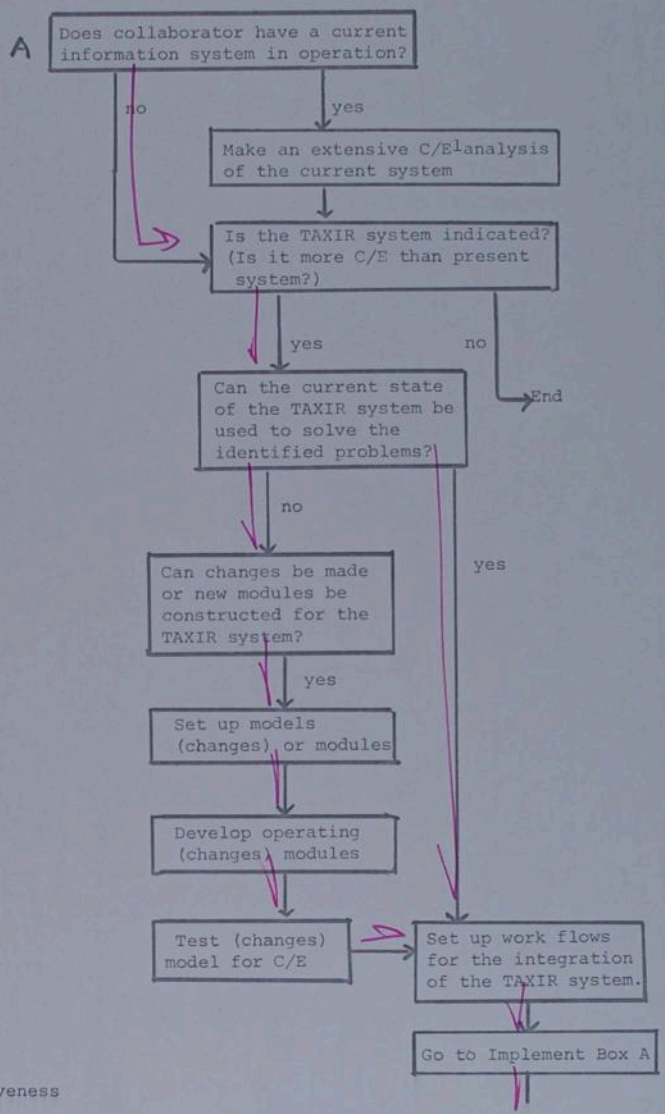
Phwps
4/18/67

THE TAXIMETRICS LABORATORY INVOLVEMENT WITH COLLABORATOR



Research, Systems Development and Testing

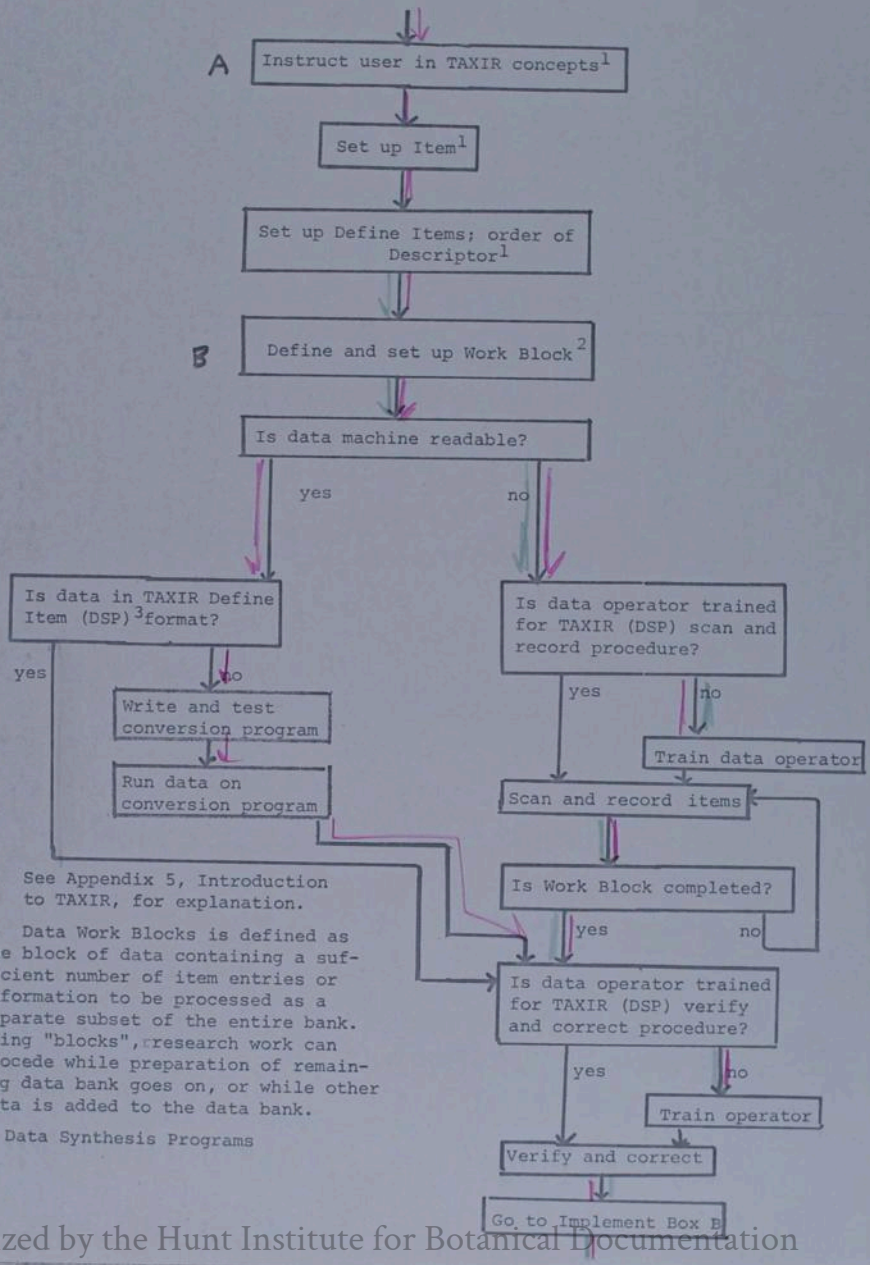




1. C/E = cost/effectiveness

for PHUPS file

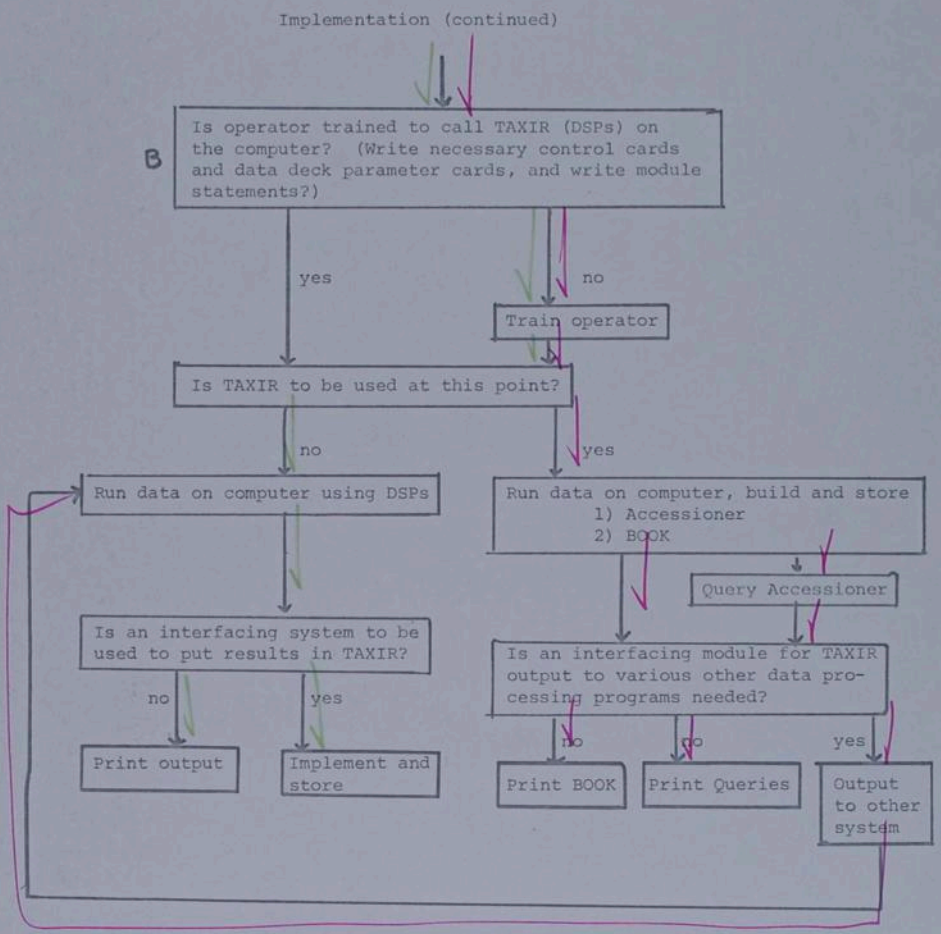
Implementation



1. See Appendix 5, Introduction to TAXIR, for explanation.

2. Data Work Blocks is defined as the block of data containing a sufficient number of item entries or information to be processed as a separate subset of the entire bank. Using "blocks", research work can procede while preparation of remaining data bank goes on, or while other data is added to the data bank.

3. Data Synthesis Programs



Work Program - Summary (continued)

1. TAXIR should be operating within the first 3 - 6 months and should be fully operational during the first 8 - 16 months. Continued updating of the TAXIR system and several TAXLab services should continue throughout the PHUPS project.

