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A PROGRAM FOR FACILITATING THE USE OF COMPUTERS IN FEDERAL CONSTRUCTION AGENCIES

TECHNICAL REPORT NO. 64

Prepared by
The Standing Committee on Computer Technology
of the
Federal Construction Council
Building Research Advisory Board
Division of Engineering
National Research Council

National Academy of Sciences
Washington, D. C.
1974

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The members of the Committee selected to undertake this project and prepare this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. Responsibility for the detailed aspects of this report rests with that Committee.

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The Federal Construction Council serves as a planning, coordinating, and operating body to encourage continuing cooperation among federal agencies in advancing the science and technology of building as related to federal construction activities.

In this pursuit, its specific objectives include: Assembly and correlation of available knowledge and experience from each of the agencies; elimination of undesirable duplication in investigative effort on common problems; free discussion among scientific and technical personnel, both within and outside the government, on selected building problems; objective resolution of technical problems of particular concern to the federal construction agencies; and appropriate distribution of resulting information.

The Council as such comprises ten members appointed by the BRAB Chairman from among BRAB membership, plus one member from the senior professional staff of each of the supporting federal agencies (currently nine), also appointed by the BRAB Chairman on nomination from the individual agencies; all appointments are subject to approval by the President of the National Academy of Sciences.

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While the Federal Construction Council itself has overall responsibility for its technical programs, specific projects such as the one reported here are carried out under the direction of appointed task groups or standing committees of engineers, architects, and scientists. Each member, so appointed, serves as a specialist in his field or as a generalist in the problem area, not as a spokesman for or representative of his own agency or any other organization with which he may be associated.

This project was assigned to the Standing Committee on Computer Technology, the members* of which are listed below.

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*Alton Bradford, Department of the Navy, and Donald W. Cryer, Department of the Air Force, served on the committee during part of the time that this report was under development.

FOREWORD

The use of computers by both federal agencies and private professional design firms as an aid in the design of buildings and other fixed facilities has increased dramatically over the past decade. Even so, it appears that the full potential value of computers is far from being realized by the building design community. At the same time, there is considerable evidence that there is substantial duplication of effort in the development of the computer software needed for computer-aided design.

This report describes a new program, developed and to be initiated by the Federal Construction Council (FCC) of the Building Research Advisory Board (BRAB), that hopefully will go a long way toward solving such problems for federal construction agencies. The program, which was developed for the Federal Construction Council by its Standing Committee on Computer Technology, has the approval and endorsement of the Board.

HERBERT H. SWINBURNE, Chairman
Building Research Advisory Board

I
BACKGROUND

Early in 1971, the Standing Committee on Computer Technology of the Federal Construction Council (FCC) undertook, at the request of FCC, an investigation of the feasibility of establishing a federal computer access system. On the basis of its investigation, the Committee concluded that:

A. The full potential of computers is not being realized by the engineering divisions of most federal construction agencies. Although most agencies have made computer facilities available to their engineers (primarily on a time-sharing basis), computer usage by agency engineers has been relatively low in comparison with usual practice in large, private engineering firms and in light of the current level of development of computer technology.

B. The principal reasons for the current underutilization of computers by federal construction agencies are:

   1. That engineers at most agencies have far too few programs of proven validity available to them, primarily because most agencies have insufficient funds available for developing new programs or even for adapting and validating programs developed by others.

   2. That most programs available in the agencies are written in such a way that they can be used only by engineers who have extensive knowledge of computers or only after the using engineer has been given detailed instructions on their use.

C. Solutions to these problems are readily available, and they can and should be implemented through an appropriate interagency program. Specifically,

   1. The problem of too few programs at individual agencies could be solved by pooling the programs already available in the various agencies into a consolidated interagency library of programs and subsequently initiating a coordinated interagency effort to develop new programs.

   2. The problem of computer programs being too difficult for the average engineer to use could be solved through use of the library system developed by the U.S. Army Corps of Engineers that employs programs in which documentation is an inherent part of the program.

