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SPACE SHUTTLE

OPERATIONS INTEGRATION PLAN

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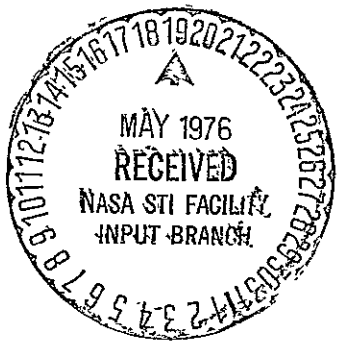

19 SEPTEMBER 1975

SPACE SHUTTLE OPERATIONS INTEGRATION PLAN

19 SEPTEMBER 1975

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SPACE SHUTTLE OPERATIONS INTEGRATION PLAN

ERRATA SHEET

19 SEPTEMBER 1975

Following final page make-up of this document, the following items were discovered to require revision:

1. Page 2-6, Figure 2.1.4-1 - Engineering and Development Directorate organization should be revised to that shown by JSC announcement #75-55, dated 9-2-75 which creates two organizational lines instead of three.
2. Page 2-6, Figure 2.1.4-1 - Data Systems and Analysis Directorate Organization; Ground Data Systems Division Chief should read J. C. Stokes.
3. Page 2-9, Figure 2.1.4-4 - McDonnell Douglas organizational block should read: Mission Planning/Analysis and Software Formulation Support.
4. Page 2-9, Figure 2.1.4-4 - Organizational code for Manager Simulation Planning should be LA5/FE.

PREFACE

The Space Shuttle Operations Integration Plan summarizes the current approach to overall operations integration management for the Shuttle Program DDT&E phase; shows how traceability of Level II requirements to tasks of implementing organizations is achieved, provides a formalized definition of tasks required to implement the Space Shuttle Program, and illustrates the interrelationship of these tasks across the Program.

SPACE SHUTTLE OPERATIONS INTEGRATION PLAN

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1.0 INTRODUCTION

This Operations Integration Plan has been developed to provide a functional definition of the activities necessary to develop and integrate Shuttle operating plans and facilities to support flight, and flight control, operations. This plan identifies the major tasks, the organizations responsible and their interrelationships, the sequence of activities and interfaces, and the resultant products related to operations integration. This plan is intended to supplement the information that is contained in Volume V - Information Management, and Volume VIII - Mission Operations which are part of the JSC 07700 Space Shuttle Level II Program Definition and Requirements documentation.

1.1 Purpose And Scope Of The Operations Integration Plan

The Space Shuttle Operations Integration Plan summarizes and provides visibility of the planned approaches, activities, and operational feedback techniques which:

- ensure that the operations requirements and integration functions are properly defined and assigned to appropriate organizations;
- ensure that the existing operations related expertise of NASA organizational elements are utilized to accomplish these functions;
- ensure that NASA and DOD joint planning for the Shuttle operational phase is accomplished; and
- provide operations related support to other program work breakdown functions as defined.

The Space Shuttle Operations Integration Plan identifies for Operations Integration, the:

- functions and supporting tasks, and responsibility for these tasks;
- lead and supporting organizations and their roles;
- products of each task and the end product it supports; and
- need date and schedule for each activity.

The Space Shuttle Operations Integration Plan is a planning tool only, and does not provide control authority for products, tasks, and schedules. Control of Directorate plans lies within the Directorates, and is vested in their management plans which are responsive to Program Level I and II approved documents and milestones.

2.0 OPERATIONS INTEGRATION FUNCTION

The Operations Integration function is a Level II activity to ensure that the development of flight operations and flight control operations plans and facilities are accomplished in a timely manner, and are properly integrated with the development of the Shuttle Systems, and Launch and Landing System. This responsibility includes the review, coordination and management of operations support contractor tasks, NASA inter-center tasks, and Shuttle Project element tasks which are identified for DSAD, FOD, EDD, and POO accomplishment, and the allocation of these tasks through the Program Work Breakdown Structure (PWBS). The Operations Integration function includes the necessary management controls and status reporting, and the avenue for coordination between all relevant Shuttle Program Level II and III elements. Existing interfaces and organizations will be used to the greatest extent possible to accomplish the above objectives.

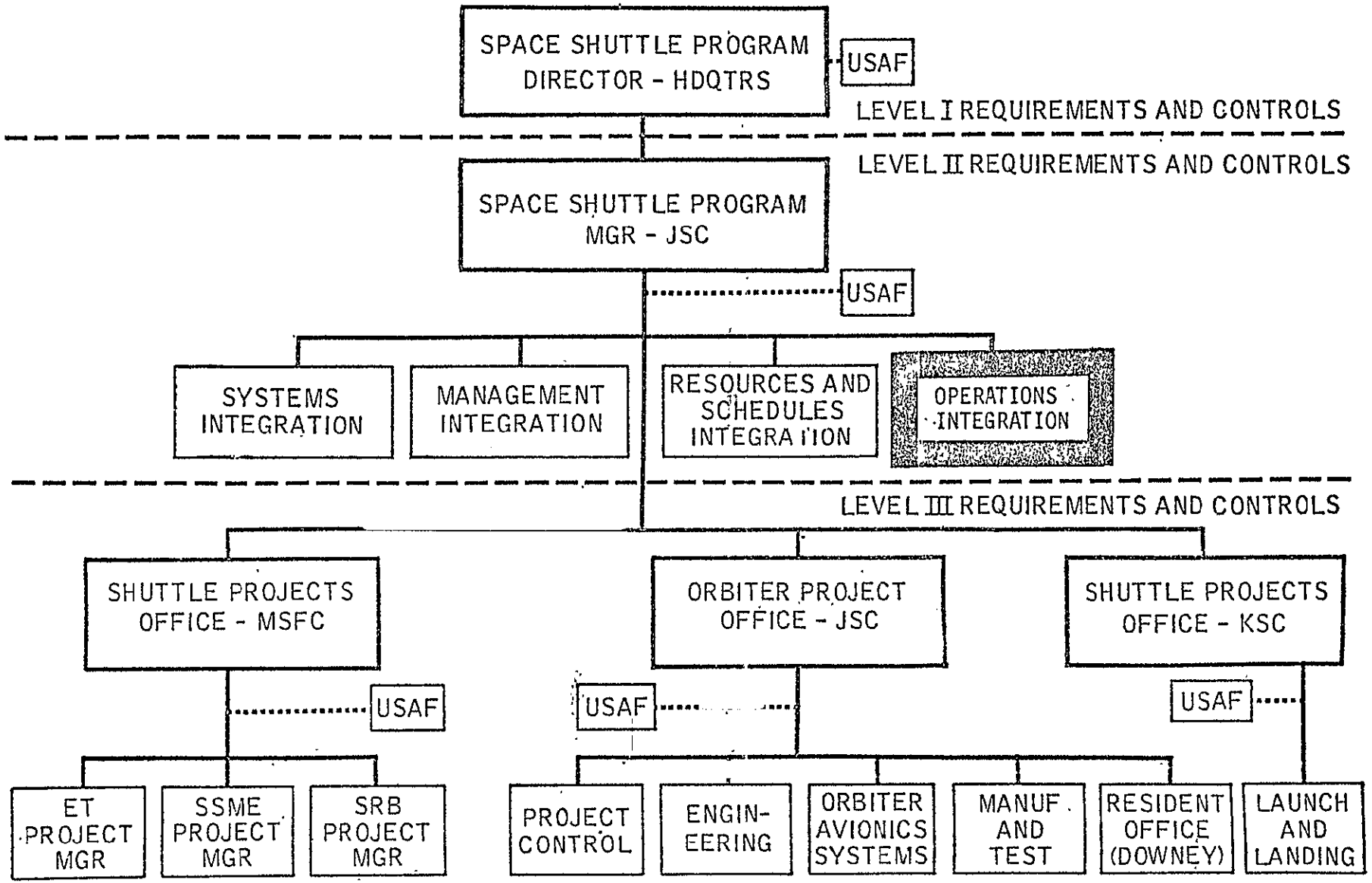
2.1 Organizational Relationships

2.1.1 Space Shuttle Program Organization - The Space Shuttle Program Manager has assigned the Operations Integration responsibility for the Space Shuttle System to the Operations Integration Office/LA5 of the Space Shuttle Program Office (SSPO). This relationship is shown by Figure 2.1.1-1.

2.1.2 Program Management Organization - JSC - The SSPO provides management of the "Lead Center" institutional functions as related to the Space Shuttle Program, and the overall systems management and integration of all elements of the program. The organization and functional relationships of the SSPO is shown in Figure 2.1.2-1. Additional detail of the responsibilities of the SSPO may be found in JSC-07700, Volume II, Book I - Section 2.0.

2.1.3 Operations Integration Organization - The SSPO Operations Integration Office provides the overall operations integration management function to assure that the planned approaches, activities, techniques, and task results of the various organizations involved in operations integration are consistent with the objectives of the Space Shuttle Program. The primary and support functions of the Operations Integration Office/LA5 are shown in Figure 2.1.3-1.

SPACE SHUTTLE PROGRAM ORGANIZATION*



*EXCLUDES THE PENDING SHUTTLE PAYLOAD INTEGRATION AND DEVELOPMENT PROGRAM OFFICE ORGANIZATION

FIGURE 2.1.1-1

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SPACE SHUTTLE
PROGRAM MANAGEMENT ORGANIZATION - JSC**

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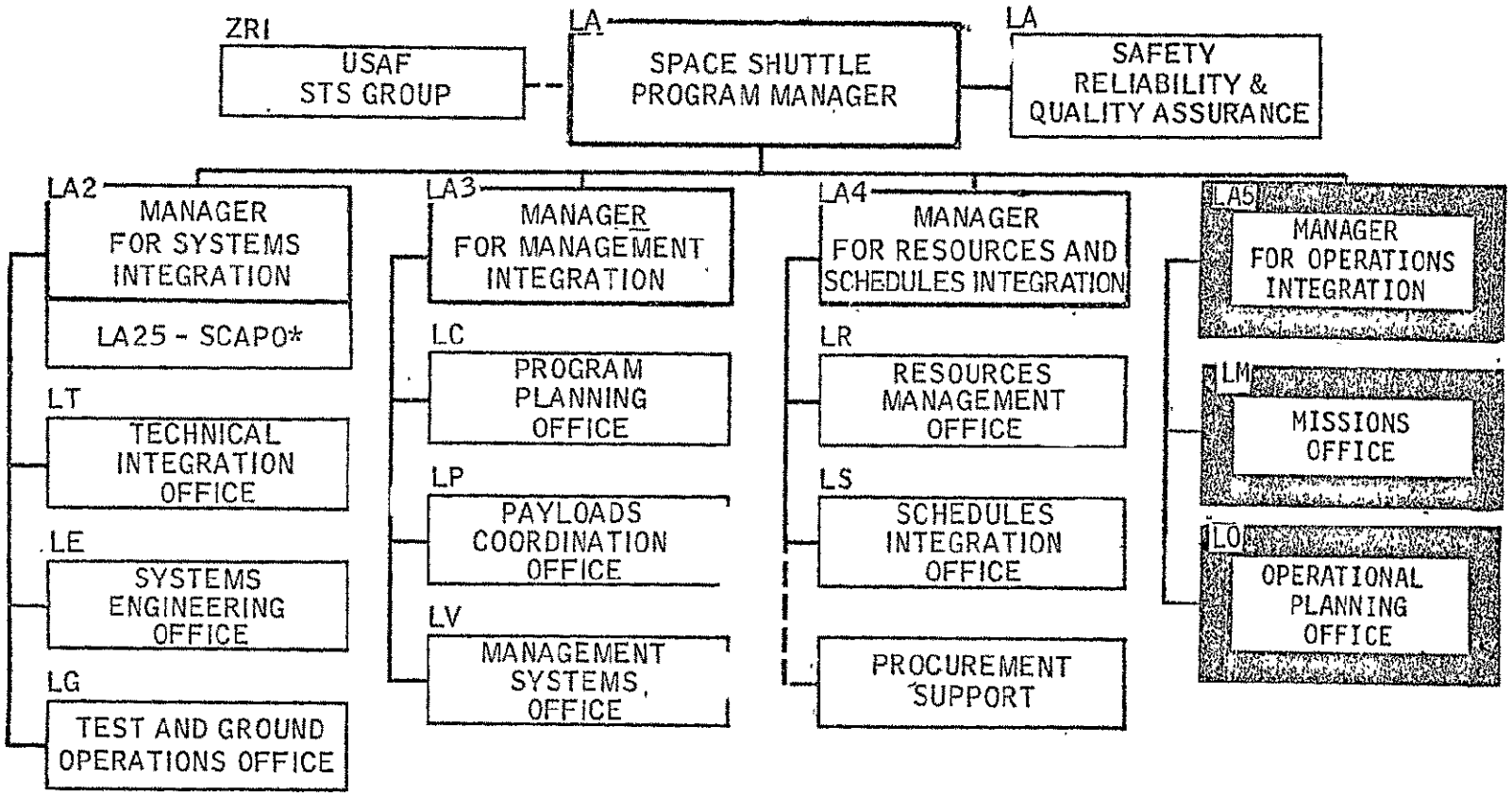

*SHUTTLE CARRIER AIRCRAFT PROJECT OFFICE

**EXCLUDES THE PENDING SHUTTLE PAYLOAD INTEGRATION AND DEVELOPMENT PROGRAM OFFICE ORGANIZATION

FIGURE 2.1.2-1

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OPERATIONS INTEGRATION ORGANIZATION

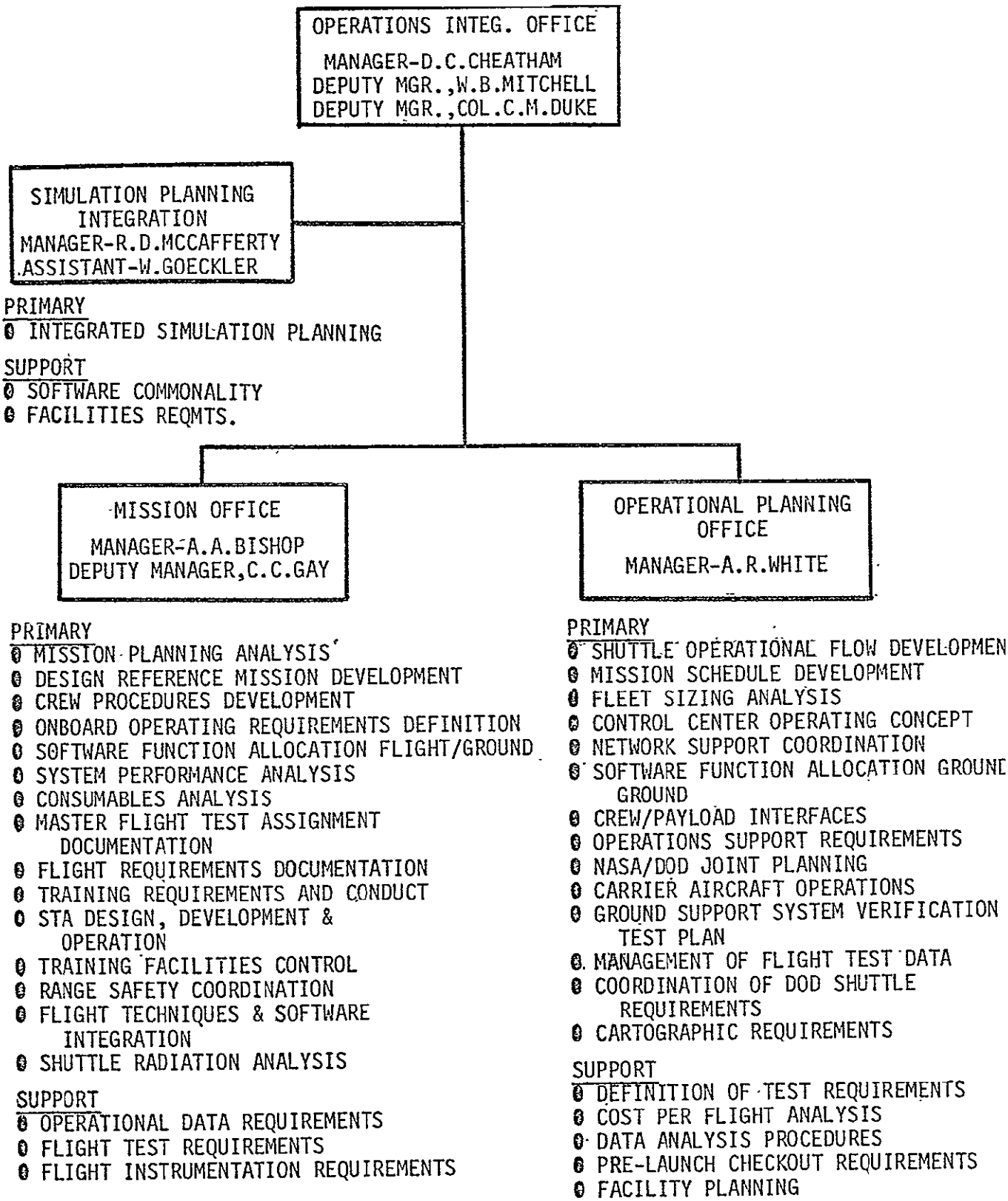

FIGURE 2.1.3-1

2.1.4 Lead Organizations Designated Outside The Program Office - A considerable portion of the functions which are part of the operations integration function have been accomplished for past programs by the Flight Operations Directorate, the Data System and Analysis Directorate, the Engineering and Development Directorate, and the Program Operations Office, and are within their present charter and capability. Therefore, these organizations have been designated the lead responsibility for some of the Operations Integration functions. This lead responsibility can be of two (2) types: 1) within the normal functioning responsibility of the Directorate; and 2) programmatic function of integrating results of technical activities across organizational lines.

- Where the functions lie primarily within a Directorate's assigned area of activity, an organizational element of that Directorate has been designated as having the "lead" responsibility.

- A lead responsibility designated to an organization outside the Program Office conveys the technical direction and integration responsibility to that organization, and an obligation to coordinate the conduct and results of the effort within the Operations Integration Office.

- The Program Office remains responsible for overall management of schedules, provision of support effort, coordination of action assignments across project lines for those lead functions designated outside the Program Office, and for ensuring that "lead" organizations activities satisfy defined program requirements.

- To provide emphasis to the Shuttle management task and to provide a recognized interface with the Program Office, each Directorate has designated a staff member to serve as Assistant Director or Technical Assistant for Space Shuttle. In each case, these offices serve not only as the focal point for Shuttle activities in their respective directorates, but also serve to represent the Shuttle program to the directorate management.

The organizational relationships of the lead organizations designated outside the Program Office are shown in Figure 2.1.4-1. Figures 2.1.4-2 and 2.1.4-3 show the primary functions of the FOD/DSAD organizations in support of the Space Shuttle operations integration function. Organizations for the contractor support provided by Rockwell/Space Division and McDonnell Douglas and their relationships are shown in Figures 2.1.4-4 and 2.1.4-5.

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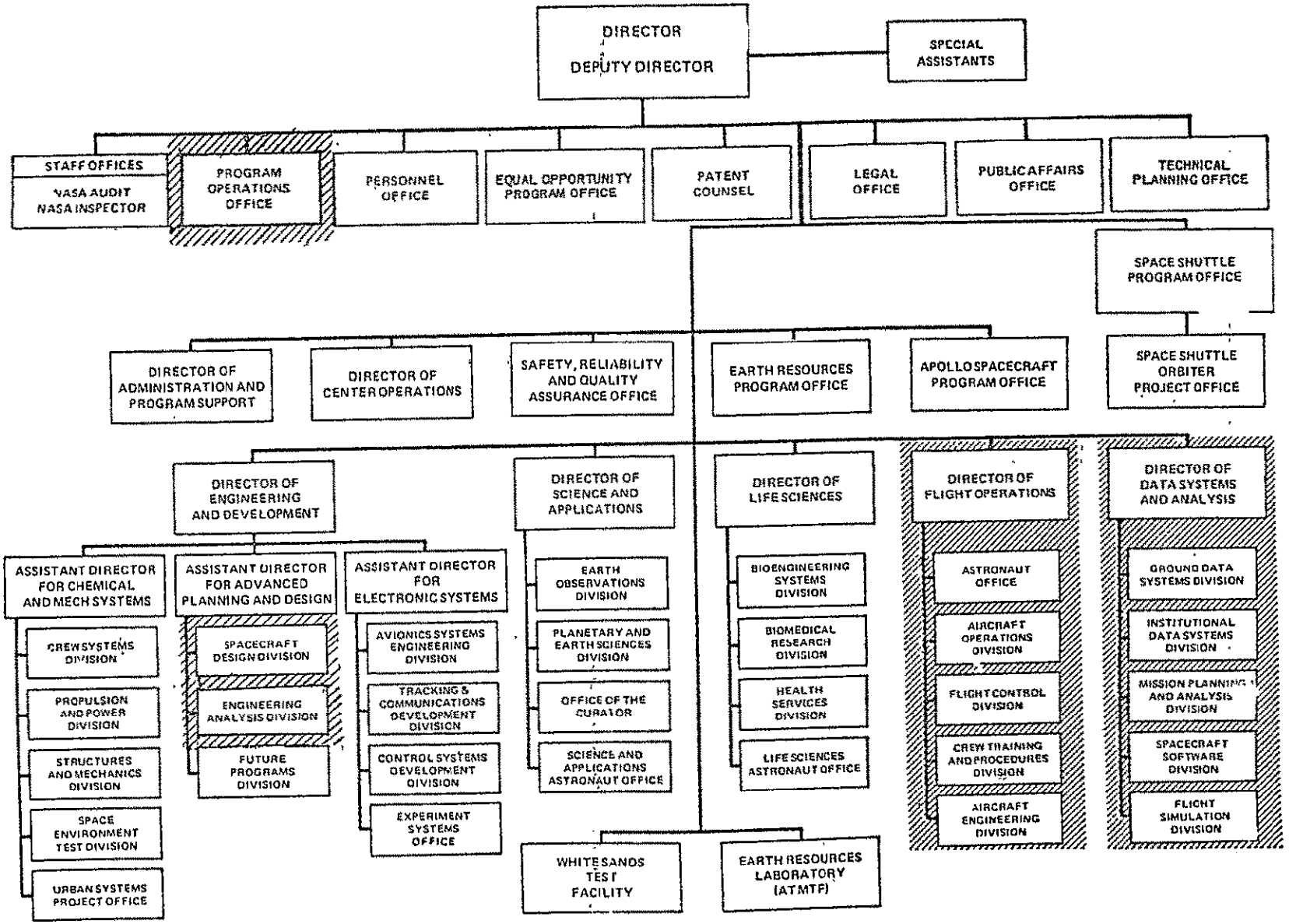
LEAD ORGANIZATIONS DESIGNATED * OUTSIDE THE PROGRAM OFFICE



*EXCLUDES THE PENDING SHUTTLE PAYLOAD INTEGRATION AND DEVELOPMENT PROGRAM OFFICE ORGANIZATION

FIGURE 2.1.4-1

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FOD PRIMARY FUNCTIONS FOR SHUTTLE OPERATIONS INTEGRATION

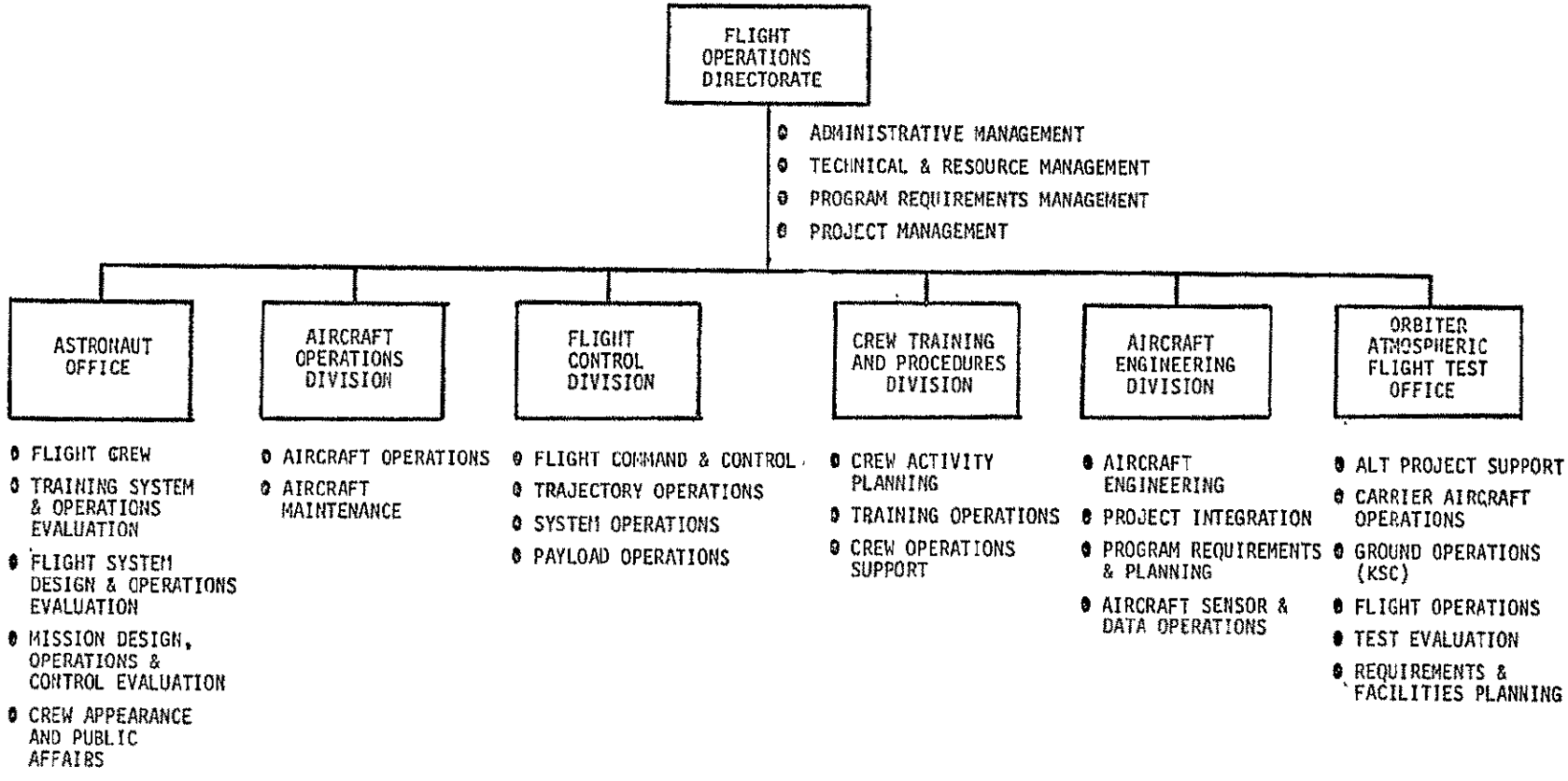

FIGURE 2.1.4-2

DSAD PRIMARY FUNCTIONS FOR SHUTTLE OPERATIONS INTEGRATION

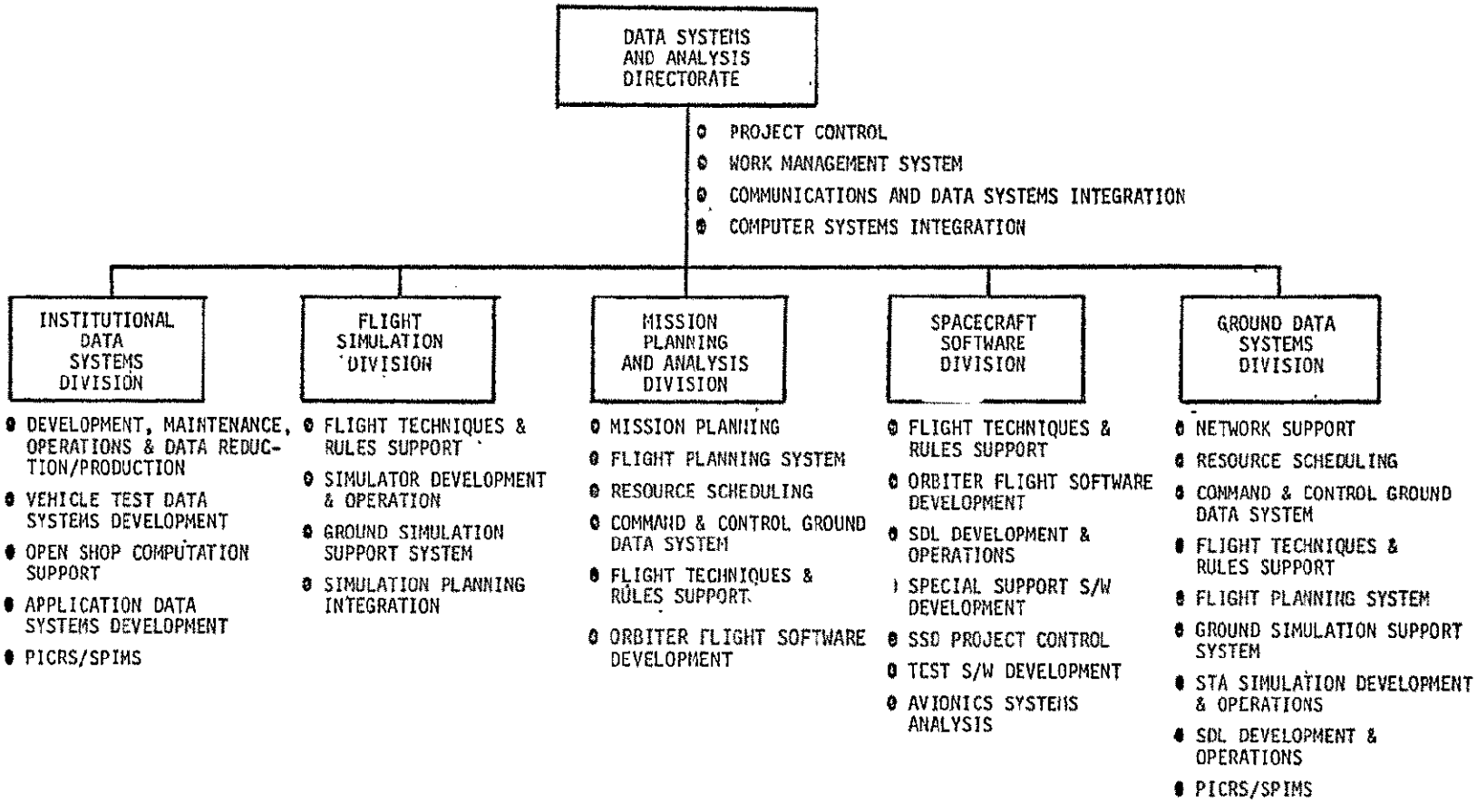

FIGURE 2.1.4-3

FOLDOUT FRAME

FOLDOUT FRAME 2

OPERATIONS INTEGRATION ROLES AND STRUCTURE - NASA/CONTRACTORS

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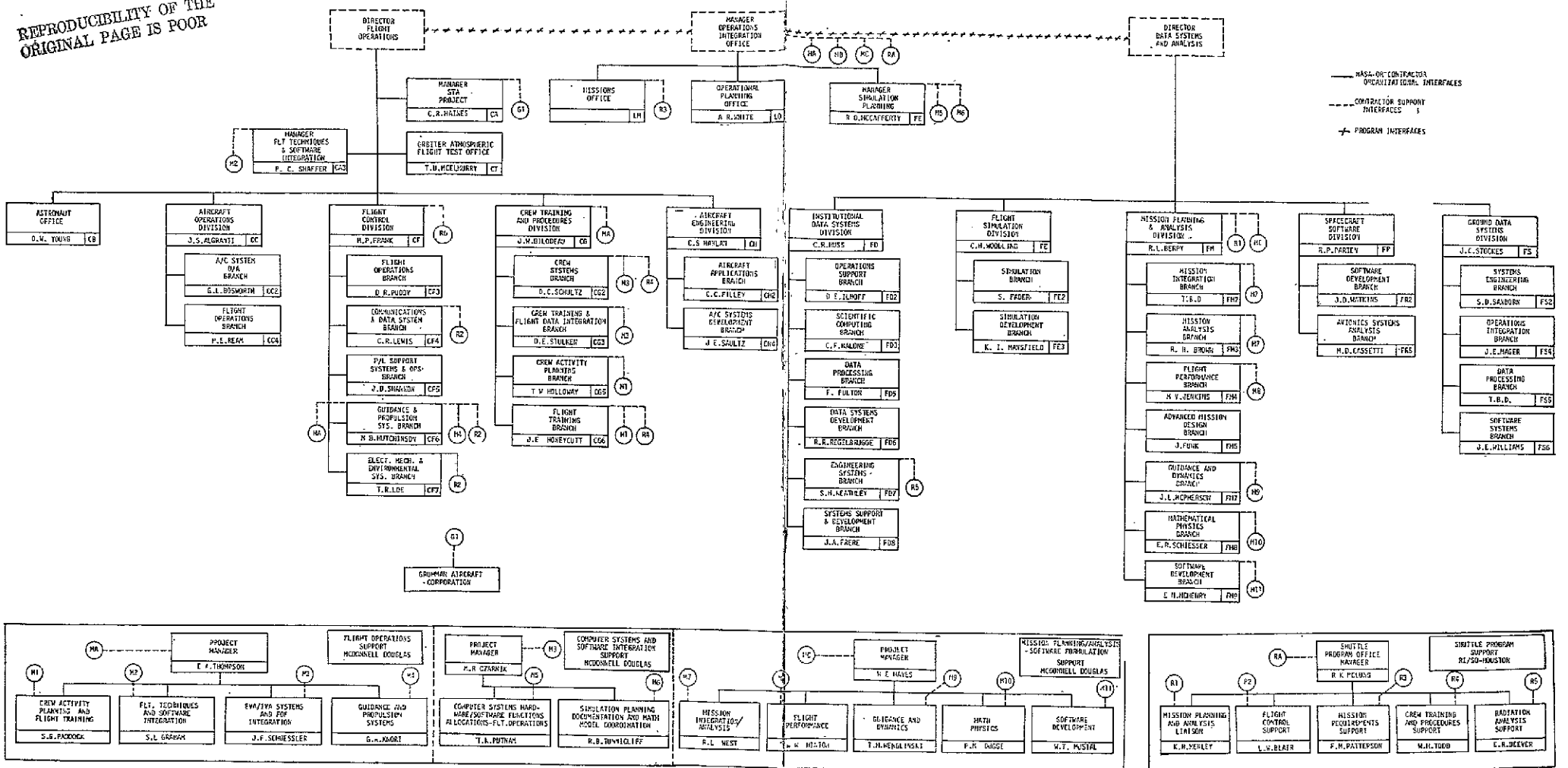

FIGURE 2.1.4-4

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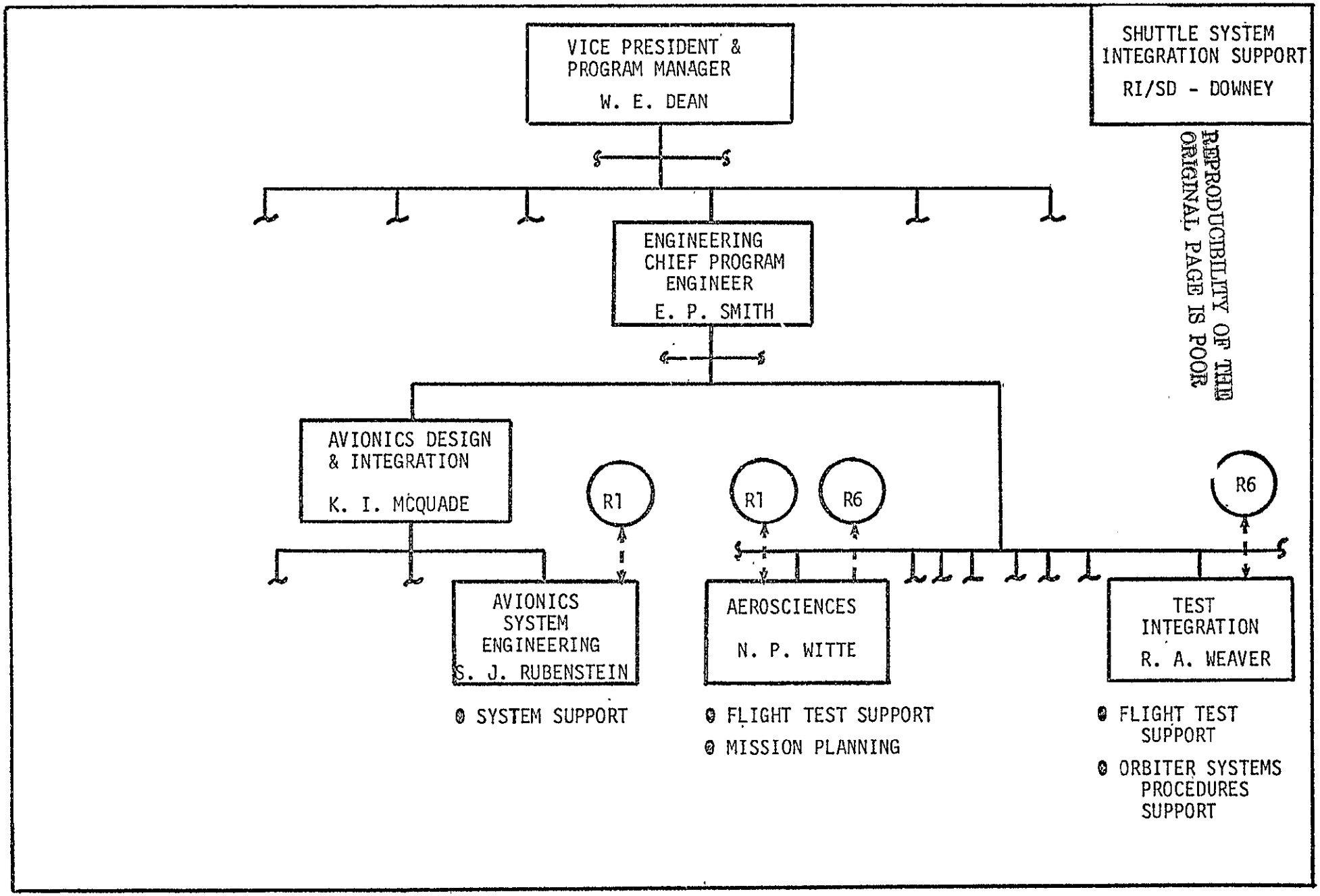

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FIGURE 2.1.4-5

2.2 Responsibilities

The major responsibilities for operations integration are distributed between the Operations Integration Office/LA5, Flight Operations Directorate/CA, the Data Systems and Analysis Directorate/FA, the Program Operations Office/WA, and the Engineering and Development Directorate/EA as shown below:

- Operations Integration Office/LA5
  - establishment and coordination of schedules for all Shuttle operational support elements to meet Shuttle Program requirements
  - definition, allocation, and management of Shuttle support resources required by operations organizations; provided by Rockwell/Space Division and McDonnell Douglas.
  - definition and coordination of program related operational requirements
  - management of the support operations related interface activities between supporting organizations and centers
- Flight Operations Directorate/CA
  - provide operational requirements and baseline operating plans for flight and ground hardware and software systems, through coordination with all Shuttle Flight Operations support elements
  - provide crew activity planning and operational procedures for Shuttle crew activity plan execution, and command and control functions through coordination with all Shuttle Flight Operations support functions
  - define training simulator and trainer requirements in coordination with other program elements
  - conduct Flight Operations training for Orbiter flight crews and flight controllers
  - provide the commander and pilot and normally the mission specialist for NASA Shuttle flights
  - provide Shuttle flight controllers and flight control coordination with the DOD and other flight control elements, if required
  - plan and conduct the Approach and Landing Test Operations
  - plan and conduct NASA Shuttle Flight Operations

- Data Systems And Analysis Directorate/FA

  - provide Shuttle flight planning and analysis

  - provide integration and design management for the Shuttle flight and ground systems software except launch site ground checkout software

  - integrate, provide implementation management, and operate the mission control center (MCC), consolidate Shuttle requirements and coordinate implementation of defined STDN and NASCOM requirements, and coordinate Shuttle operational requirements, plans and procedures with GSFC for ground data systems

  - provide operate, and maintain a flight simulation facility for Shuttle flight operations training

  - provide for integration and coordination of Program support requirements and implementation

  - develop management plans and procedures for the collection and integration of data requirements, and the processing and distribution of data to support OFT post flight engineering and scientific evaluation and analysis.

  - provide managerial activities and coordination necessary to implement the test data management plans and procedures.

- Engineering and Development Directorate/EA

  - provide integrated Orbiter systems constraints, margins, and requirements for use in flight design; flight techniques, and flight and launch rules development

  - coordinate one-g and neutral buoyancy trainer requirements, develop trainer configurations, provide trainers, and operate and maintain trainers and facilities.

2.3 Operations Requirements Baseline

The JSC-07700 Program Definition and Requirements Documents and Master Verification Plan provide the Level II operations requirements baseline. The operations integration function is responsive to satisfying these requirements, and in some instances has the prime SSPO responsibility for development of certain volumes. The Level II requirements that provide the operations baseline, and those that are LA5's prime responsibility for development, are shown in Figure 2.3-1

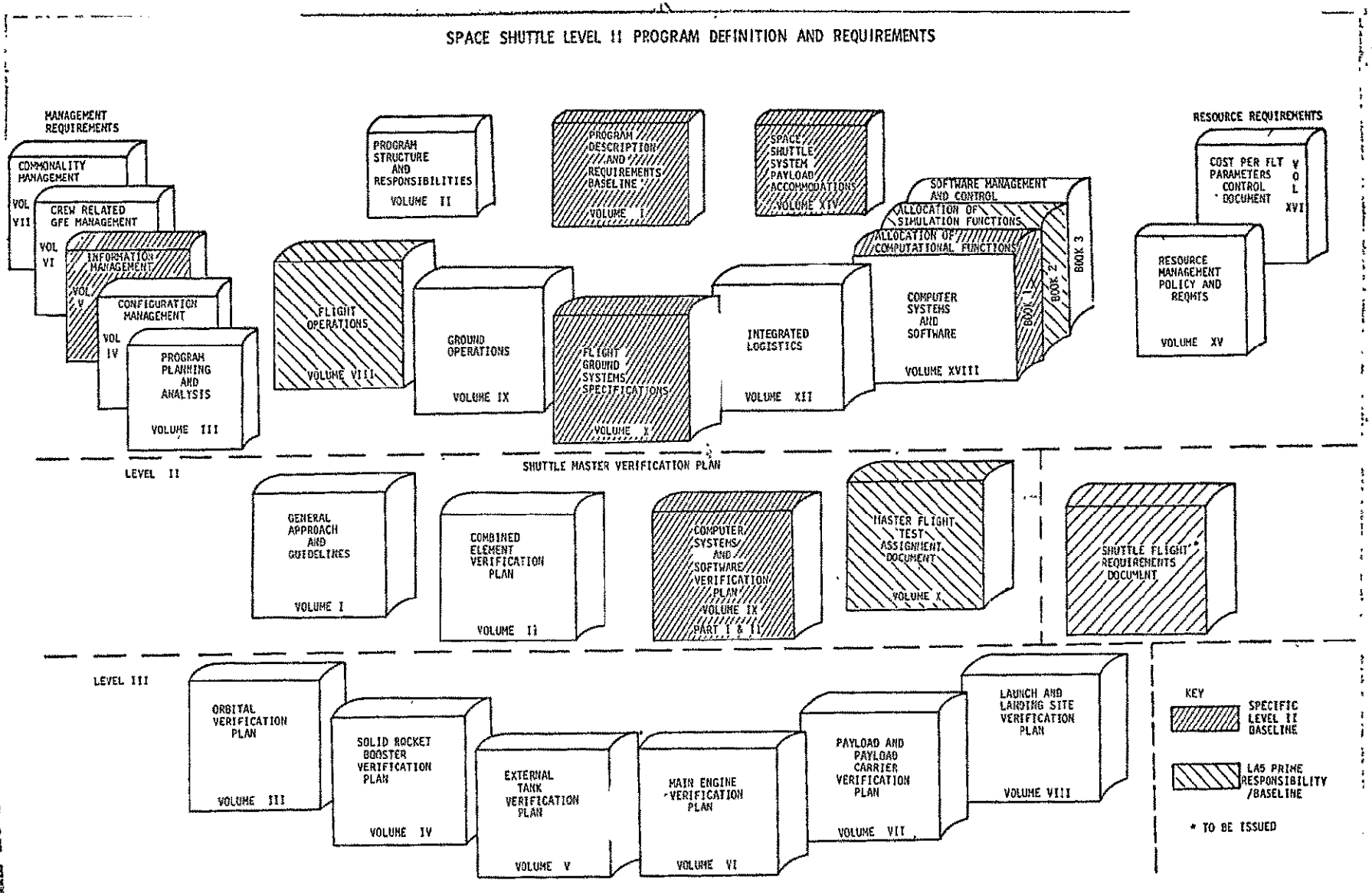

FIGURE 2.3-1

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2.4 Operations Integration Overview

The task activities of operations integration result in three major functional products. These products are:

1) Training Systems and Operations;

2) Flight System Design Support and Operations Planning; and

3) Mission Design, Operations and Control

In addition, two other products result:

4) Management of Post-Flight Test Data for OFT; and

5) OFT Carrier Aircraft Operations

Figure 2.4-1 presents an overview of the top level tasks, the major products, and their inter-relationship for the Operations Integration function. Each of the five (5) functional product areas is treated at a lower level of detail in Section 3.4.

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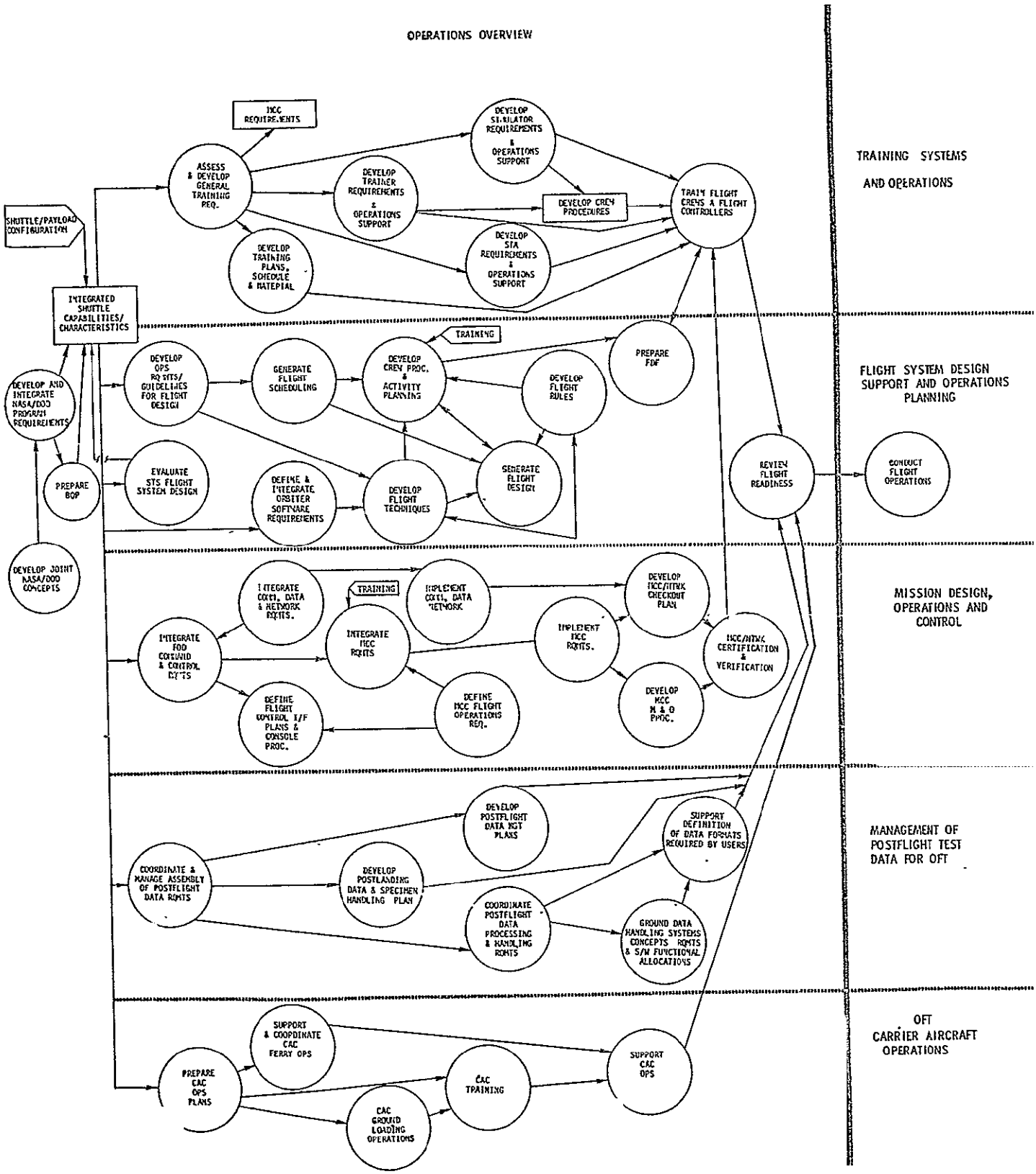

FIGURE 2.4-1

3.0 OPERATIONS INTEGRATION IMPLEMENTATION

3.1 Program Work Breakdown Structure (PWBS) Utilization

The PWBS is used by the Space Shuttle Program Manager to control the Level II responsibilities and requirements defined earlier. In order for operations integration to be implemented, it is necessary for lower level requirements to be imposed on the functional organizations at JSC. The PWBS is utilized to:

- implement requirements defined by JSC-07700 Volume III, Program Planning and Analysis - "All Space Shuttle Program activities shall be planned and implemented within the framework of the PWBS";
- enable operations integration work, starting at the program level, to be divided into lower level increments in a manner representing the way in which work will be performed; and
- provide manageable units for planning and control of costs, schedule and technical performance.

The Space Shuttle Program allocation of functions and responsibilities by PWBS is shown in Figure 3.1-1.

3.1.1 Inhouse Shuttle System Functions Allocation - The Space Shuttle Program Manager has assigned the responsibility for certain key Shuttle system functions to the Operations Requirements and Integration PWBS (1.7). These functions, defined in JSC-07700 Volume VIII Flight Operations, are summarized below:

- Develop Mission Control and Operations Requirements
- Define Operations Requirements on Design of Flight and Ground Systems
- Develop Crew Procedures and Crew Activity Plans
- Develop and Conduct Flight Crew and Flight Controller Training Program
- Conduct Mission Planning and Analysis
- Integrate Communications and Mission Data Flow
- Implement Mission Control Center
- Implement Flight Training Simulations
- Conduct NASA Shuttle Flight Operations

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PROGRAM FUNCTIONS AND RESPONSIBILITIES ALLOCATION BY PWBS

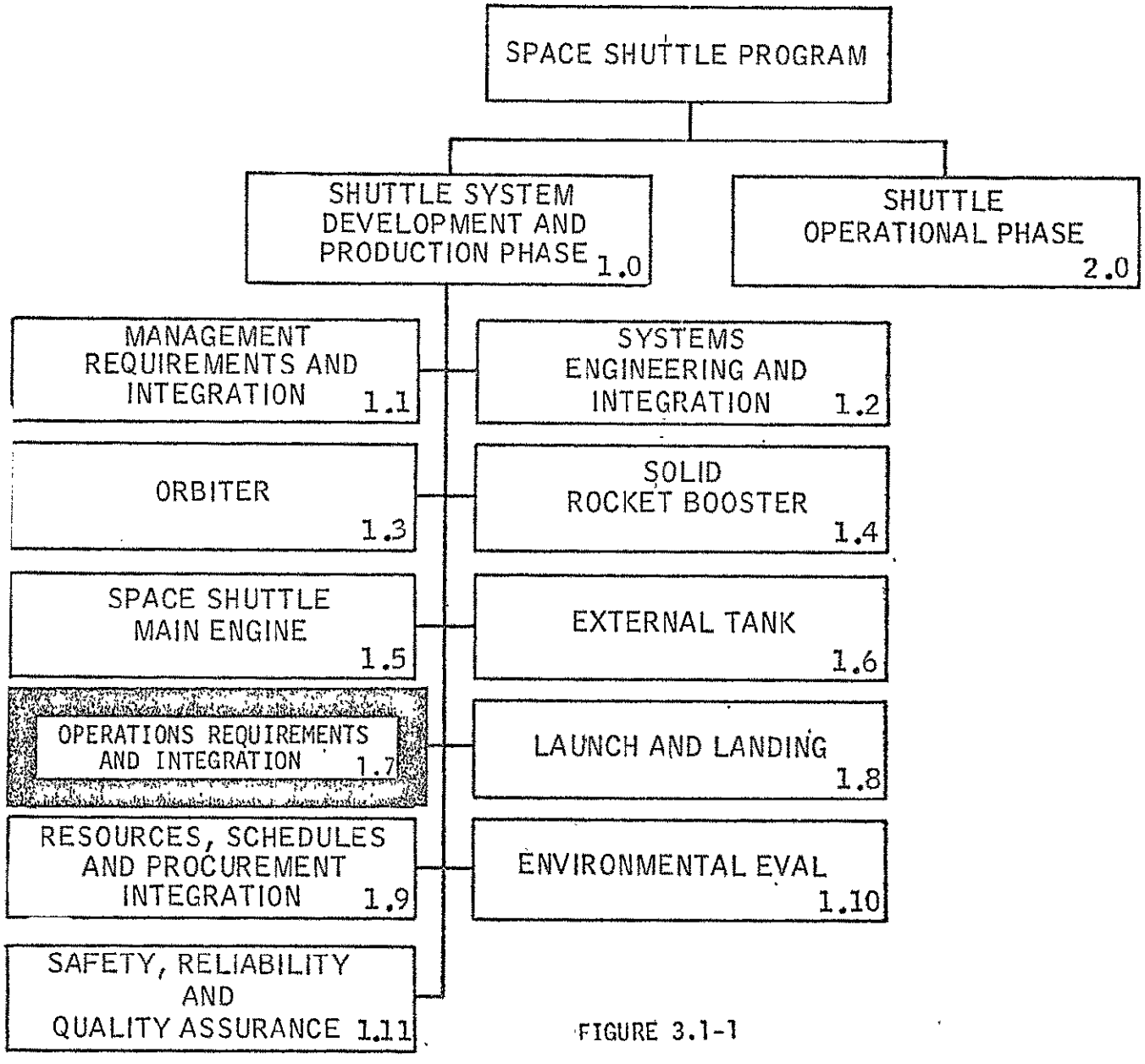

FIGURE 3.1-1

3.1.2 Operations Functions and Responsibilities Allocation - The Operations Integration Manager has assigned the key inhouse Shuttle system functions and other responsibilities by use of lower PWBS allocations. Figure 3.1.2-1 shows the relationships and responsibilities assigned.

3.1.3 Program Office Responsibilities Allocation - The Operations Integration Office responsibilities for those tasks assigned to other Directorates is to assure an overall compatible integrated set of operational schedules that are responsive to the Shuttle milestones, to coordinate the Rockwell/Space Division and McDonnell Douglas support to the Operations Directorates commensurate with Program resources allocation, and to coordinate the adjustment of those resources as Program changes dictate, and finally, to maintain a daily coordination and support interface with the Directorate points of contact for the individual sub-tasks.

3.1.4 Lead Directorate Responsibilities Allocation - In those cases where a four (4) digit PWBS has been assigned to a lead directorate for implementation, there are certain responsibilities which the directorates have. The initial activity consists of a review of the PWBS to insure that the task has been adequately and completely defined, and that the schedule and end products are appropriate to the task and fit the directorate area of responsibility. Any necessary corrections or expansion of the task is coordinated with the Operations Integration Office. For those cases in which the lead responsibility includes an integrating function which requires technical input or support from other directorates, the lead directorate provides the necessary coordination to obtain the support of other organizations involved.

3.2 Task Planning and Resource and Schedule Management

3.2.1 Operations Integration Office - Overall progress and accomplishment of operations integration tasks is assured by Program level management and overview in a number of ways:

1. The Operations Integration Office provides the lead roles necessary to ensure accomplishment of specified tasks. The planning, coordination, documentation and direction of activities necessary to achieve the required end results is provided by this office.

2. Assignment of the tasks to a lead organization whose line responsibility contains the major part of the functions contained within the tasks. This requires that the lead organization accepts the assignment of the effort and accomplishes the coordination, liaison, and negotiation as necessary to obtain support required of other organizations in the accomplishment of the assigned tasks.

OPERATIONS FUNCTIONS AND RESPONSIBILITIES ALLOCATION BY PWBS

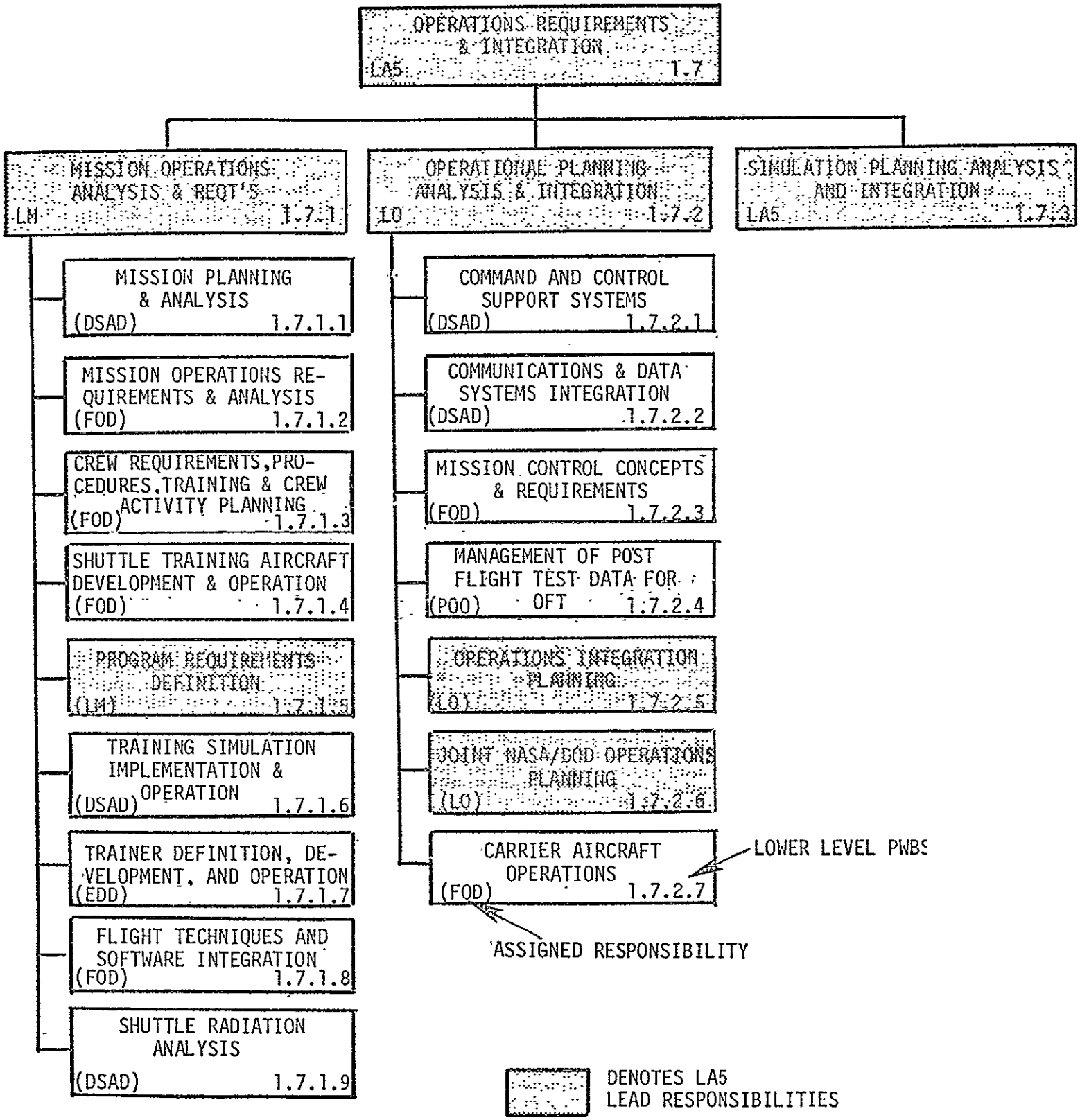

FIGURE 3.1.2-1

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3. Delegation and assignment by program directives, the responsibility for specific tasks to specific organizations which do not necessarily have the functions of the tasks within their line responsibilities, but do have the expertise and capabilities to assume the lead organization responsibilities to accomplish the tasks. Again, the lead organization provides the coordination with other organizations as necessary to accomplish the tasks.

4. Reviewing and commenting on Directorate/Division drafts and final documentation, including participation on review teams and boards, and concurrance review of those documents requiring Program Manager concurrance or approval.

5. Generating Level II changes with proper coordination, and performing the OPR (Office of Prime Responsibility) functions for Level II Change Requests that fall within the Operations Integration area of responsibility. Evaluation and coordination of the assessment of all Level II/ Level III Change Requests.

6. Review and evaluation of Directorate/Division POP planning and submittals.

7. Providing chairmen for and participating in meetings, panels, working groups and boards.

8. Coordinating and participating in special review teams and studies.

9. Daily interface on assigned tasks between Operations Office personnel and sub-task points of contact in Directorate Offices and Divisions.

10. Direct coordination with lead organization and supporting personnel to establish schedules to meet required program milestones, in allocation of resources required to accomplish the required tasks, and establish necessary interface with outside organizations and contractor activities.

3.2.2 Lead Directorates

Each of the Operations Directorates which are assigned lead responsibility by the Operations Integration PWBS have their own system for defining work tasks, for assignment of those tasks to their divisions, for accounting for man hours and funds expended, and for reporting on accomplishments and schedule status. While the systems vary somewhat in detail, they each contain the basic elements enumerated above. In order to provide the necessary continuity between this document and the management plans of the

lead directorates, a summary description of the system utilized by both FOD and DSAD is presented in the following paragraphs:

3.2.2.1 Data Systems and Analysis Directorate Operations Integration Plan - The DSAD Operations Integration Plan is composed of two basic components: 1) Directorate Management Plan; and 2) Shuttle Operations Product Activity Flows and Schedule. An outline of the contents of each is shown below:

1) Directorate Management Plan
   - Work Management System
   - Project Control
   - Interfaces
2) Shuttle Operations Product Activity Flow and Schedules
   - Products
   - Flow Charts
   - Activity Definitions
   - Schedules

3.2.2.1.1 Work Management System - The directorate work breakdown structure is the primary element of the DSAD Work Management System. This WBS is a multi-tiered system involving the successive sub-division of the basic responsibilities assigned to the directorate until the basic work tasks are defined at the branch level. The structure is shown in Figure 3.2.2-1. It is divided into three sections, each of which are associated with levels of management in the organization of the directorat The first is the responsibility of the directorate office where the progra is divided into major project areas which are then further sub-divided int the sub-projects. The sub-project codes and the participating divisions are then assigned. The sub-projects are designed to support the major activities of the directorate for each of the projects. The DSAD Work Management System and relationship of major activities and sub-projects in support of Shuttle is shown in Figure 3.2.2-2. Also included are the participating organizations and the major functions being supported. The complete project and sub-project codes are contained in JSC-09596, "Projec Sub-project Directory and Work Management System Guide," March 26, 1975.

The second level of the work breakdown structure is associated with the division level where the sub-projects may be divided into division level tasks if appropriate, or further assigned to the final level which is the branch organization. As shown in Figure 3.2.2-1, the branch level tasks which represent the detail work required to accomplish the assigned functi

DSAD WORK BREADDOWN STRUCTURE

(SHUTTLE/OFT EXAMPLE)

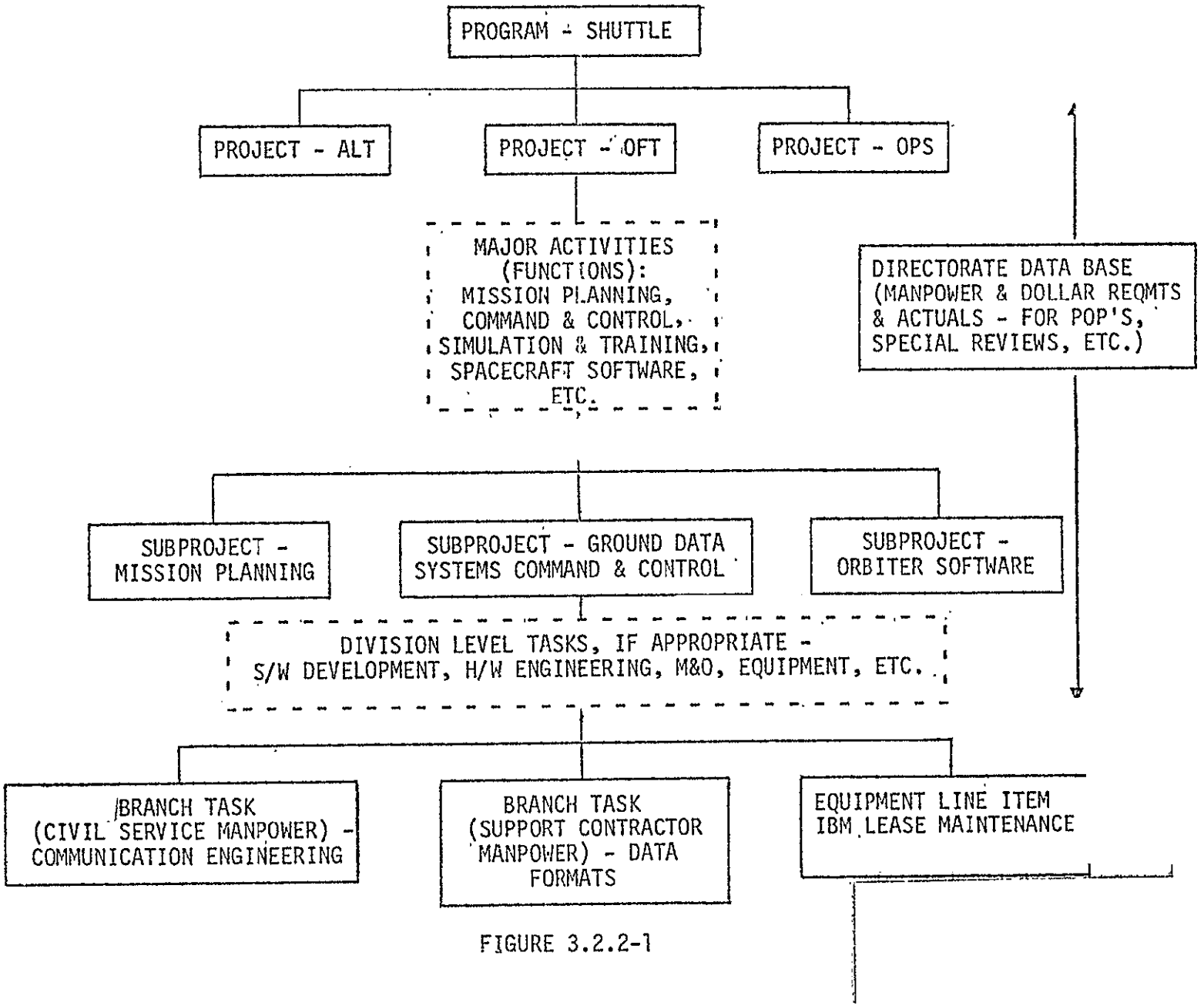

FIGURE 3.2.2-1

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DSAD WORK MANAGEMENT SYSTEM

SUB-PROJECTS	MAJOR ACTIVITIES: Mission Planning, Systems Perf... (MISSION)			Command & Control Support, including ... (C&C)			Sim & Training Support, including . . . (SIM)			Spacecraft Software Development . . . (S/W)		
	PROJECTS: ALT	OFT	OPS	ALT	OFT	OPS	ALT	OFT	OPS	ALT	OFT	OPS
Mission Planning	MPAD	MPAD	MPAD									
Resource Scheduling			MPAD GDSD									
Flight Planning System						MPAD GDSD						
Command & Control Ground Data System				GDSD MPAD	GDSD MPAD	GDSD MPAD						
Network Support				GDSD	GDSD	GDSD						
Mission Techniques & Rules Support				MPAD GDSD FSD SSD	MPAD GDSD FSD SSD	MPAD GDSD FSD SSD						
OAS Development and Operations							FSD	FSD	FSD			
SMS Development and Operations							FSD	FSD	FSD			
SPS Development and Operations							FSD	FSD	FSD			
Ground Simulation Support System							GDSD FSD	GDSD FSD	GDSD FSD			
STA Development and Operations							GDSD	GDSD	GDSD			
CPES Development and Operations							FSD					
IUSS Development and Operations									FSD			
MMUS Development and Operations									FSD			

FIGURE 3.2.2-2

may be civil service and/or support contractor tasks, or may be associated with equipment acquisition. The branch level tasks are the final level of the work breakdown structure.

3.2.2.1.2 Project Control - Project controls within DSAD are accomplished for directorate controls down thru the sub-projects, and for division controls down thru branch level tasks. Work assignments/agreement procedures are established and accomplished by Project (sub-project) Planning Directives (PPD) to the divisions, and by Project (sub-project) Implementation Plans (PIP) from the divisions.

Project meetings are scheduled at the directorate level to provide effective management of

- status overview,
- management and control boards,
- project management,
- technical requirements
- schedule control, and
- budget and cost control

Division level project meetings are conducted to ensure errective management of subsets of the above, and subsystem boards and working groups.

Directorate and division/program/project/subsystem managers are assigned. Interfaces with external organizations, boards and panels are identified and appropriate management statusing effected.

Branch level task definitions are used as the basis for the DSAD Resources Management System. A computerized task accounting system is maintained to provide a means of accumulating costs and man hours against each of the defined tasks. The data base contains all of the identified tasks with associated information concerning the division and branch organizations involved, the project and sub-project being supported, funding information and hours expended.

3.2.2.1.3 Interfaces - DSAD internal interfaces for normal input and output flows from the divisions, and control boards and panels for these interfaces and external interfaces are established. External interfaces are of two types: 1) Requirements and Data Exchange, and 2) Participation in Level II Boards and Panels.

1) Requirements and Data Exchange Interfaces include SSPO, FOD, EDD, RI/SD, DOD, etc.

2) Participation in Level II Boards and Panels interfaces include the Flight Operations Panel, Communication and Data System Integration Panel, Flight Techniques Activities, Software Design Boards, etc.

An example of the DSAD internal interfaces and outputs is shown in Figure 3.2.2-3.

3.2.2.1.4 Products - DSAD operations products for Shuttle ALT, OFT and OPS are sub-divided into the categories shown below:

- Mission Control Center
  - Computers
  - Hardware engineering
  - Command and control software
  - Non real time software (FPS, TMDR)
- Onboard software formulation (GN&C)
- Flight Plans
  - System design support (BRM, DRM, special)
  - Development flight test (CFP, PMP, RFP, OFP)
  - Operational flights (RFP, OFP)
- Simulators
  - Orbiter Aero Simulator (OAS)
  - Shuttle Procedures Simulator (SPS)
  - Shuttle Mission Simulator (SMS)
  - Crew Procedures Evaluation Simulator (CPES)
- Program Support Data Systems
  - Data Reduction Center (DRC)
  - Shuttle Program Information Management System (SPIMS

DSAD INTERNAL INTERFACES

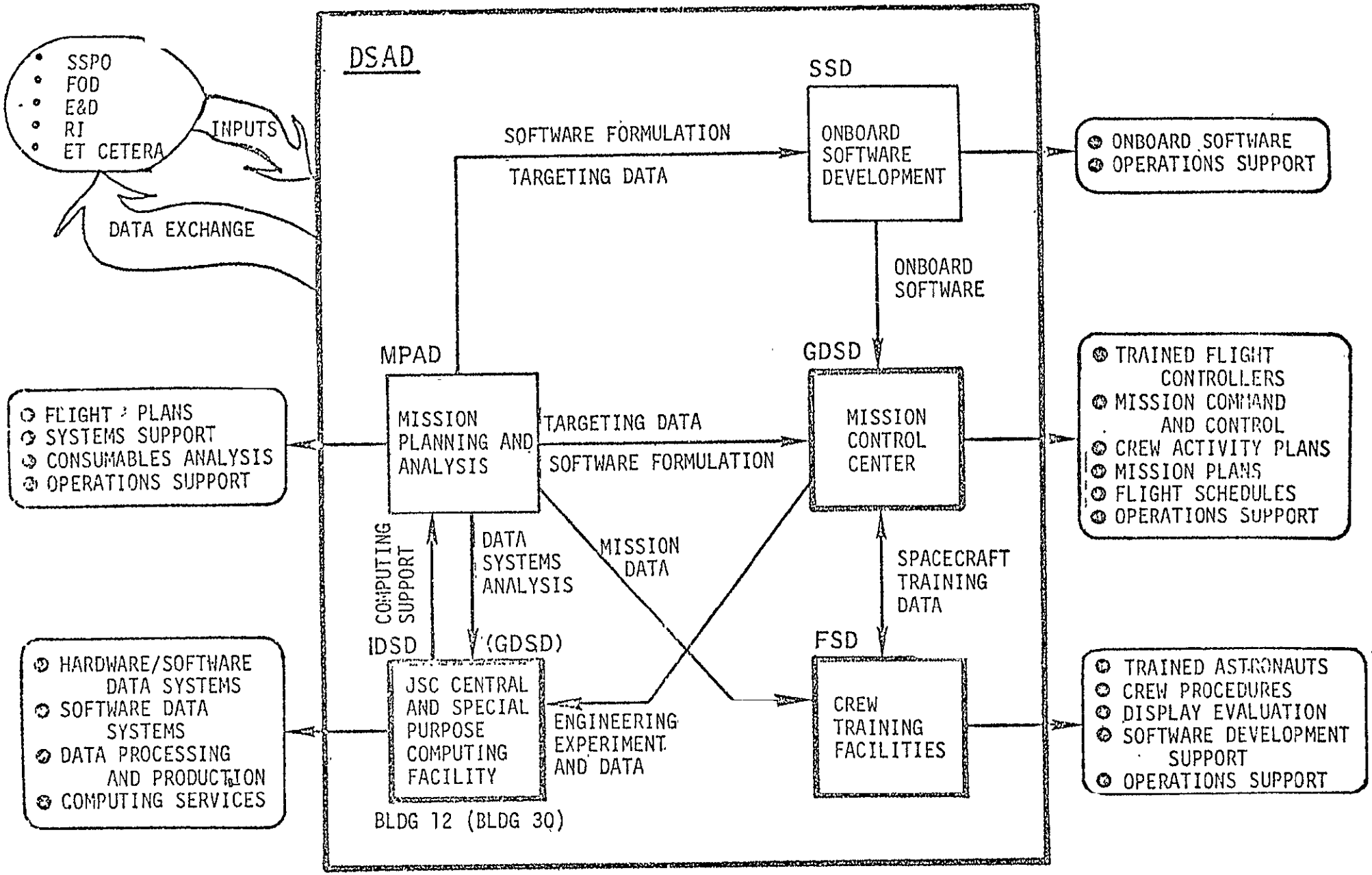
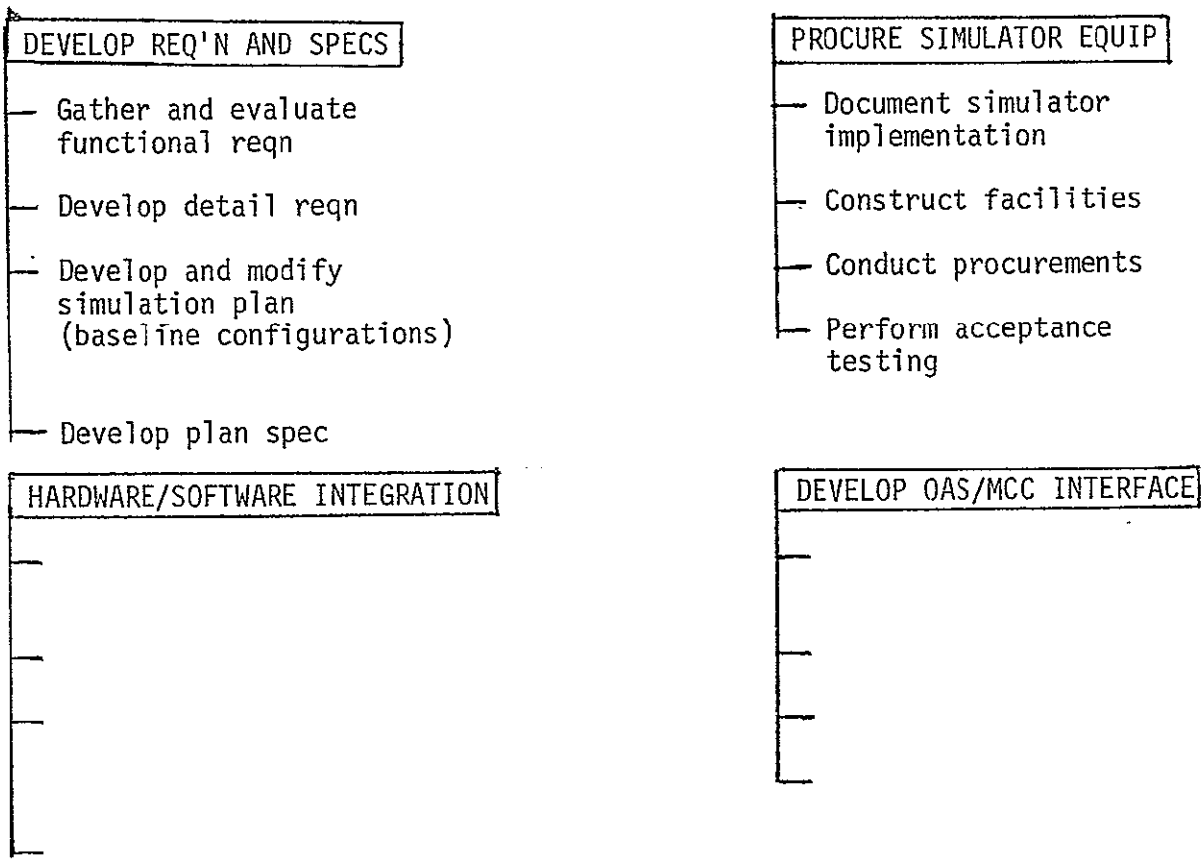


FIGURE 3.2.2-3

3.2.2.1.5 Flow Charts - An example Activity Flow for Orbiter Aero Simulator development and operation which references the Program PWBS (1.7.1.6) is shown in Figure 3.2.2-4.

3.2.2.1.6 Activity Definitions - Detail sub-tasks to accomplish the activity flows will be developed which provide the activity definition. An example correlating to the activity flow of Figure 3.2.2-4 follows:



3.2.2.1.7 Schedules - The last element of the DSAD Operations Integration Plan is the directorate schedule book which is published monthly. The book shows the accomplishments and schedule status of the major tasks being undertaken by each of the divisions. An example of the schedule which correlates to the activity flow shown by Figure 3.2.2-4 is included as Figure 3.2.2-5.

3.2.2.2 Flight Operations Directorate Operations Integration Plan - In the Flight Operations Directorate, the job definition, resources management, and schedule reporting is controlled through three separate but interrelated documents:

ACTIVITY FLOW

ORBITER AERO SIMULATOR DEVELOPMENT AND OPERATION

(PWBS REF. 1.7.1.6)

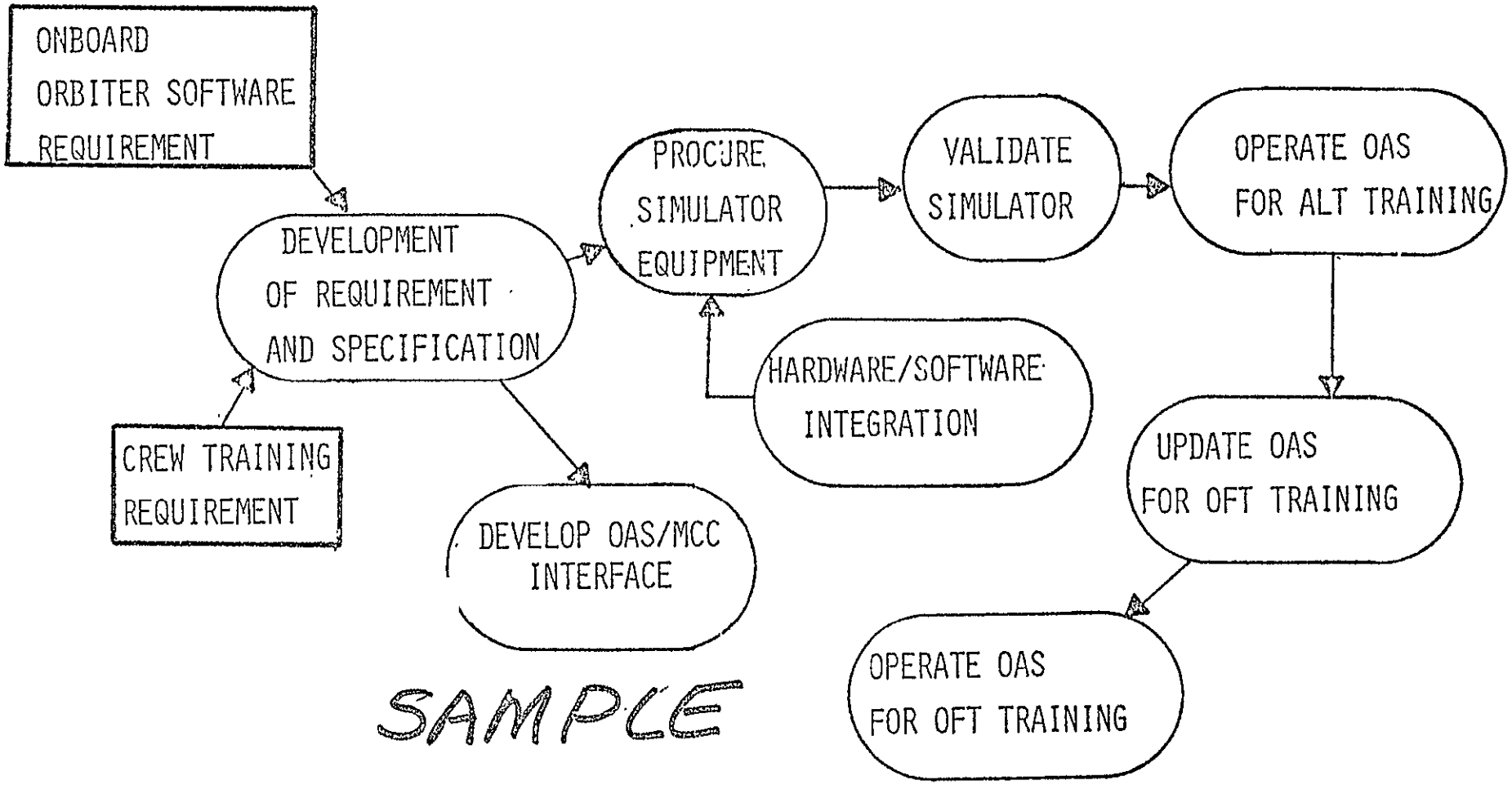


FIGURE 3.2.2-4

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DIRECTOR: TINDALL
PESP: WOODLING GRG: FE
CONTACT: THIBEAULT EXT: 6200

SHUTTLE SCHEDULE
FLIGHT SIMULATION DIVISION
SHUTTLE OFT/OPERATIONS

UPDATE FREQ: MONTHLY
STATUS AS OF: 3/28/75
DATE: 3/28/75

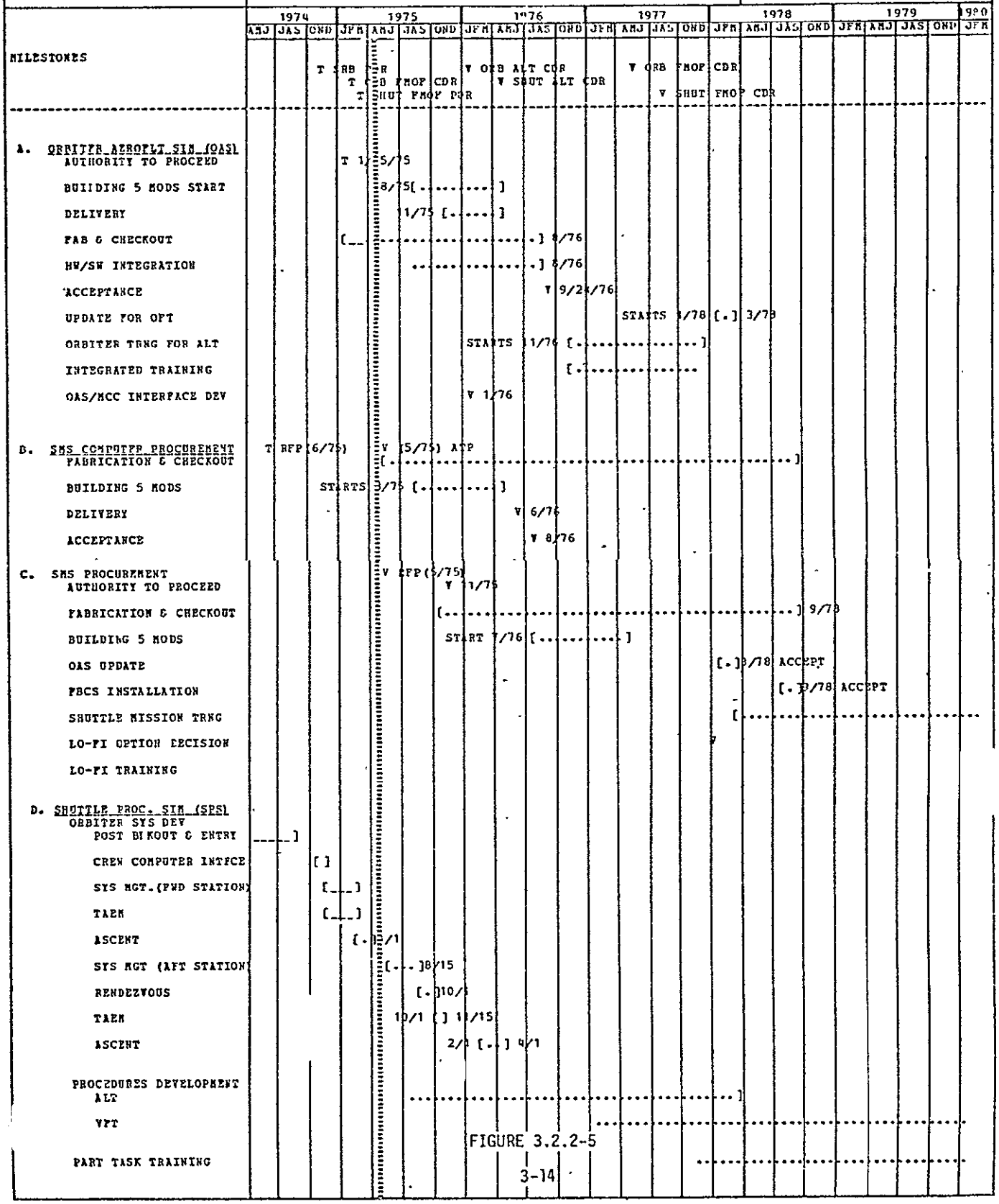

FIGURE 3.2.2-5

1) FOD Program Support and Management

2) Manpower Utilization System Plan

3) FOD Product, Task Plan and Schedule Summary

3.2.2.2.1 FOD Program Support and Management Plan - In the Management Plan, the Directorate task in support of the Shuttle Program is divided into four basic functions at the directorate level, and nine functions, at the division level. (Several functions assigned to the Aircraft Operations and Aircraft Engineering Divisions have been grouped under one heading). These functions are shown below within the organizational element assignment for each.

Flight Operations Directorate Management Functions

Directorate Office

- Technical and Resource Management Functions, Administrative Management Function, Program Requirements Management Function, and Project Management Function

Organizational Elements

Flight Control Division

- Flight Command and Control Function, Trajectory Operations Function, System Operations Function, and Payload Operations Function

Crew Training and Procedures Division

- Crew Activity Planning Function, Crew Operations Support Function, and Training Operations Function

Aircraft Operations Division

- Aircraft Operations and Maintenance Functions

Aircraft Engineering Division

- Aircraft Engineering Function

In addition, the management plan includes flow charts for each of these functions which serve to define the basic output products for each function, and provides broad definition of the task required to generate the products. These flow charts, plus the function allocation shown above, constitute the work assignment system for FOD. An example functional flow for Training Operations is shown in Figure 3.2.2-6.

TRAINING OPERATIONS FUNCTION

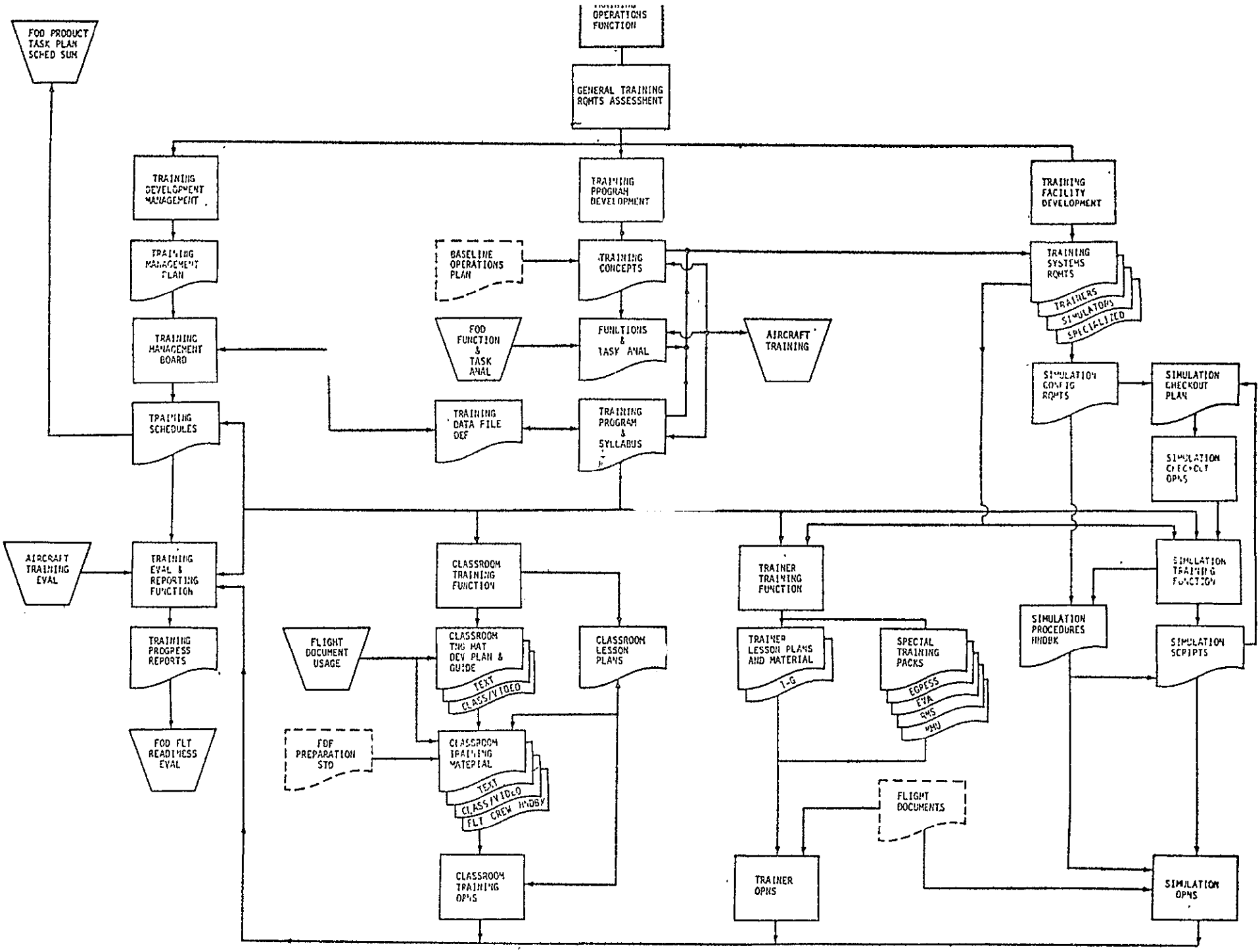

FIGURE 3.2.2-6

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3.2.2.2.2 Manpower Utilization System Plan - The manpower and resources accounting system in FOD is accomplished through the Manpower Utilization System Plan which is a computerized system for accumulating man hour expenditures in accomplishment of specific tasks. Task identification codes are assigned to each of the products and tasks generated in the work assignment system identified in the Directorate Program Support and Management Plan. Specific Instructions for use of the Manpower Utilization System are contained in the FOD Management Guide.

3.2.2.2.3 FOD Product, Task Plan and Schedule Summary - The final document required to close the loop in the work definition, control, and reporting system is the directorate schedules document entitled Flight Operations Directorate Product, Task Plan, and Schedule Summary. This document is published bi-monthly, and contains the products, schedule, and schedule status for each of the tasks identified in the directorate management plan and tracked in the task accounting system. The document also contains the applicable Shuttle Program and Orbiter Project Milestones for comparison. An example of the schedule which correlates to the functional flow shown by Figure 3.2.2-6 is included as Figure 3.2.2-7.

3.3 Task Allocation Through the PWBS

Operations Integration PWBS' 1.7.1 and 1.7.2 have been sub-divided into four (4)-digit tasks which equate to the Directorate Division or Office level for those overall task responsibilities that have been assigned to the line directorates for lead. These four digit PWBS tasks have been further expanded into sub-tasks that define the overall functions to be accomplished for the Shuttle Program.

Each four (4)-digit PWBS is described by a graphic which is preceded by a narrative overview of the PWBS. The graphics depict the lead organization for task accomplishment (shown by heavy black border), the support organizations when not a part of the lead organization (shown by a double border line), reference the appropriate Directorate functional code or sub-project activity assignment, and identify the lead responsibility (usually division or staff office level) so that clear visibility from the Level II task allocation into the line organization detailed task planning implementation is possible. Each PWBS sub-task is traceable to a task activity logic flow diagram in Section 3.4. The Directorate functional codes used and the implementing organizations are shown in Figure 3.3-1.

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DIRECTOR: BLANKNECHT
RESP: CC
CF
CG
CR

SHUTTLE INTEGRATED SCHEDULE
OPERATIONS SUPPORT PRODUCTS
OPERATING DIVISIONS
FLIGHT OPERATIONS DIRECTORATE

UPDATE FREQ: BIMONTHLY
STATUS AS OF: 06/27/75
DATE: 07/15/75

SHUTTLE UNIQUE KEY
(A) ALT DLV PERIOD....
(D) OFT ------(D) CHANGE
(D) OPERATIONS COMPLETED (A)
(D) PAYLOADS (TYPICAL)
[U] UNIVERSAL SHUTTLE PRODUCT
NUMBER ID/DOC NO ORG

	1975									1976						1977				1978				1979
	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
OFT			V	-45		V	-42		V	-39		V	-36	V	-33	V	-24	V	-18	V	-12	V	-6	
ALT			V	-21		V	-18		V	-15		V	-12	V	-6	V	FCF	V	FAL					

CREW OPERATIONS SUPPORT

CREW INTG PLAN — (A) — (D)

SHUT EVA DESCRIPTION AND DESIGN CRITERIA — [U] FINAL

ORB CRASH & RESCUE INFO MAN
OV-101 — (A) OUTLINE — (A) BASIC
OV-102 — (D) BASIC

EMERGENCY EGRESS TNG RQMTS — (D) BASIC

FLT TEST DEBRIEFING PLAN
ALT — (D)
OFT — (D)

FLT TEST DEBRILFING REPORT (QUICK LOOK 7 DAYS, FINAL 30 DAYS AFTER EACH MISSION)
ALT — (A)
OFT

TRAINING OPERATIONS

TNG MGT PLAN — [U] — [D] BASIC

TRAINING CONCEPTS — (A) — (D) — (D) LSD TEST-2

TNG PROGRAM & SYLLABUS
ALT — (A) BASIC — (D) BASIC
OFT

TNG DATA FILE DEF — [U] PRELIM.. [U] BASIC

FLT CREW HNDBK
ALT — (A) DEF.... (A) BASIC
OFT — (D) DEF.... (D) PRELIM.... (D) BASIC

CLASSROOM TNG
MATERIAL DEV PLAN/GUIDE — [U] BASIC

CLASSROOM LESSON PLANS
BACKGROUND — [U]
ALT SPECIFIC — (A)
OFT SPECIFIC — (D)

TNR LESSON PLANS & MATERIAL
ORBITER 1-G NEUT BUOY — (D) BASIC
SPECIAL CREW EQPT — (D) BASIC

CLASSROOM TRAINING MATERIAL
BACKGROUND — [U]
ALT SPECIFIC — (A)
OFT SPECIFIC — (D)

SPECIALIZED TRAINING PACK — (TBD)

SIM PROCEDURES HNDBK
ALT — (A) BASIC
OFT — (D) BASIC

SIM CONFIG RQMTS
ALT — (TBD)
OFT — (TBD)

SIM SCRIPTS
ALT — (A) BASIC
OFT — (D) BASIC

SIM CHECKOUT PLAN — (A) BASIC

TNG SCHEDULES — (D) PUBLISH.... (D) PUBLISH....

TNG PROGRESS REPORTS — (D) PUBLISH.... (D) PUBLISH

FIGURE 3.2.2-7

LEAD ORGANIZATION FUNCTION CODES

FUNCTION-ACTIVITY/CODE	DIRECTORATE LINE ORGANIZATIONS: FOD: STA PROJECT OFFICE/CA	FOD: FLIGHT TECHNIQUES AND SOFTWARE INTEGRATION/CA3	FOD: ASTRONAUT OFFICE/CB	FOD: AIRCRAFT OPERATIONS DIVISION (AOD)/CC	FOD: FLIGHT CONTROL DIVISION (FCD)/CF	FOD: CREW TRAINING AND PROCEDURES DIVISION (CTPD)/CG	FOD: AIRCRAFT ENGINEERING DIVISION (AED)/CH	FOD: ORBITER ATMOSPHERIC FLIGHT TEST OFFICE (OAFTO)/CT	DSAD: FLIGHT SIMULATION DIVISION (FSD)/FE	DSAD: MISSION PLANNING AND ANALYSIS DIVISION (MPAD)/FM	DSAD: SPACECRAFT SOFTWARE DIVISION (SSD)/FR	DSAD: GROUND DATA SYSTEMS DIVISION (GDSD)/FS	DSAD: INSTITUTIONAL DATA SYSTEMS DIVISION (IDSD)/FD
PROGRAM REQUIREMENTS MANAGEMENT FUNCTION (PROG REQ MGT)		✓	✓		✓	✓	✓	✓					
PROJECT MANAGEMENT FUNCTION (PROJ MGT)	(✓)		✓					✓					
FLIGHT COMMAND AND CONTROL FUNCTION (FLT C&C)		✓	✓		(✓)	✓							
TRAJECTORY OPERATIONS FUNCTION (TRAJ OPS)			✓		(✓)	✓							
SYSTEMS OPERATIONS FUNCTION (SYS OPS)		✓	✓		(✓)	✓							
PAYLOAD OPERATIONS FUNCTION (P/L OPS)			✓		(✓)	✓							
CREW ACTIVITY PLANNING FUNCTION (CAP)			✓			(✓)							
CREW OPERATIONS SUPPORT FUNCTION (COS)			✓			(✓)							
TRAINING OPERATIONS FUNCTION (TRNG OPS)			✓			(✓)							
AIRCRAFT OPERATIONS FUNCTION (A/C OPS)			✓	(✓)									
AIRCRAFT ENGINEERING FUNCTION (A/C ENG)			✓				(✓)						
MISSION PLANNING, SYSTEM PERF ..... (MISSION)										(✓)		✓	
COMMAND AND CONTROL SUPPORT, INCLUDING ..... (C&C)									✓	✓	✓	(✓)	
SIM AND TRAINING SUPPORT, INCLUDING ..... (SIM)									(✓)			✓	
SPACECRAFT SOFTWARE DEVELOPMENT ..... (S/W)									✓	✓	(✓)		

(✓) DENOTES "PRIME" SUPPORT

FIGURE 3.3-1

3.3.1 Operations Requirements and Integration (PWBS 1.7) - The primary tasks and products to be accomplished under this top level PWBS element are summarized below.

Tasks

- Assuring that the Space Shuttle Program operations requirements and integration functions are properly accomplished.
- Assuring that the existing operations-related expertise of NASA organizational elements is utilized to accomplish the Space Shuttle Program operations integration functions.
- Assuring that NASA and Department of Defense joint planning for the operational phase of the Space Shuttle Program is accomplished.
- Providing operations-related support to other PWBS elements as defined.

Products

- Mission operations resource allocations and recommendations.
- Mission operations tasks, plans, and status reporting
- Operational planning and status reporting.
- Program operations requirements and documentation.

3.3.2 Mission Operations Analysis and Requirements (PWBS 1.7.1) - The Missions Operations Analysis and Requirements PWBS encompasses those Shuttle Program activities dealing with the generation and iteration of Program Flight Requirements, and the implementation of these requirements into the Shuttle Flight Design and Crew Activity Planning. A second major function is the Shuttle Program task of training flight crews and flight controllers with the attendant definition and implementation of trainers and simulators. The third major function is the operational review and iterative feedback of Shuttle flight hardware and software design integration, and the generation of the operational requirements and constraints necessary to assess operational compatibility and capability of the Shuttle vehicle.

Those functions where the lead responsibility is retained in the Missions Office are contained in PWBS 1.7.1.5. The task graphics that follow (Figure 3.3.2-1 thru 3.3.2-9) cover PWBS 1.7.1 functions. There are certain Missions Office responsibilities that are not explicitly spelled out in the PWBS structure. The more significant of these activities are:

1. Coordination of operational requirements for Shuttle primary, secondary, and contingency landing fields.

2. MSBLS requirements coordination and integration planning.

3. Range safety requirements coordination and integration support.

4. Lead for Shuttle Program operation-oriented feasibility and compatibility studies, such as the Manned/Unmanned First Orbital Flight.

5. Level II Operational Requirements coordination and sponsoring of Change Requests to the baseline; e.g., Baselining of Ascent Manual Guidance Capability.

These activities require support from JSC Directorates, other Shuttle Program elements, and from other Centers.

The overall functional responsibility involved with generation and maintenance of Orbital Flight Test Requirements, and the necessary monitoring of and feedback from the implementation of these requirements into the Flight Design, Crew Activity Planning, Training, Procedures Development, and Hardware/Software Development and deferral planning, is the prime integration thread of the Missions Office function. The Level II Flight and Ground Systems Specification, Master Flight Test Assignments Document, Orbital Flight Test Requirements, and the Flight (Mission) Requirements Document contain those requirements that must be satisfied by the above development activities.

The separate areas of this overall Operations Integration activity were shown with their prime interfaces in Figure 2.4-1. Individual narrative and graphics covering the Missions Office responsibilities, both those that are a coordinating function with other Directorates as the lead, and those where the detail responsibility lies in the Missions Office, are presented in Sections 3.3.2.1 through 3.3.2.9.

3.3.2.1 Mission Planning and Analysis (PWBS 1.7.1.1) - The DSAD Mission Planning and Analysis Division (MPAD) has the lead responsibility for accomplishment of this task. Principal support is required from the other organizations at JSC as well as close interfacing with Rockwell/Space Division. This overall Shuttle task is the continuation of the MPAD role in previous programs.

The more significant sub-tasks consist of generating Design Reference Missions for use in assessing and verifying vehicle design, the development and design of the flight profiles for OFT along with the necessary contingency flight planning, the gradual development and implementation of standard flight phases and types, dispersion analyses for all flight phases including data required for range safety input, and the performance evaluation of the Shuttle vehicle's capability versus the baselined flight requirements and implementation planning. Visibility and coordination of these developments are through the Flight Operations Panel, the Operations Integration Review, Flight Techniques Activities, and through publication of review drafts of the development plans. Contractor support funded by the Program Office is provided by Rockwell/Space Division and McDonnell Douglas.

MISSION PLANNING & ANALYSIS TASKS (PWBS 1.7.1.1)

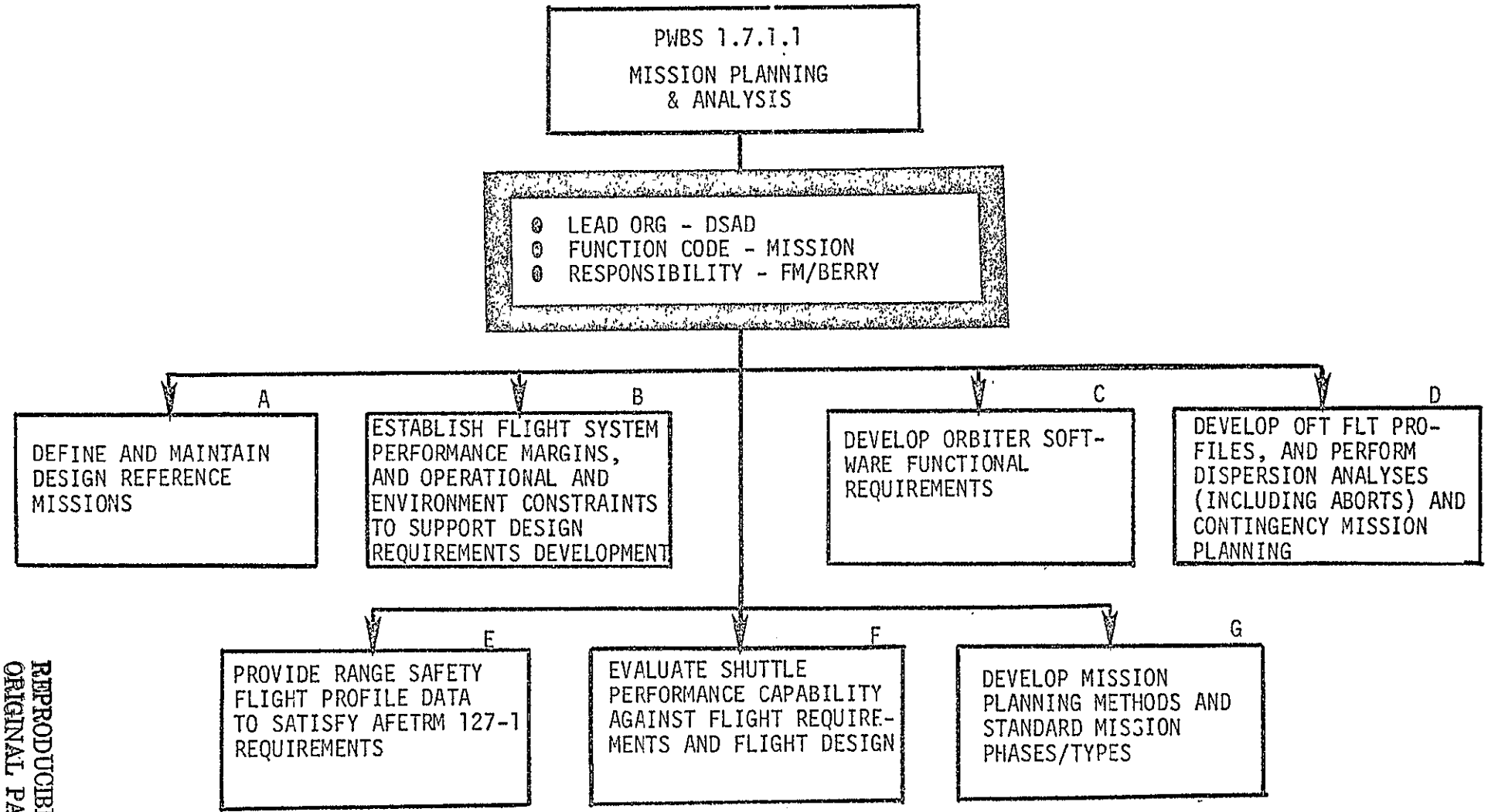

FIGURE 3.3.2-1

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3.3.2.2 Mission Operations Requirements and Analysis (PWBS 1.7.1.2) - The FOD Flight Control Division has the lead responsibility for this task. Principal support is required from other organizations at JSC. This overall function has been accomplished by the Flight Operations Directorate in past programs. The more significant sub-tasks are the development of operational requirements and constraints for input into the flight hardware and software design and use of same in evaluating those designs, the development of Shuttle systems operating procedures and attendant Flight Data File articles, development and coordination of Flight Rules and inputs to Launch Rules, providing the interface for range safety activities, and the development of operational requirements for flight design. Visibility and coordination for these developments are through the Flight Operations Panel, the Flight Techniques Activity, the Flight Software Working Groups, the Operations Integration Review, and through publication of review drafts of the development plans. Contractor support funded by the Shuttle Program Office is provided by Rockwell/Space Division and McDonnell Douglas.

MISSION OPERATIONS REQUIREMENTS AND ANALYSIS TASK (PWBS 1.7.1.2)

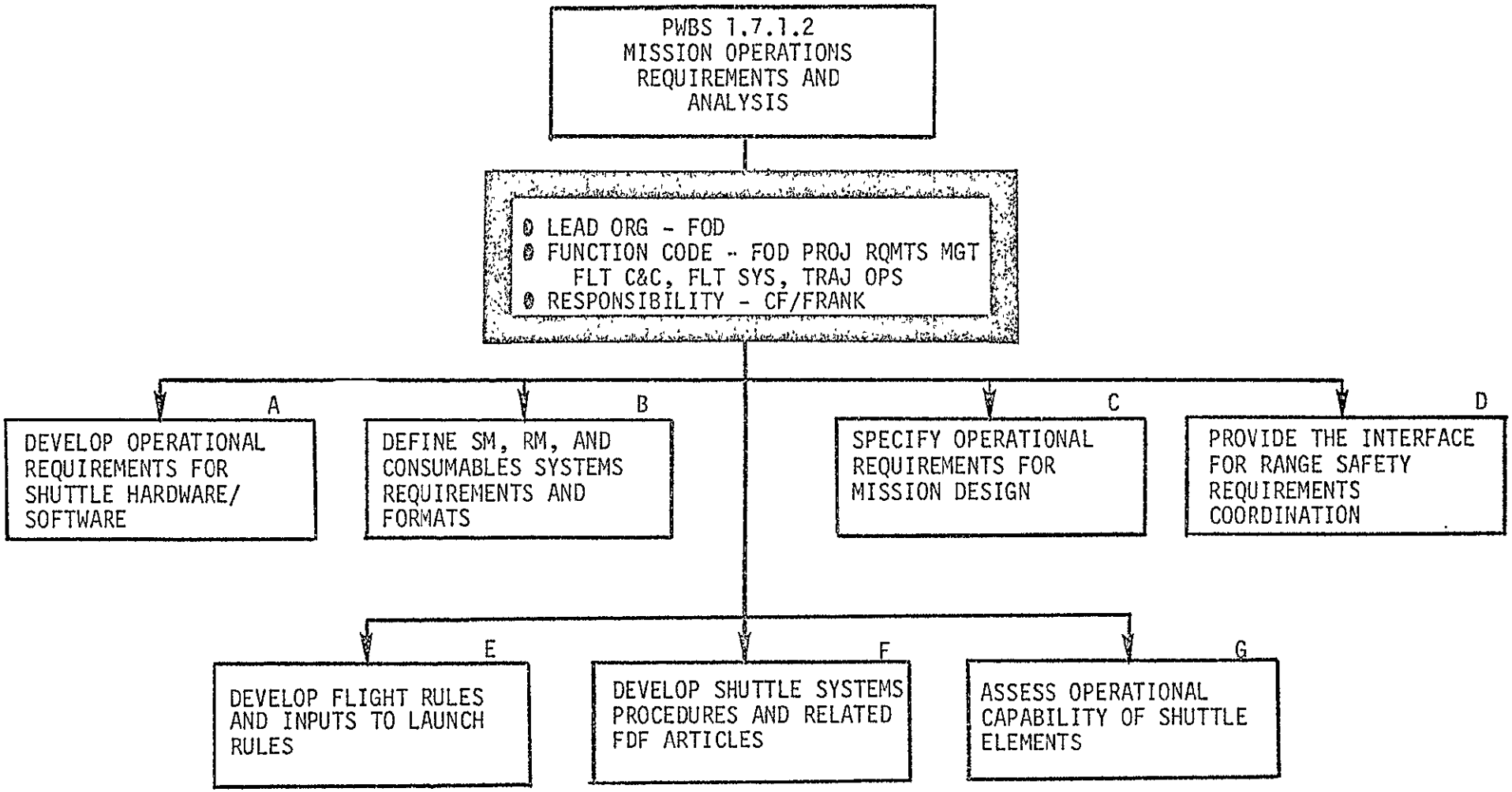

FIGURE 3.3.2-2

3.3.2.3 Crew Requirements, Procedures, Training, and Crew Activity Planning (PWBS 1.7.1.3) - The FOD Crew Training and Procedures Division has the lead responsibility for this task. Principal support is required from other organizations at JSC. This overall function has been accomplished by JSC Operations Organizations on previous programs. The more significant sub-tasks are the establishment of crew procedures requirements and the development and control of those crew procedures, the development of the crew and flight controller training requirements and the implementation of those resulting plans, and the development of a flight operations data base with the ultimate crew activity plan generation. Visibility and coordination of these developments are through the Crew Procedures Control Board, the Training Simulator Control Panel, the Flight Operations Panel, the Flight Techniques Activity, the Operations Integration Review, and through publication of review drafts of the development plans. Contractor support, funded by the Shuttle Program Office, is provided by Rockwell/Space Division and McDonnell Douglas.

CREW REQUIREMENTS, PROCEDURES, TRAINING AND CREW ACTIVITY PLANNING TASKS (PWBS 1.7.1.3)

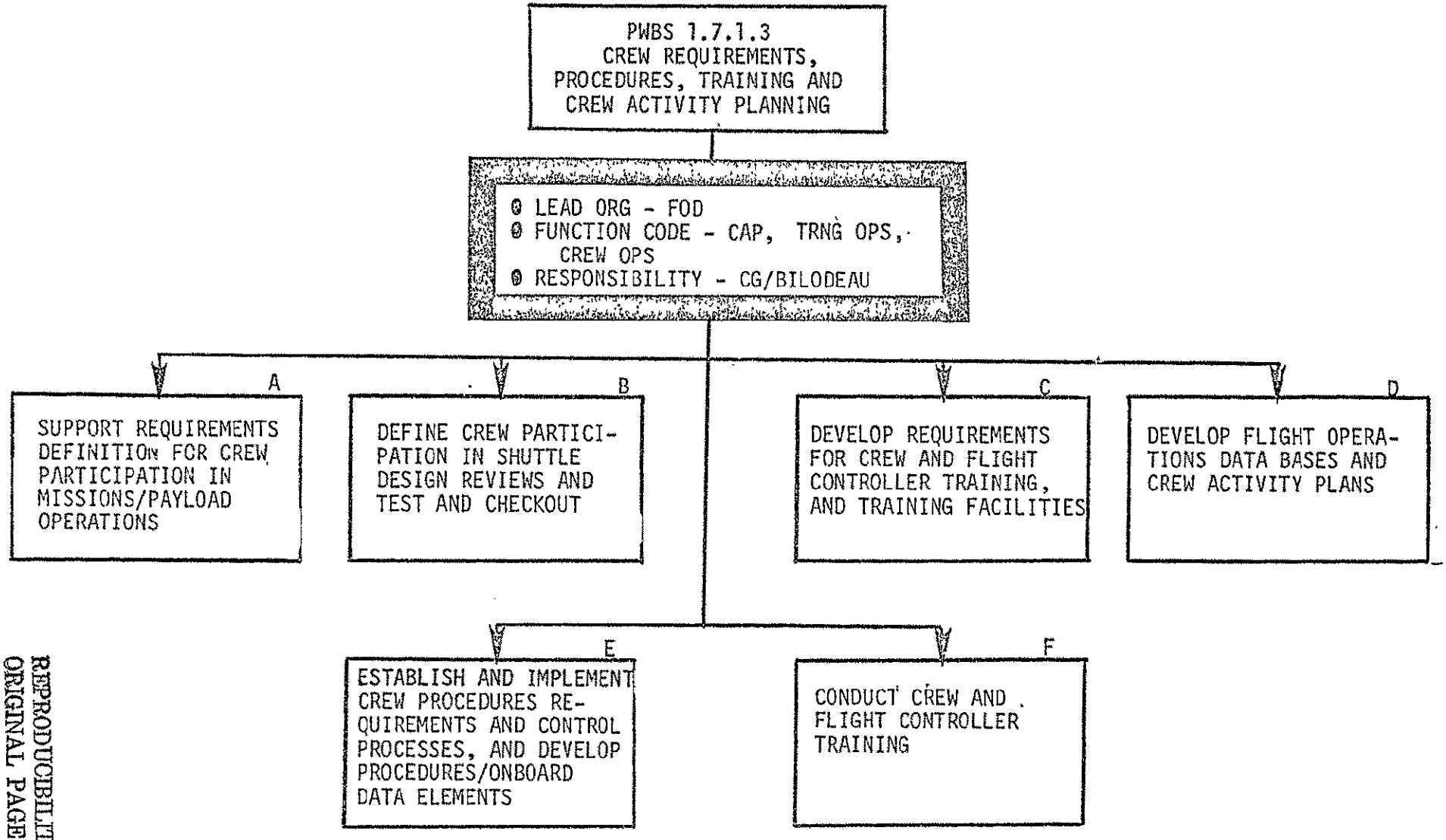

FIGURE 3.3.2-3

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3.3.2.4 Shuttle Training Aircraft Development and Operations (PWBS 1.7.1.4) - The Flight Operations Directorate has the lead responsibility for this task. A Project Office, with primary support from the Aircraft Engineering Division and the Aircraft Operations Division, has the day-to-day management of this task. Support from other JSC organizations is required. The more significant sub-tasks consist of Shuttle Training Aircraft (STA) design, development, and verification testing, STA maintenance and operation, and development and implementation of STA training plans and flight rules. Visibility and coordination of these activities are through Center supported contractor reviews, status presentations to various levels of program management, and through publication of the above plans. Contractor support, funded by the Shuttle Program Office, is provided by Grumman Aircraft Corporation, the STA development contractor.

SHUTTLE TRAINING AIRCRAFT (STA) DEVELOPMENT AND OPERATION TASKS
(PWBS 1.7.1.4)

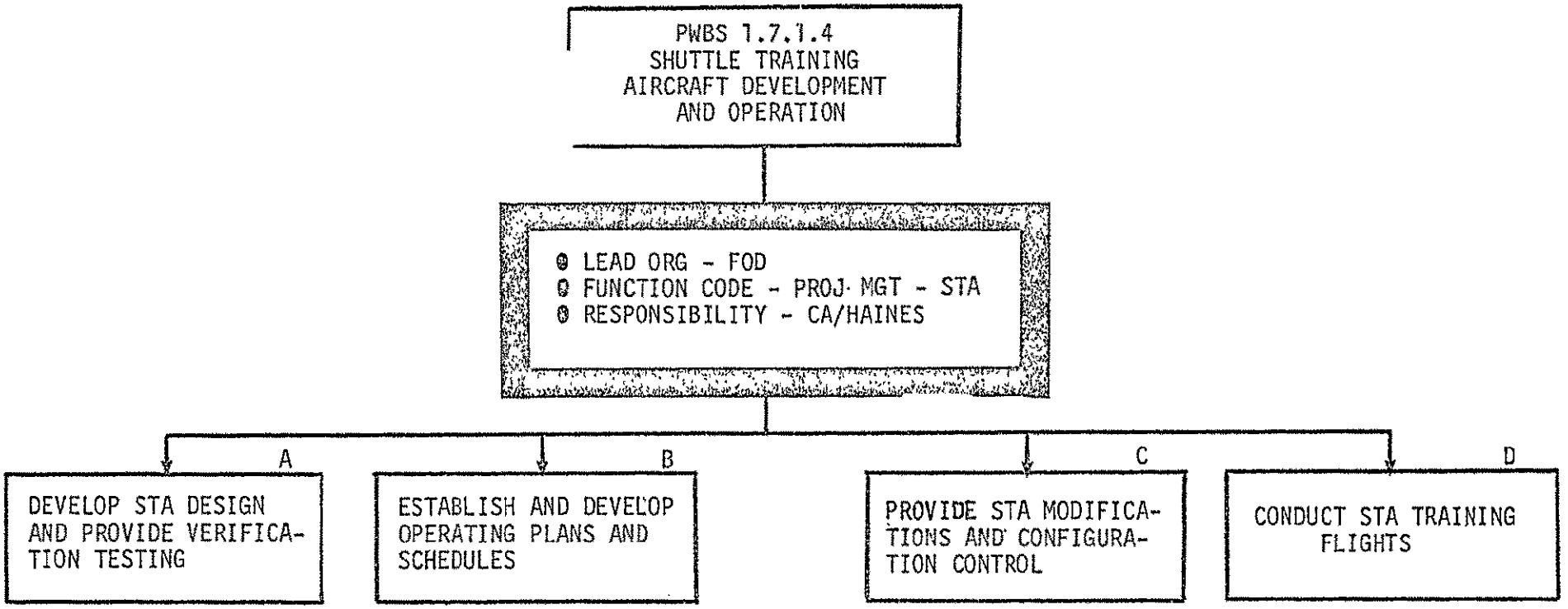

FIGURE 3.3.2-4

3.3.2.5. Program Operations Requirements Definition (PWBS 1.7.1.5) - The Shuttle Missions Office has the lead responsibility for this task. Support is required from all elements of the Shuttle Program. The more significant sub-tasks are the maintenance and update coordination of the Level II Flight Operations document, and the development and iterative revision of Shuttle Program orbital flight requirements with the feedback from the implementation of these requirements into the flight design and crew activity planning. Volume VIII (JSC-07700), Flight Operations, contains the basic operational responsibility assignments for the Shuttle DDT&E portion of the program, and coordinated revisions to these assignments are the responsibility of the Missions Office. The Level II orbital flight requirements are contained in the Master Flight Test Assignments Document, the Orbital Flight Test Requirements, and the Flight Requirements Document. Generation and review of these requirements are accomplished via the Flight Test Program Panel, the Flight Operations Panel, Center and Program wide review meetings, the Operations Integration Review, and by publishing review drafts of the documents. Contractor support for this task is provided by Rockwell/Space Division.

PROGRAM REQUIREMENTS DEFINITION TASKS (PWBS 1.7.1.5)

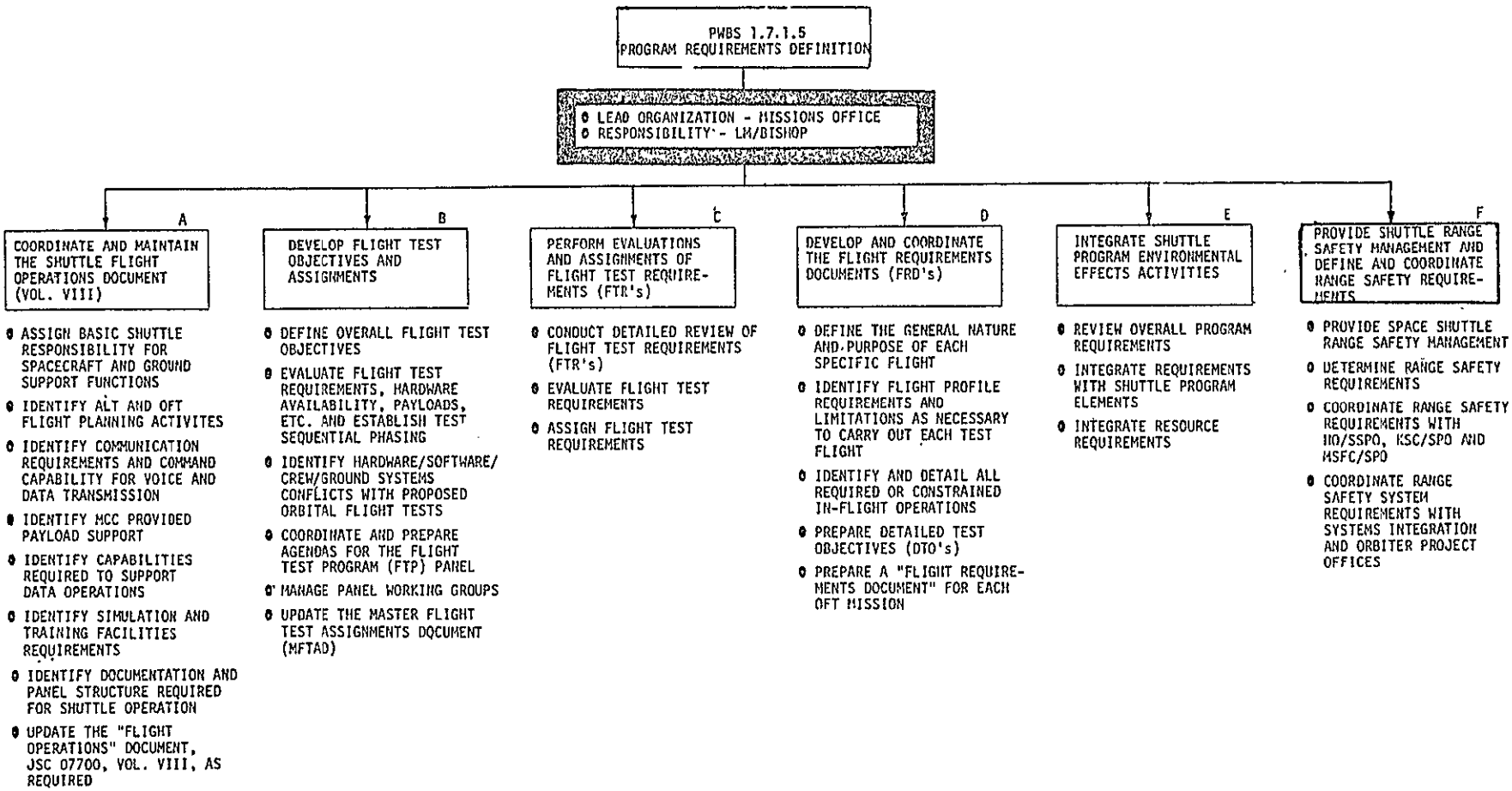

FIGURE 3.3.2-5

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3.3.2.6 Training Simulation Implementation and Operation (PWBS 1.7.1.6) - The DSAD Flight Simulation Division has the lead responsibility for this task. Principal support is required from other JSC organizations. This overall function has been accomplished by JSC operations organizations on past programs. The more significant sub-tasks consist of coordinating the FOD training requirements and developing simulator specifications that meet those requirements; procurement, development, and activation of training simulators; maintenance, configuration control, and modification of the simulators; and operation of the simulators during training and procedures verification sessions. Visibility and coordination of these activities are via the Training Simulation Control Panel, Operations Integration Review, Source Board Activities, and status reviews with Shuttle management. Procurement of the simulators are Shuttle Program funded.

TRAINING SIMULATION IMPLEMENTATION AND OPERATION TASKS (PWBS 1.7.1.6)

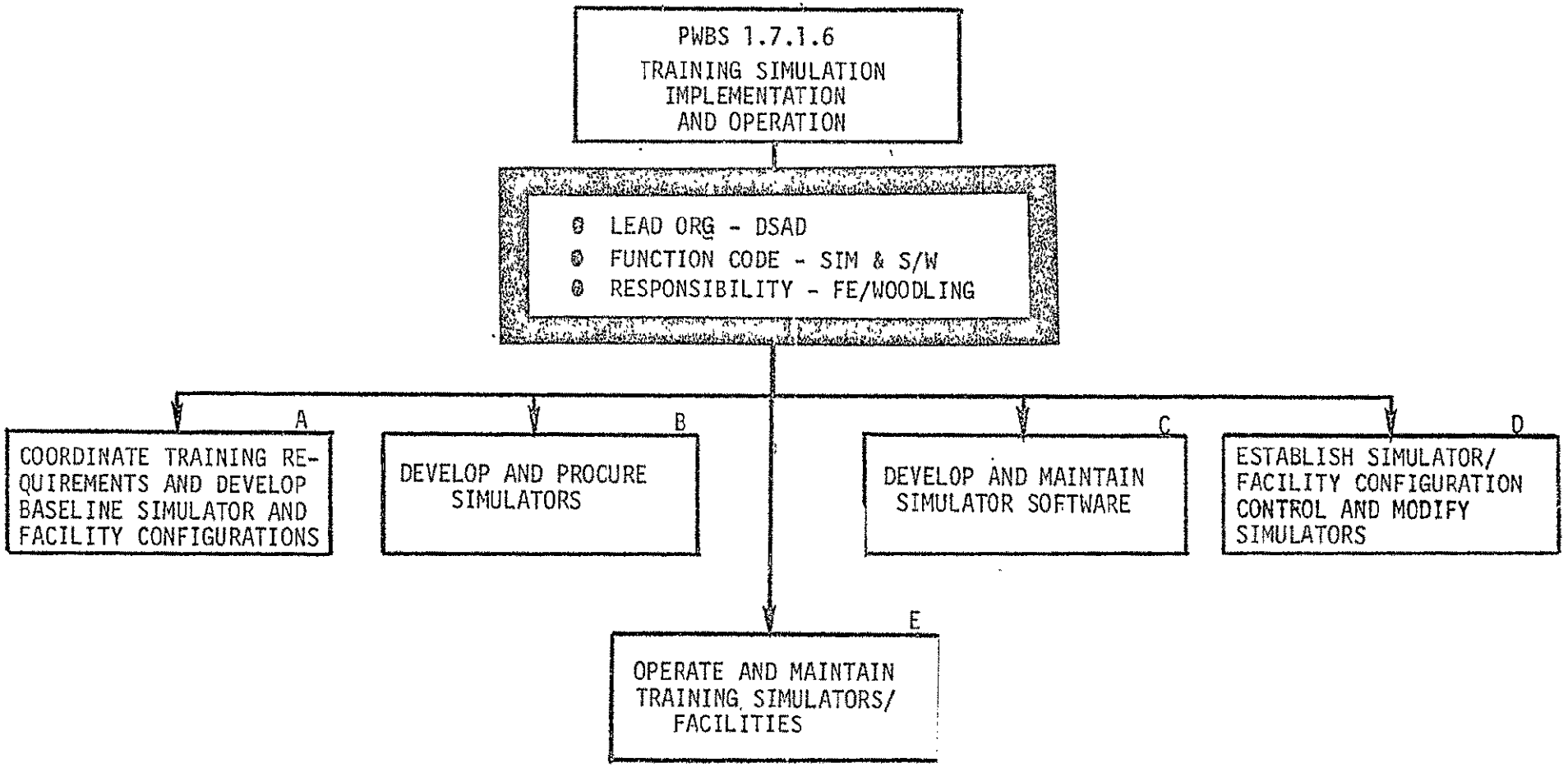

FIGURE 3.3.2-6

3.3.2.7 Trainer Definition, Development, and Operation (PWBS 1.7.1.7) The E&DD Spacecraft Design Division has the lead responsibility for this task. