N O T I C E

THIS DOCUMENT HAS BEEN REPRODUCED FROM MICROFICHE. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE

FOREST RESOURCE INFORMATION SYSTEM

Phase III Quarterly Report

for the period

1 April 1979 to 30 June 1979

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Johnson Space Center
Earth Observations Division
Houston, Texas 77058

Contract: NAS 9-15325
Technical Monitor: R. E. Joosten/SF5

Submitted by:

The Laboratory for Applications of Remote Sensing
Purdue University
West Lafayette, Indiana 47906

Principal Investigator: R. P. Mroczynski

Star Information Form

1 Report No	2. Government Accession No.	3. Recipient's Catalog No

4. Title and Subtitle	5. Report Date
Forest Resource Information System Phase III Quarterly Report	30 June 1979
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No
R. P. Mroczynski	063079

9. Performing Organization Name and Address	10. Work Unit No
Laboratory for Applications of Remote Sensing Purdue University West Lafayette, IN 47906	11. Contract or Grant No. NAS 9-15325

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
NASA/Johnson Space Center Earth Observation Division Houston, TX 77058	Quarterly 1 Apr 79 to 30 June 79
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report covers the first quarter of the fifteen-month System Transfer Phase of the Forest Resource Information System Application Pilot Test. The principal Activities during this quarter revolved around developing implementation plans, and training St. Regis staff in Landsat analysis procedures

This report includes the implementation schedule planned for Phase III.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Implementation LARSYS Preprocessing Management Technology Transfer	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*

*For sale by the National Technical Information Service, Springfield, Virginia 22161

NASA - JSC

FOREST RESOURCE INFORMATION SYSTEM

Phase III Quarterly Report

for the period

1 April 1979 to 30 June 1979

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Johnson Space Center
Earth Observations Division
Houston, Texas 77058

Contract: NAS 9-15325
Technical Monitor: R. E. Joosten/SF5

Submitted by:

The Laboratory for Applications of Remote Sensing
Purdue University
West Lafayette, Indiana 47906

Principal Investigator: R. P. Mroczynski

INDEX

FRIS PROJECT OVERVIEW

The Forest Resource Information System Project (FRIS) is a cooperative effort between the National Aeronautics and Space Administration (NASA) and St. Regis Paper Co. (STR). Purdue University's Laboratory for Applications of Remote Sensing (LARS), under contract to NASA, will supply technical support to the project.

FRIS is an Application Pilot Test (APT) Project funded by NASA. The project is interdisciplinary in nature involving expertise from both the public and private sectors. FRIS also represents the first APT to involve a large broad base forest industry (STR) in a cooperative with the government and the academic communities.

Purpose

The goal of FRIS is to demonstrate the feasibility of using computer-aided analysis techniques applied of Landsat Multispectral Scanner Data to broaden and improve the existing STR forest data base, thereby creating the foundation of a dynamic information system. The successful demonstration of this technology during the first half of the project will lead to the establishment by STR of an independently controlled operational forest resource information system in which Landsat data is expected to make a significant contribution. FRIS can be viewed by the user community as a model of NASA's involvement in practical application and effective use of space technology. Additionally, FRIS will serve to demonstrate the capability of Landsat MSS data and machine-assisted analysis technology to private industry by:

- Determining economic potentials,
- Providing visibility and documentation, and

- The ability to provide timely information and thus serve management needs.

The ultimate long term successfulness of FRIS can be measured through future development of remote sensing technology within the forest products industry.