2. Certain of the Data Synthesis Systems sould be operational during the first 22 - 30 months. Continued research dialog for theoretical modelling should continue during the PHUPS project.

3. The operational analysis will be on-going during the entire project. The time needed varies as changes are made in the operating systems.

III. The Budget

The cost figures are based on:

1) the costs for the professional staff for the estimated man-days of work;

2) the cost for support staff for the estimated number of man-days; and

3) the cost of equipment (input/output device rented, typewriters, etc.);

4) the rental of computer time for program development and cost/efficiency testing;

5) travel (Boulder-Denver);

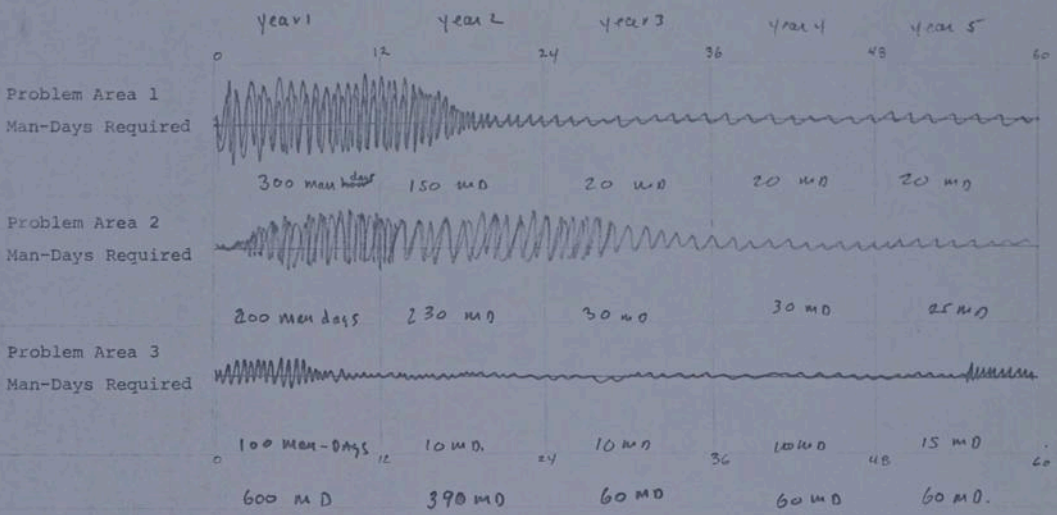
6) general Taximetrics Laboratory overhead;

7) consumable supplies.

Color Code	Months					
	0	12	24	36	48	60
Pink	$25,000	$10,000	$1700	$1700	$1700	
Blue	88000	2,500	800	800	1200	
Green	170000	17,500	2500	2500	2100	

Scale down to $30,000

These amounts should be pro-rated over 12-month periods (years) and paid in equal payments for that year (e.g., Year 1 - about $4,167 per month, etc.)



Each set of tasks faced by the TaxLab to address a major PHUPS problem area is color coded and run through the Task Flow Chart.

The above chart summarizes the times during which tasks will be faced, and the approximate time needed for each task flow.

Man-days - of TaxLab professional research staff only. TaxLab support staff services to be rated at approximately 1 Man-day support staff = 2 days professional staff for this project.

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3. Operating programs for data manipulation (analysis and synthesis) be made available to handle large amounts of data for research programs. Some of the needs have been defined and programs found (statistical package) but the needs for synthetic systems (combinatoric models) will need further development. Training in the use of these programs must be provided for the research staff.

4. These systems must be made available as soon as feasible in order to produce research results so that (a) it can be published, and (b) that the researchers may reevaluate their experimental designs.

5. A determination of the costs of running such programs and systems and of their effectiveness in handling this type of information is necessary.

Under National Science Foundation Grant GN 656, entitled "Development of a Biological Information Retrieval System" the Taximetrics Laboratory has achieved its goal, a system known as TAXIR. The TAXIR system is a currently operative, computer-assisten information storage retrieval system comprised of several related but independent modules, each specifically designed to serve a particular function in information retrieval. One such module is the TAXIR Accessioner. Its task is to accept any Boolean expressions (logical combinations of search criteria) for a collection of items and respond with the list of items which meet the conditions of that Boolean expression.

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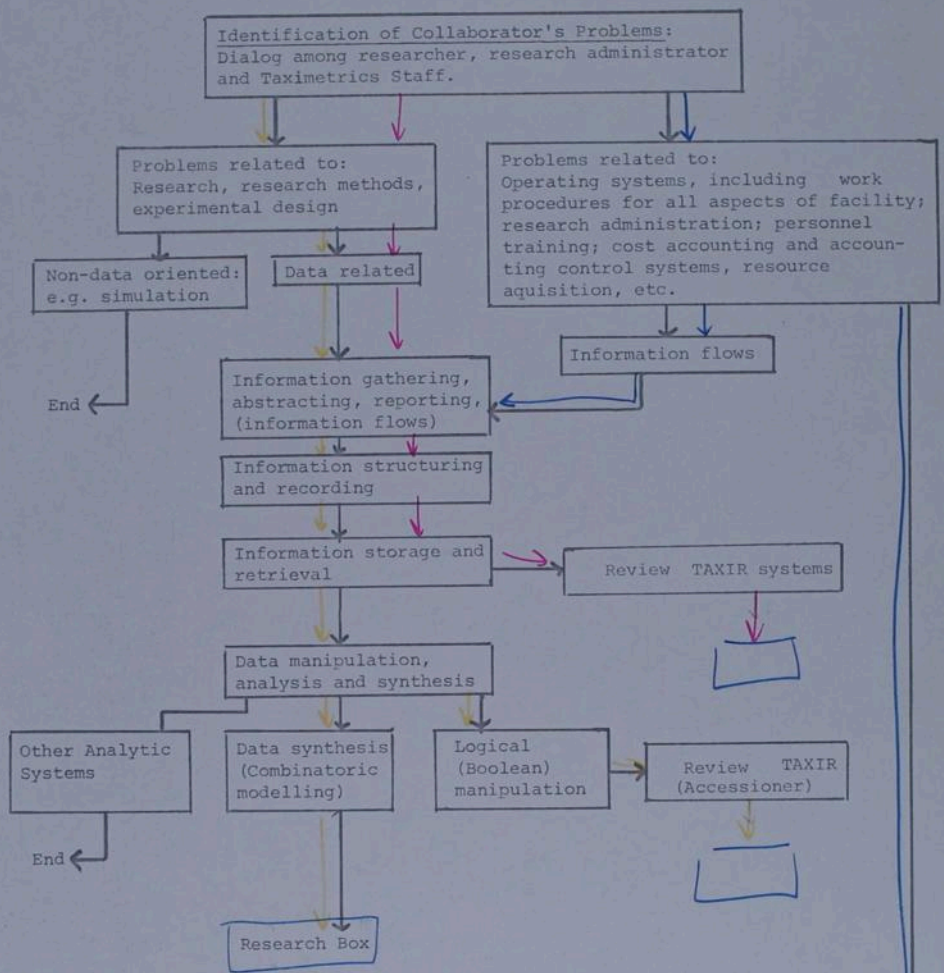