The Committee reported these conclusions to the FCC in the spring of 1971 and, at the same time, requested and received FCC authorization to develop the type of interagency program suggested in conclusion C above. This effort was initiated immediately, and in due course, the Committee transmitted to the FCC a prospectus on "A Proposed Program for Facilitating the Use of Computers in Federal Construction Agencies."

The FCC approved the proposed program and authorized its implementation as soon as the various agencies slated for participation agreed. Such agreement has been obtained, and the program is now being implemented. This report describes that program.

II
PURPOSES OF THE PROGRAM

The purposes of the FCC program for facilitating the use of computers in federal construction agencies are:

A. To make available for use by all federal construction agencies, through remote terminals, an extensive library (to be designated FACTS*) of fully validated, easily utilized computer programs dealing with a wide variety of construction-related engineering problems.

B. To promote the continual expansion and refinement of the FACTS library through the coordinated, voluntary efforts of the various agencies.

III
MAIN FEATURES OF THE PROGRAM

Through this program the federal construction agencies will, in essence, pool and share their computer-program resources and coordinate their computer-program development efforts for the benefit of all.

The program will be coordinated by the Federal Construction Council through its Standing Committee on Computer Technology. Work associated with the development, adaptation, refinement, and validation of computer programs will be carried out on a voluntary basis by participating federal agencies. Work associated with the development of the executive program for the FACTS library (i.e., the computer program that serves as librarian) and the preparation of manuals on writing programs for the library and on using the library will be carried out by the Office, Chief of Engineers, U.S. Army Corps of Engineers. The library itself will be maintained by the Atlanta Data Processing Center of the General Services Administration (GSA) and will be made available to federal agencies through the Center's time-sharing system identified as RAMUS, Random Access Multi-user System.

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*Federal Agencies Computer Time-sharing System.

Costs associated with the work of the Standing Committee on Computer Technology will be covered by the general operating funds of the FCC. Costs incurred by the Atlanta Data Processing Center in maintaining the library will be covered by the standard charges for time-sharing services. Costs associated with the work of the Office, Chief of Engineers, U.S.Army Corps of Engineers, will be absorbed by that agency.

IV
ANTICIPATED BENEFITS

Since many more computer programs will be stored in the FACTS library than in the library of any single agency and since these programs will be in a more usable format than are most current programs, agency engineers will be able to use computers more often and more easily than they have in the past. As a result, agency engineers should be able to perform more effectively such duties as preparing design criteria, reviewing and checking design calculations of private consulting engineers, and developing original designs.

It is believed that the increase in computer usage will be at little or no additional cost for most agencies, except for the added direct time-sharing charges. The FCC believes that the extra time-sharing charges will be more than offset by the increase in efficiency and effectiveness of agency engineers.

V
ROLES OF ORGANIZATIONS PARTICIPATING IN THE PROGRAM*

A. Federal Construction Council

The FCC generally will be responsible for overall coordination of the program and specifically for ensuring that the level and nature of activity under the program are in accordance with the needs of the agencies. To carry out its responsibilities, the FCC will require periodic status reports from its Standing Committee on Computer Technology, the group responsible for coordinating the program on behalf of the FCC.

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*See Figure 1.

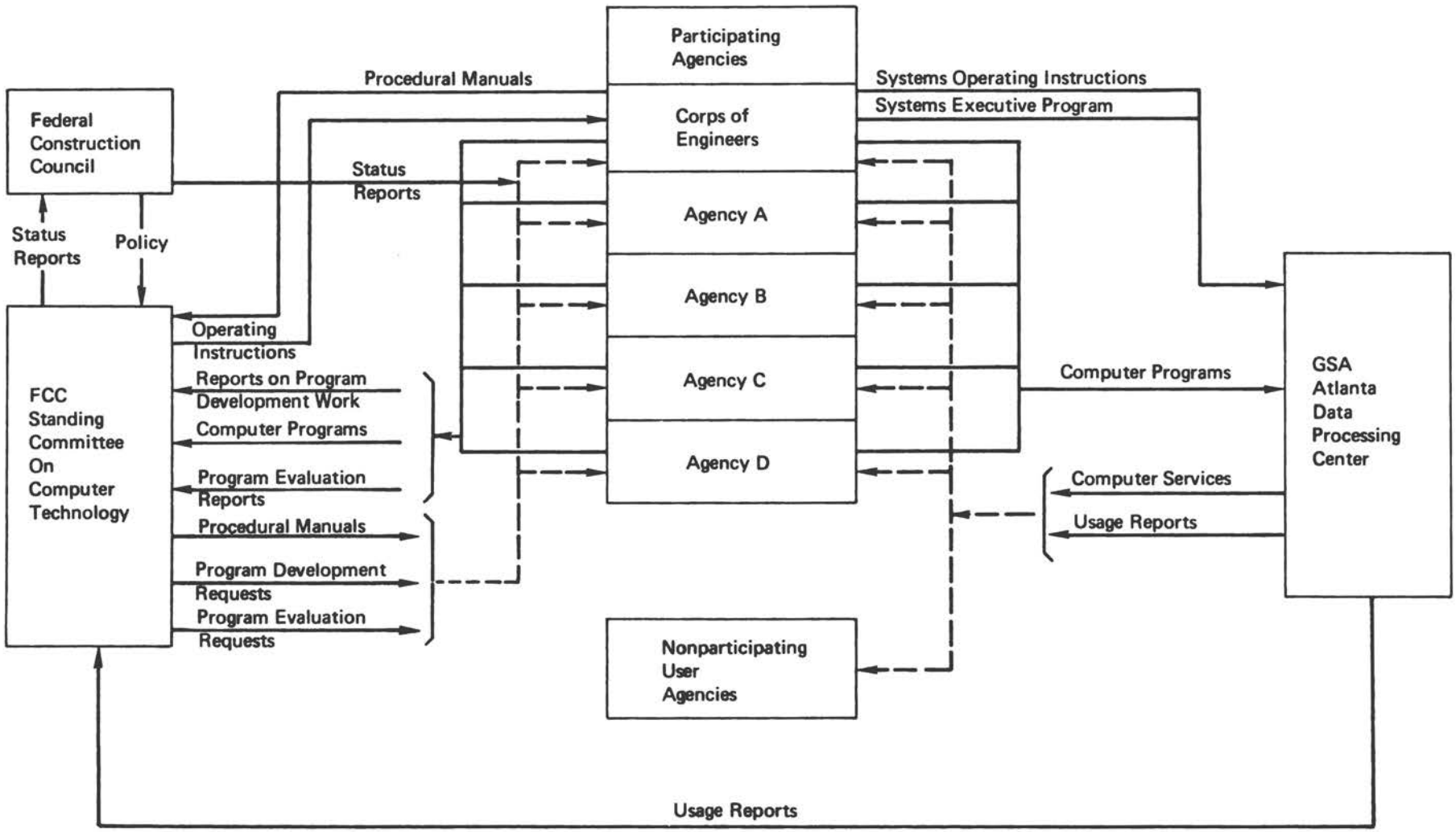

Figure 1 Flow-of-information diagram

B. FCC Standing Committee on Computer Technology

The FCC Standing Committee on Computer Technology generally will be responsible for coordinating the program on behalf of the FCC and specifically for:

1. Disseminating to participating agencies information on the program including lists of computer programs available in the FACTS library, manuals on how to prepare programs for inclusion in the library and how to use the library system, and reports on computer-program development work under way at participating agencies.

2. Arranging workshops to instruct appropriate agency personnel in the use of and the preparation of programs for the FACTS library.

3. Identifying areas in which computer-program development work is needed and promoting the initiation of such work at the agencies.

4. Determining the nature and level of activity at participating agencies with regard to computer-program development and FACTS library usage.

5. Arranging for evaluation of the technical quality of programs placed in the FACTS library.

6. Periodically reviewing the operation of the FACTS library and, when necessary, recommending changes in its operation.

7. Providing the FCC and participating agencies with periodic status reports on the program.

C. Office, Chief of Engineers, U.S. Army Corps of Engineers

The Office, Chief of Engineers (OCE) will be responsible for developing the executive program that controls the FACTS library (i.e., acts as librarian). The OCE also will be responsible for developing and maintaining manuals on how to prepare computer programs to be placed in the library and on how to use the library, for directing (on behalf of the Standing Committee) the daily operation of the FACTS library, and for answering user questions during the start-up period.*

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*Much of the development work for which the OCE will be responsible has already been completed, and the OCE's task essentially will be to adapt available material. The documents prepared by the OCE will be made available to the central offices of federal agencies through the FCC Standing Committee on Computer Technology.

D. Participating Agencies*

Each agency participating in the program will be expected to:

1. Be a RAMUS subscriber.**

2. Modify, in accordance with the instructions to be prepared by the OCE, those computer programs it currently has that are selected for inclusion in the FACTS library.

3. Coordinate its computer-program development work with other participating agencies through the FCC Standing Committee on Computer Technology.

4. Assist in evaluating computer programs prepared by other agencies.

5. Train its personnel in the use of the FACTS library and in the preparation of programs for inclusion in the library (the FCC Standing Committee will provide training for a cadre of agency personnel).

6. Publicize the existence of and promote the use of the FACTS library among its personnel.

E. GSA Atlanta Data Processing Center

The Atlanta Data Processing Center will store the FACTS library in its computer and will make it available to all federal agencies through RAMUS, its time-sharing system. If deemed desirable in the future, the Center also may assume the administrative responsibilities of the OCE in the program.***

VI
PROCEDURES AND PRACTICES

A. Appointment of Members to the Standing Committee on Computer Technology

Members of the Standing Committee on Computer Technology will be appointed in accordance with the usual procedures of the Federal Construction

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*Initially, there will be five participating agencies: the Naval Facilities Engineering Command, the Public Buildings Service of GSA, the National Aeronautics and Space Administration, the Veterans Administration, and the Corps of Engineers.

**Agencies not presently subscribing to RAMUS can do so by contacting the GSA.

***If the Atlanta Data Processing Center does assume these responsibilities, some means of reimbursement for services will have to be devised.

Council; i.e., by the Chairman of the Building Research Advisory Board, based on nominations by federal construction agencies, with the approval of the President of the National Academy of Sciences. All supporting agencies of the Council and all other federal construction agencies participating in the program will be invited to nominate individuals for committee membership.

B. Eligibility Requirements for Agencies Wishing To Participate in the Program

Any federal agency directly responsible for construction that possesses a construction-related computer activity and indicates a willingness to carry out the duties of a participating agency will be eligible to participate in the program. (An agency would not be required to participate in all aspects of the program, such as submitting programs or reprogramming present programs, to use the FACTS library; the only essential requirement is that an agency be a RAMUS subscriber.)

C. Preparation and Dissemination of Required Manuals

Manuals on preparing computer programs for incorporation in the FACTS library and on using the library will be prepared by the OCE and will be reviewed and disseminated by the FCC Standing Committee on Computer Technology. After dissemination, the Committee will seek suggestions from users on improving the manuals and will arrange for the preparation of revisions when necessary.

D. Administration of the FACTS Library

Acting on behalf of the FCC Standing Committee on Computer Technology, the OCE will handle the day-to-day administration of the FACTS library including such matters as directing the placement of new programs in the library, instituting changes in the executive program, and answering inquiries from agencies regarding the operation of the FACTS library. (Inquiries about a specific program in the library will be referred to the agency that prepared the program.)

E. Selection of Computer Programs To Be Developed or Adapted for Use in the FACTS Library

After initiation of the program and development of the required manuals, the FCC Standing Committee on Computer Technology will obtain documentation on the programs already in use at the various agencies. In consultation with specialists in the different engineering disciplines, the Committee will select from among the programs available at each participating agency those having broad applicability and will submit to each participating agency a request that it adapt the selected program for use in the FACTS library in accordance with the program preparation manual.*

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*It is anticipated that approximately 100 currently available programs will be adapted for inclusion in the FACTS library within one year.

At the beginning of the second year of the program, or after a significant number of available computer programs have been adapted for use in the FACTS library, the Committee will, in consultation with specialists in the different engineering disciplines, identify engineering problems for which computer programs should be developed. The Committee then will request that the various participating agencies volunteer to develop one or more new programs for solving identified problems. This process will be repeated annually.*

With regard to both adapting existing programs and developing new programs for use in the FACTS library, participating agencies will be free to undertake work other than that requested by the Standing Committee; however, agencies will be expected to give some priority to requested work and to keep the Committee informed of the status of program development work under way.

Annually, the Standing Committee will prepare for dissemination by the FCC a report indicating program adaptation and development work scheduled, under way, and completed at the various agencies.

F. Composition of the FACTS library

The FACTS library will include programs dealing with all construction-related engineering disciplines. A directory of programs stored in the library will be maintained and periodically printed and distributed to users; users also will be able to obtain a printout of the directory from the computer, via time-sharing terminals.

The FACTS library will not be stored as an entity in the Atlanta Data Processing Center computer. Rather, it will be stored as part of various other libraries in the computer (see Figure 2). Frequently used, widely applicable programs in the FACTS library will be stored in the general library section of the computer (to which all time-sharing customers have access); infrequently used programs in the FACTS library will be stored in the libraries of individual agencies. (Generally an infrequently used program will be stored in the library of the agency that developed it.) This manner of storage will not adversely affect the user of the FACTS library since any program in the FACTS library will be available to a user regardless of where it is stored. Some agencies, however, might have special programs stored in their individual libraries that are not in the FACTS library, and other users would not have access to such programs.

Actually the storage arrangement for the library is important only because it affects storage charges. The cost of storing programs in the general library section of the computer will be absorbed by the Atlanta Data Processing Center, whereas agencies will pay the standard RAMUS storage fee for programs stored in their individual libraries.

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*It is anticipated that in five years the FACTS library will include at least 250 programs.

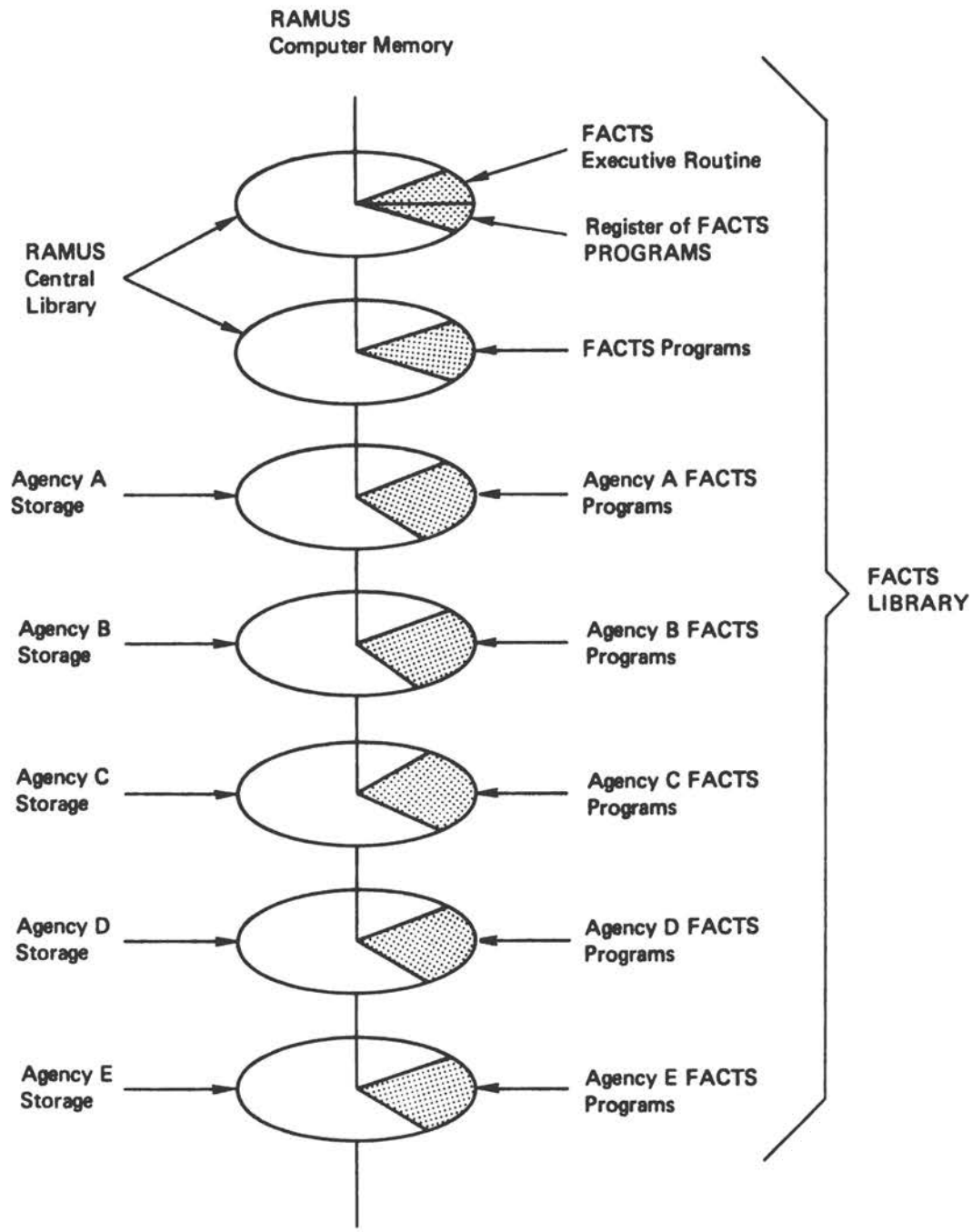

Figure 2 FACTS Library Storage Arrangement

The Atlanta Data Processing Center and the Standing Committee will jointly decide which programs are to be placed in the general library section. This determination will be made on the basis of frequency of use; a record of the number of times each program in the FACTS library is used will be maintained in the computer and a quarterly report on usage will be prepared for the agencies and the FCC by the Standing Committee.

G. Review and Validation of Computer Programs

A two-step procedure will be used to ensure the technical validity of programs in the FACTS library.

First, each program newly developed or adapted for inclusion in the FACTS library will be labeled an "unvalidated program" and users will be requested to comment to the FCC on the results obtained using it.*

Second, after a new program has been in the library for six months to one year, the FCC Standing Committee on Computer Technology will ask a participating agency, other than the preparing agency, to evaluate the program. In evaluating a program, an agency will be expected to review comments received from users in addition to making an independent analysis of the program. The evaluating agency will be instructed to judge the technical validity of the program, the clarity of user instructions, and the appropriateness of the input and output formats. After completing its evaluation, the reviewing agency will be expected to submit a brief report of its findings to the Committee. If the reviewing agency finds no problems with the program, the "unvalidated program" label will be removed and the program will be considered fully approved. If the reviewing agency identifies problems with the program, the report of the reviewing agency will be sent to the preparing agency with a request that it consider correcting the identified faults. After correction of the identified faults, the revised program again will be placed in the library with or without the "unvalidated program" label, depending on the extent and nature of the changes made. If the revised program is labeled "unvalidated," the review process will be repeated. Should the reviewing agency and preparing agency disagree on the need for changes, the Standing Committee will mediate the dispute. If a mutually satisfactory solution cannot be found, the program may be retained indefinitely in the library with the "unvalidated program" label.

H. Training of Programmers and Users

Introduction of the system requires both the training of programmers to assemble the preambles necessary for each program, and the training of

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*Users will be free to submit comments on any program in the library, but they will be specifically requested to submit comments only on unvalidated programs.

users. The Committee will conduct training workshops of both types for a cadre of personnel from each agency and this cadre will be responsible for dissemination of the information throughout that agency. After these initial workshops have been completed and evaluated, a series of "updating" workshops will be held as needed to discuss new innovations in the system, train personnel from new agencies, and provide additional training required by the original agencies.

VII
IMPLEMENTATION SCHEDULE

The overall program will become fully operational within one year of initiation. The schedule for carrying out the various start-up tasks during the first year is shown in Figure 3.

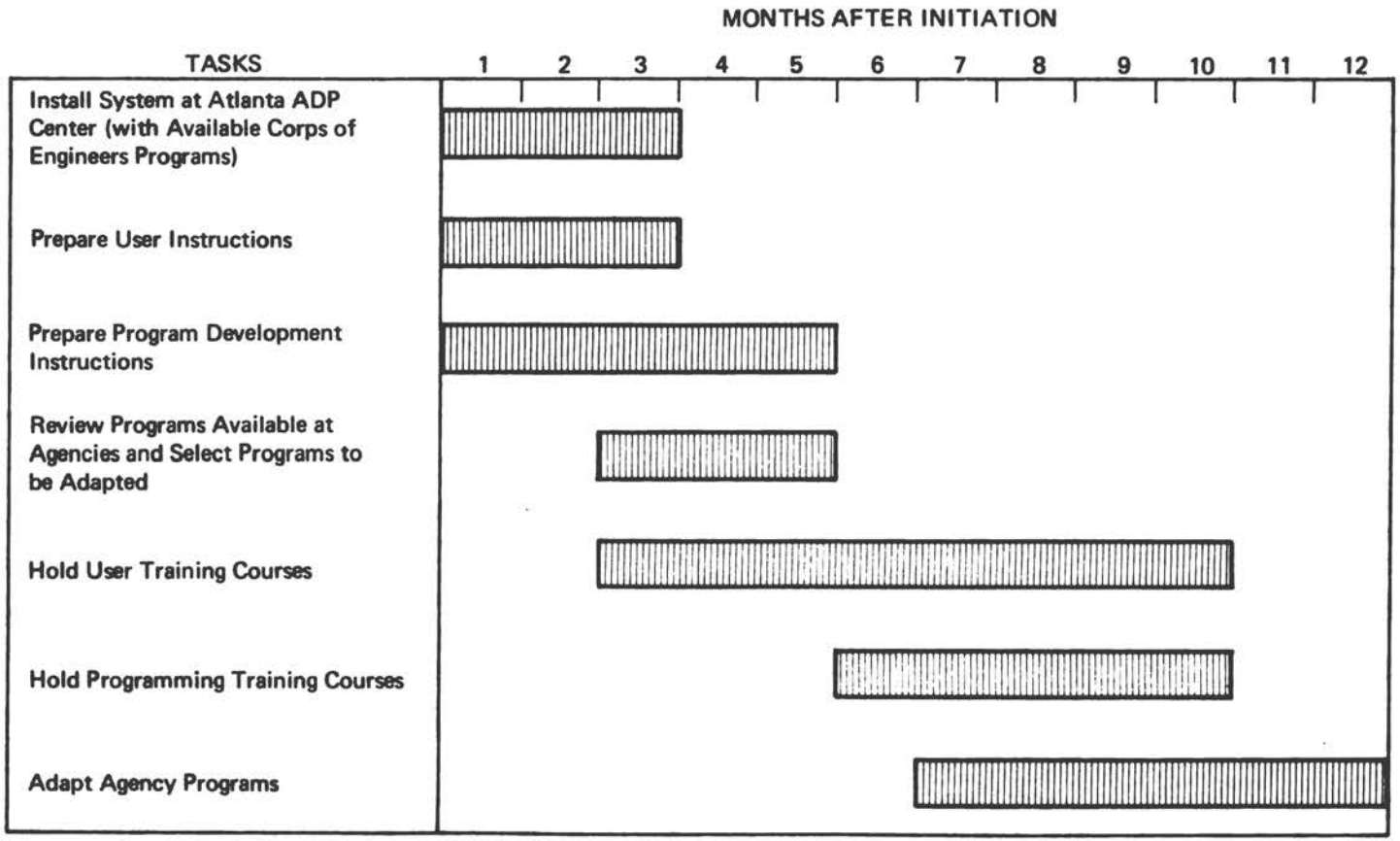

Figure 3 Implementation Schedule