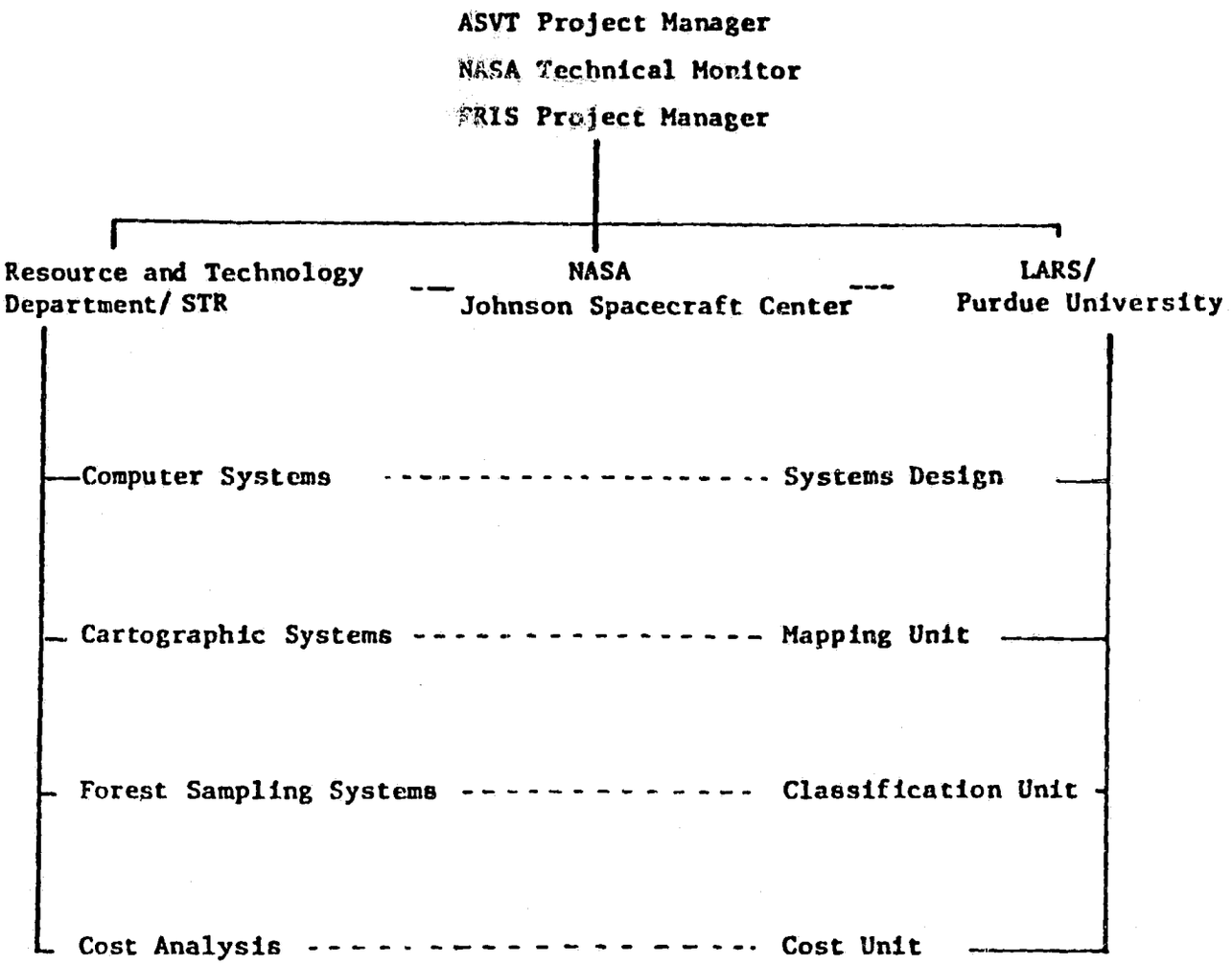
Scope

FRIS is funded as a modular or Phase project with an anticipated duration of three years. The original project concepts were developed in 1973, and a formal project plan was submitted to NASA by STR in 1976. The project officially began in October 1977 after the signing of a cooperative agreement between NASA and STR; and after the compelltion of contractual arrangements with Purdue University.

Organization

The organization of FRIS is depicted in the chart that follows. Since FRIS is a cooperative involving three independent agencies, a steering committee consisting of a project manager from each institution was formed to provide for overall guidance and coordination. Operationally, both STR and LARS have project managers and project staff to insure for the timely completion of acitivities within the project. The NASA technical coordinator monitors project activities and provides a liaison between the STR and LARS staffs. The solid lines on the chart indicate the flow of management responsibility. The dash lines reflect the technical and scientific inter-changes between operating units.

FRIS Organization



Acknowledgements

In any project of this size and scope there are a number of individuals who provide inputs to the principal investigator. Often some of these individual efforts go unheralded and are lost in the glut of paperwork a contract, such as FRIS, produces. Even the principal investigators efforts to acknowledge such contributions sometimes fail. Such was the case in the acknowledgements section of the previous report. Bill Shelley made a significant contribution to the System Design section of the Phase II Demonstration report but was not properly acknowledged. This unfortunate occurrence went unnoticed by the editor until after publication of the document. Such an occurrence will hopefully be avoided in the future.

Contributors of note to this document are Dave Freeman and Bill Shelley. Both individuals have provided invaluable guidance to the principal investigator in developing task activities, timelines and resource requirements.

1.0 Introduction

This report marks the completion of the first quarter of the System Transfer Phase, or the third Phase of FRIS. Phase III is designed to span a 15-month period culminating in ~~September~~ June 1980. As the name implies Phase III deals with the definition, transfer and preliminary implementation of the FRIS Image Processing Subsystem (FIPS). As with the preceding phase, Phase III is directed at meeting the overall Project goal:

> To document and transfer remote sensing technology developed throughout the project that will provide St. Regis with an independent operational system, having Landsat data as a significant and viable contributor.

This report will serve to document the organizational structure of the project to meet this goal. Task objectives, timelines and significant milestones will also be outlined as will the planned allocation of financial resources.

1.1 Background

The approach to the System Transfer Phase was promulgated through the results of tasks conducted during Phase II. Specific direction for FIPS was developed as part of the preliminary system design task initiated during Phase II. Figure 1 defines the proposed structure for FRIS. The three major components are:

- o The Image Processing Subsystem
- o The Graphics Subsystem, and
- o The Inventory and Tabular Data Base

Since the inventory and tabular data base component of FRIS already

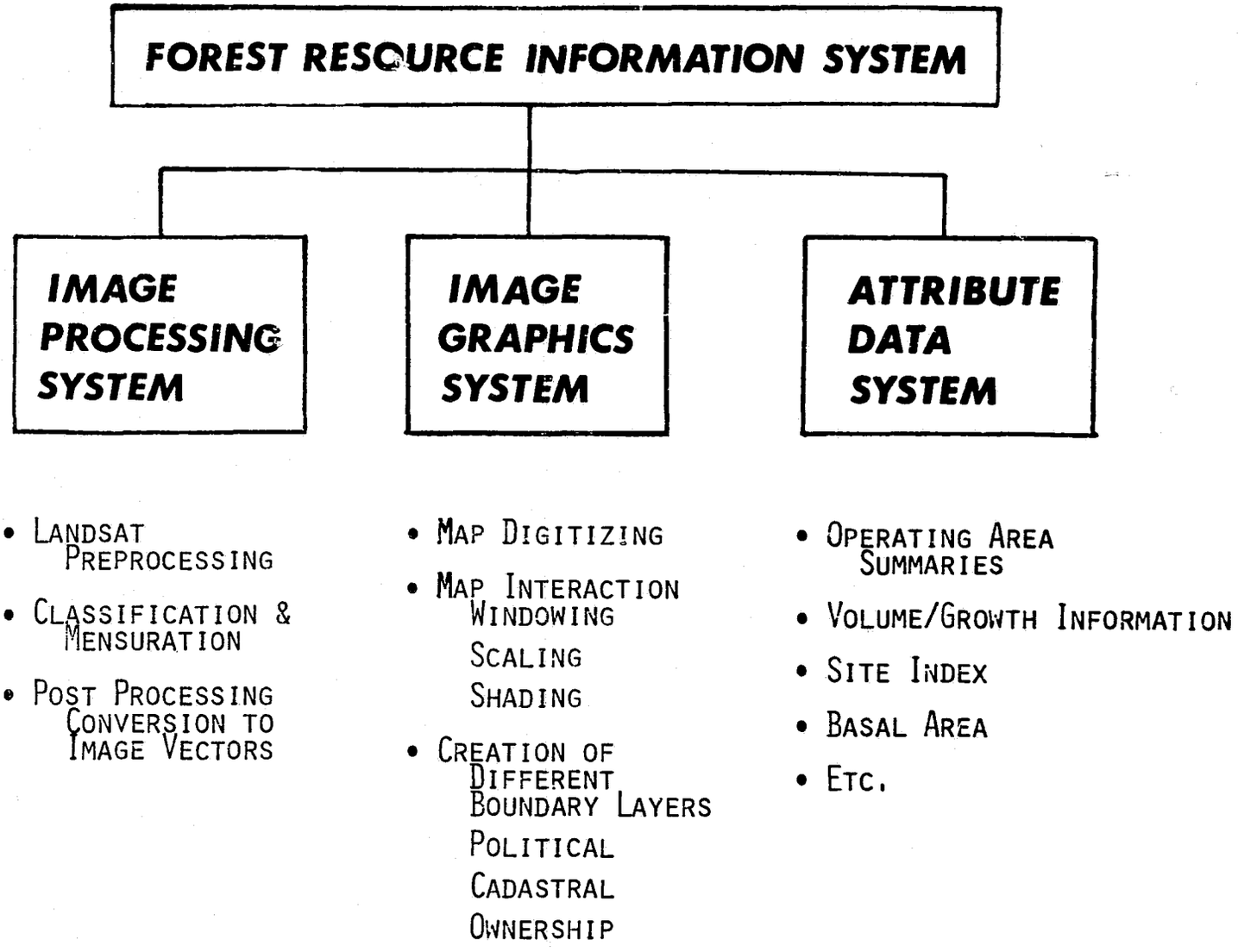


Figure 1. The proposed structure for FRIS consisting of three independent subsystems.

exist, the emphasis during Phase III will be aimed at developing the first and second subsystems.

Results from the preliminary system design committee indicated:

- LARSYS 3.1 and LARSYSDV would be the basis of any image processing software transferred to St. Regis.
- LARS Landsat preprocessing software would be transferred to St. Regis as part of the LARSYS package.
- Classification techniques developed during Phase II would be the procedures used for an operational FRIS.
- LARSYS and its accompanying preprocessing software would be implemented on an IBM Computer located at St. Regis' National Computer Center.
- The software would be converted to operate in a batch rather than virtual machine operating environment.
- The geo-referenced data base would be acquired from an independent vendor.
- The data base would have to be able to interface with the LARSYS software.
- The data base software would be installed on a mini-computer located at the Southern Timberlands Divisional Offices.

1.2 Approach

In order to meet the requirements of transferring a technology together with its requisite software, certain organizational changes were made in the project structure. The Unit organization developed

for the Demonstration Phase was not appropriate for Phase III. Therefore, the Project has been restructured according to the organization chart in figure 2.

A detailed discussion of the activities involved during the System Transfer Phase appears in the sections that follow.

2.0 Detailed Implementation Schedule

For the System Transfer Phase to be successful, three major activities must occur. The ability to classify Landsat data and interpret classification results has to be transferred to the user. The required software used in preparing and analyzing Landsat data must be implemented and operational on the users computer. Therefore, the major project tasks for Phase III have been defined as:

- o Technology Transfer
- o LARSYS Transfer
- o Preprocessing Transfer

Detailed discussion of these activities can be found in the sections that follow.

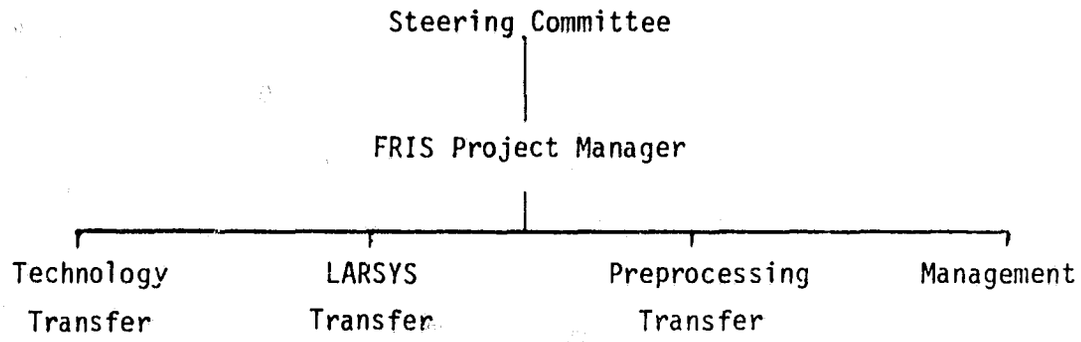


Figure 2. System Transfer organizational structure.

2.1 Technology Transfer

The technology transfer task deals with educating the user on the classification procedures developed during Phase II. In order to help develop an independent capability for STR staff to handle the Landsat classifications a remote terminal to the LARS computer has been installed and is operational at Jacksonville, FL. This terminal facility will be the focal point of most training activities under this task.

The terminal installation will serve a dual function during the 15-month transfer phase. Initially, it will provide on-site access to LARSYS for the STR users. Secondly, after the system is operational at NCC it will again serve as a training vehicle by which STR users will learn to manipulate their own system.

Other activities that will occur as part of technology transfer include:

- o Photo-interpretation short course
- o Development of user documentation for operating both the LARS and NCC Systems, and
- o User consultation.

A breakdown of these activities follows. Timelines for these activities appear in Exhibit 1.

A. Training

Training activities are in two forms, short courses and workshops. Short courses are more formalized, classroom environment sessions. They are usually aimed at providing concepts and background information. Workshops usually involve more interactivity with the data, and hands-on involvement by the user.

Both forms will be offered to STR staff as required.

1. Short Courses
2. Workshops
3. Photo-interpretation Short Courses

B. Consultation

Consultation is an on-going activity associated with the operation of the remote terminal. It is designed to assist the user solve problems that he may encounter during a terminal session.

C. Documentation

There are two levels of user documentation required during the system transfer phase. The first involves support of terminal sessions to LARS. The second will occur after LARSYS is operational at Dallas, and involves support of terminal sessions to NCC.

1. LARS User Documentation
2. NCC User Documentation

D. Terminal Operations

Like consultation this activity is on-going as long as the JAX terminal operates to LARS. This activity is designed to insure that the terminal, modems, phone lines, and other communications links are operational and that the user has access to the system.

Exhibit 1

FRIS III Timeline Chart

Task: TECHNOLOGY TRANSFER	Calendar Year				
	1979			1980	
	4/1 - 6/30	7/1 - 9/30	10/1 - 12/3	1/1 - 3/31	4/1 - 6/30
Activity:					
A. TRAINING					
1. SHORT COURSES	▼				
2. WORKSHOPS		▼			
3. PHOTO-INTERPRETATION SHORT COURSE			▽		
B. CONSULTATION	▼———	———	———▽		
C. DOCUMENTATION					
1. LARS USER DOCUMENTATION		▼			
2. NCC USER DOCUMENTATION			▽	———	———▽
D. TERMINAL OPERATIONS	▼———	———	———▽		

▽ planned start of activity

▼ actual start of activity

▽——▽ duration of activity

▼——▽ progress toward activity completion

2.2 LARSYS Transfer

The core of FIPS consists of the LARSYS software package. LARSYS is a well documented system designed to process digital multispectral scanner data. The system currently operates on an IBM 370/148 in a virtual machine environment. FIPS will not include the entire LARSYS package, will operate on either an IBM 370/168 or 3033, and will have job initiation through remote job entry stations.

The major requirements of this task will be the modification of the existing software to run on a batch machine. STR staff will assist in this implementation, and LARS personnel will provide guidance and consultation as needed. A list of potential functions and subroutines that will be transferred are included as Appendix I of this report.

A list of anticipated task activities follows. Timelines for these activities appear in Exhibit 2.

A. Planning

Since the transfer of software will involve individuals from both STR and LARS, it is important that planning occurs early during Phase III to identify organizational responsibilities. The System Design Committee established during Phase II will coordinate these activities and be responsible for developing implementation timelines.

B. Transfer

This activity involves the physical act of preparing software elements and transferring these to STR staff.

C. Consultation and Debugging

This activity will occur on an as needed basis once the program

tapes have been physically transferred to NCC.

D. Documentation

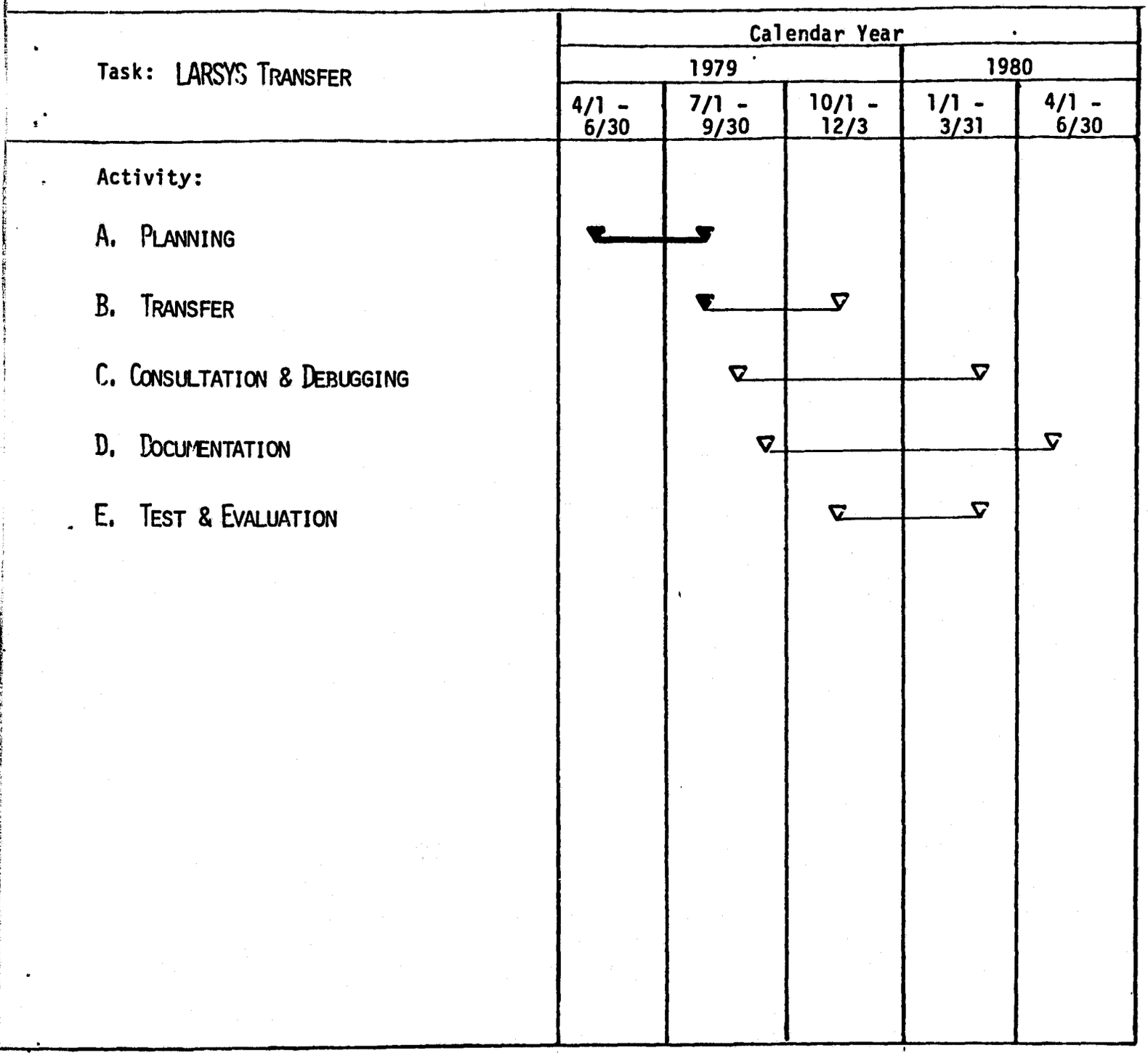
Software documentation is a requisite for successful system operation. Various levels of documentation that may be provided include; program, system, and user levels. The precise details of documentation to be provided will be determined by the System Design Committee.

E. Test and Evaluation

Once the software has been transferred and is operational system tests will be run from a remote terminal between LARS and NCC.

Exhibit 2

FRIS III Timeline Chart



planned start of activity

actual start of activity

duration of activity

progress toward activity completion

2.3 Preprocessing Transfer

This task involves transfer of the "front-end" software that is necessary to prepare the Landsat data for classification. A significant expenditure of effort is required for this task because of the complexity of the software and its current level of documentation. Initially, a software definition or planning activity is required to define the specific components to be transferred to NCC.

Software to handle the new Landsat 3 formats has been defined and is currently in development. An evaluation of the Landsat 3 data will be made so that we can define the extent which other processors should be transferred to STR. Minimally, we know that parts of the geometric correction and image registration software will be transferred.

Other major activities included under this task involve assisting in the development of a FRIS map coordinate system and defining the form and operations of a remote reformatting capability. A breakdown of the preprocessing task activities will follow. Proposed timelines for these activities appear in Exhibit 3.

A. Planning

The early portions of this task in Phase III have been dedicated to defining processors and developing implementation plans. Uncertainty regarding EDC data products, especially for corrected Landsat 3 data, has caused some delays in developing these plans. As more information becomes available regarding the Landsat 3 formats, more refinement of the implementation schedule is possible.

B. Program Refinement

Since EDC will be providing geometrically corrected Landsat data as a standard product, we must adapt our preprocessing programs to accomodate this new format. Specific programs that will be reworked include: reformatting, geometric correction, and image registration.

1. Landsat 3 Reformatting

These programs are designed to handle the new MDP format CCT's from EDC. Data is converted to a LARSYS tape format compatible for classification. Program development was initiated during Phase II.

2. Geometric Correction

The Landsat 3 data evaluation activity (G.1) will help define the extent of the geometric correction programs to be transferred. Minimally, we anticipate some of the geometric corrections sub-routines (such as the image rotation sub-routine) will be transferred.

3. Image Registration

The image registration routines are those programs used to create multi-temporal Landsat data sets, and data sets that include ancillary map information. The extent to which the image registration programs will be used to create map data depends on the data base system STR selects. This decision is still pending.

C. Program Transfer

This activity involves the physical transfer of program tapes to NCC.

D. Consultation and Debugging

This activity involves working closely with STR staff to help insure that the preprocessing program functions at NCC.

E. Documentation

This is a support activity associated with all the above. However, once the system has been installed, tested and is stabilized at NCC, a major documentation coordination activity will be undertaken. Output will consist of a set of preprocessing user and system documents.

F. Test and Evaluation

This activity will involve the initiation of preprocessing jobs from a remote terminal at LARS. Results will be evaluated against the same set of jobs run on the LARS computer.

G. Support Activities

There are a number of ancillary activities that support the transfer of the preprocessing software. These are indicated below:

1. Landsat 3 Data Evaluation

This involves an evaluation of the Landsat 3 data product and its suitability as the only satellite data source for an operational FRIS.

2. FRIS Map Coordinates

This activity addresses the problems of relating data in raster form to data in vector form. LARS personnel will work closely with STR staff to define an internal coordinate system which will accept both data forms.

3. Reformatting Operations

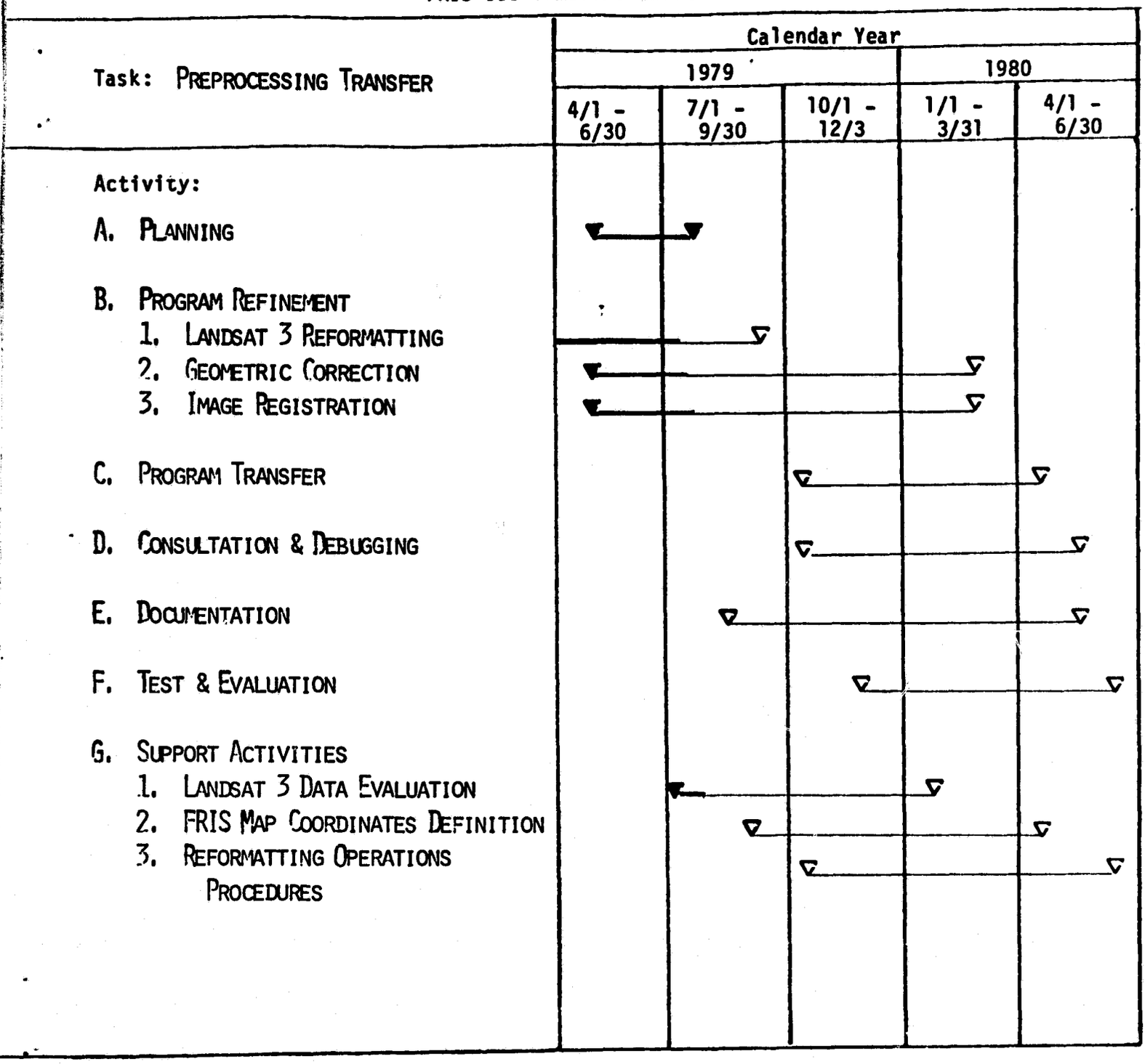
Ultimately the preprocessing activity for FRIS will operate in a batch environment with user initiation from a remote site. This is a slightly different environment from the current operation. Because of the different operating environment, we will develop procedures documents for the preprocessing activities. Likewise, we anticipate developing some scheduling tools to assist the remote site initiate batch preprocessing jobs.

a. Preprocessing procedures

b. Scheduling tool development

Exhibit 3

FRIS III Timeline Chart



▽ planned start of activity

▼ actual start of activity

▽——▽ duration of activity

◀——▽ progress toward activity completion

2.4 Management

Coordination of task activities, overall project monitoring, and performance and fiscal reporting are the prime functions of the management task. Other activities that will occur within the framework of the overall project management responsibility include:

- Information Dissemination
- Project Cost Evaluations
- Classification Evaluation
- Program Development

Timelines for the activities included under the Management Task are presented in Exhibit 4. A short discussion of these activities follows:

A. Reporting

This activity is responsible for monitoring and/or production of the various contract reports.

1. Informal Monthly Status Reports
2. Monthly Fiscal Reports
3. Quarterly Progress Reports
4. Semi-Annual Project Reviews

B. Information Dissemination

This activity will be directed at pursuing opportunities to brief the professional community about FRIS. Symposia, technical meetings, and scientific literature will be the primary avenues for dissemination.

C. Cost Evaluations

This is an ongoing activity which was intiated during Phase II. LARS staff will work with St. Regis personnel to monitor the cost of transferring the technology. Estimates of the costs of an operational system will also be assessed.

D. Special Projects

This is a contingency activity designed to handle any research items that does not fall within any of the major project tasks. Currently there are two such activities.

1. Classification Accuracy Evaluations

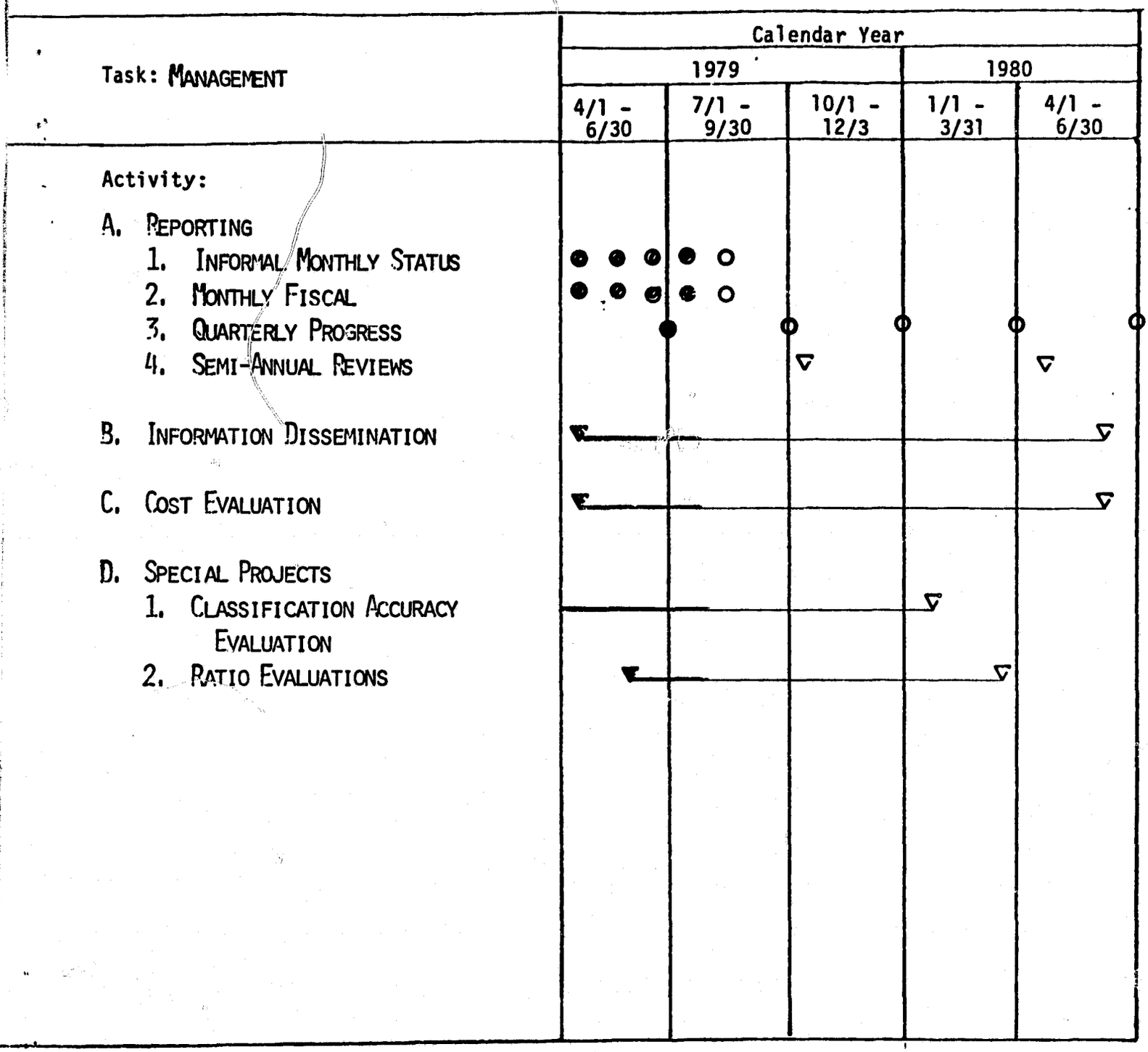
   This effort is aimed at refining the classification evaluation procedures.

2. Ratio Evaluations

   This effort is directed toward developing a better understanding of the relationship between forest communities and spectral response.

Exhibit 4

FRIS III Timeline Chart



▽ planned start of activity

▼ actual start of activity

▽——▽ duration of activity

▼——▽ progress toward activity completion

2.5 Resource Requirements

An evaluation of the resources required to accomplish the tasks in Phase III is presented in Exhibit 5. Task resources are broken down in the following categories:

- Personnel;

  by MYE for the task and by average man-months/month

- Travel;

  by destination and number of trips, and by

  days per diem

- Computer;

  by Services provided, and by estimated CPU hours

Detailed monthly fiscal reports are provided to the contractor monitor by the 20th of the month following the reporting period.

Exhibit 5

Summary FRIS Resource Requirements for Phase III by task

Resources Requirements	Technology Transfer	LARSYS Transfer	Preprocessing Transfer	Management
Personnel				
MYE	2.625	2.125	4.69	2.31
Ave. mm/mo.	2.1	1.68	3.75	1.85
Travel (no. of trips)				
Jacksonville	8	1	1	2
Dallas		4	4	1
Houston		2	2	4
Washington, D.C.				2
New York			1	1
Other		1	1	3
Per Deim (days)	40	24	28	40
Computer				
Est. CPU hours	25	80	80	15
Services	JAX Remote Terminal Support			

3.0 Technical Issues

A number of technical issues surfaced during the demonstration phase of FRIS. Some of these issues specifically dealt with the ability to acquire and process Landsat data. As we progress through Phase III we will address these issues and identify their resolution as appropriate.

The first issue that we addressed was the availability of Landsat data from EDC. Although we are not aware of a reasonable preview capability as of yet, we have been impressed with improvements in data turnaround. Recent CCT orders from EDC have been received within the published two week from date of order delivery time. Under this delivery schedule, we anticipate no difficulty in data acquisition other than the problem posed by data preview.

The new Landsat 3 data format may alleviate the requirement for extensive preprocessing at NCC. This would also cause a savings in time and make data available to the analyst much quicker. We will continue to evaluate the suitability of the Landsat data format especially the quality of the geometric correction modifications to the preprocessing transfer plan may occur as a result of these studies.

Appendix I

LARSYS Software to be Transferred to St. Regis

LARSYS

PICTUREPRINT

STATISTICS

IDPRINT

LISTRESULTS

PUNCHSTATISTICS

LINEGRAPH

COLUMNGRAPH

HISTOGRAM

GRAPHHISTOGRAM

LARSYSDV

BIPLOT

CHANGE

CLUSTER

SEPARABILITY

CLASSIFYPOINTS

PRINTRESULTS

DUPLICATERUN

COPYRESULTS

MERGE

BROWSE

RATIO

GDATA

GRESULTS

ECHO