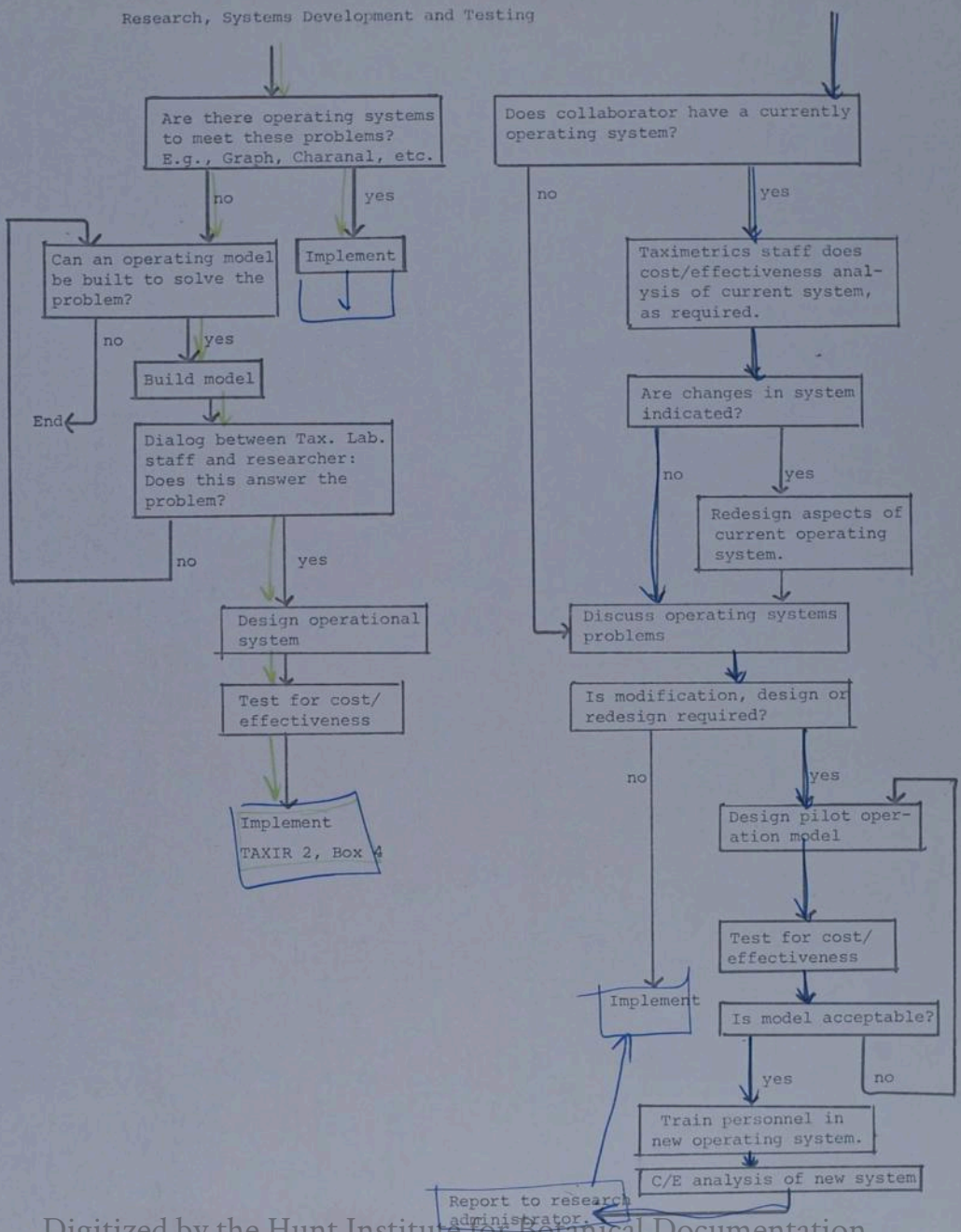
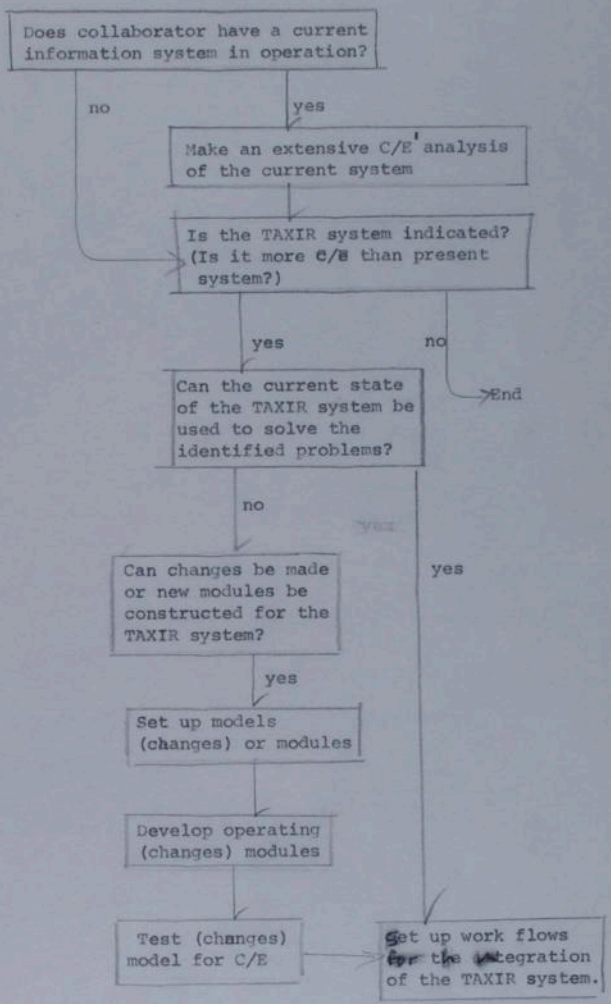
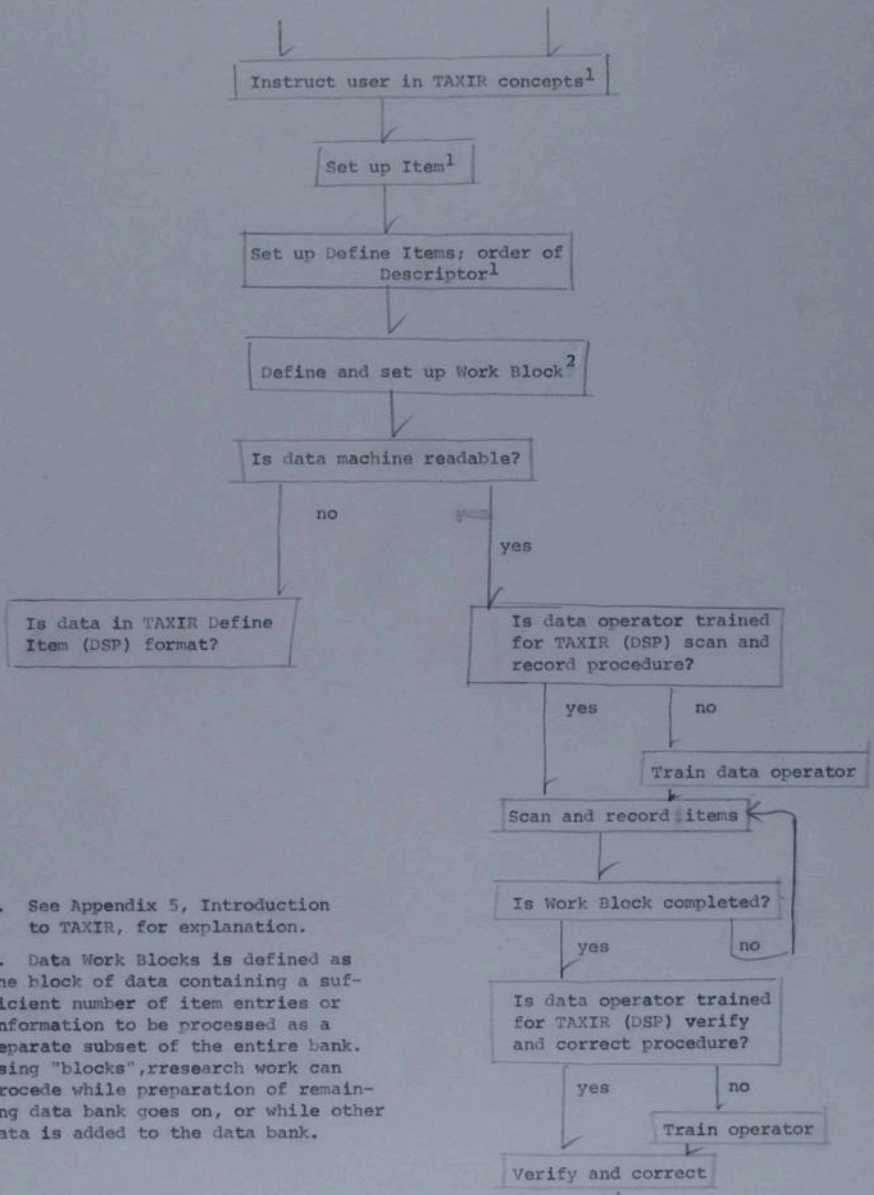






'C/E = Cost Effectiveness

Implementation



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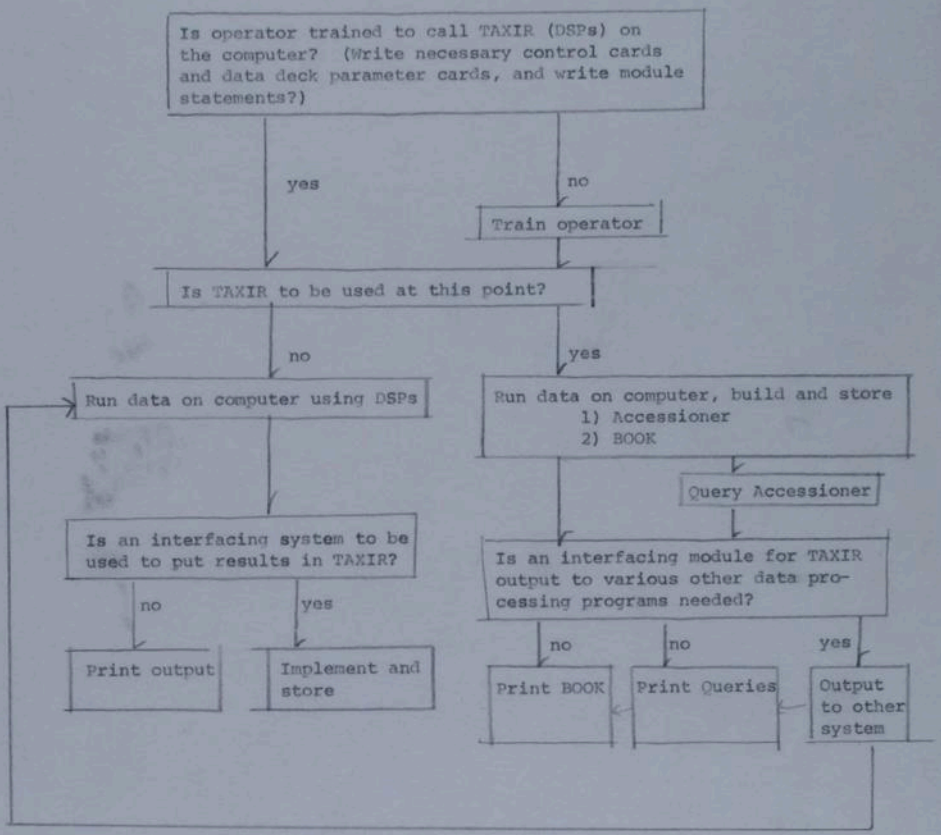

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TAXLAB Resources - [redacted].

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(For a discussion the the TaxLab's view of the relation between mathematics and science, see Appendix .)

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The work program summary and notes indicate the estimated amount of time needed to accomplish these tasks and the estimated time periods during which various tasks will be faced.

The Budget follows, indicating roughly from the work program the amount of money needed to accomplish the various tasks and how payment is requested.

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The cost figures are based on:

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Problem Area 1

Man-Days Required

Problem Area 2

Man-Days Required

Problem Area 3

Man-Days Required

Each set of tasks faced by the TaxLab to address a major PHUPS problem area is color coded and run through the Task Flow Chart.

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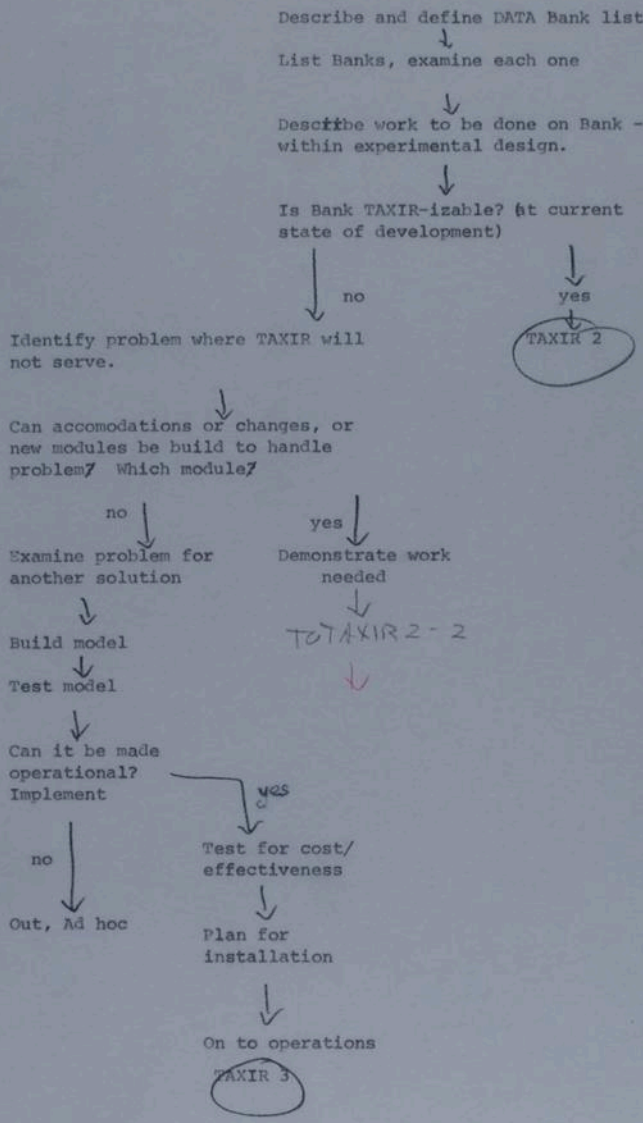

TAXIR 2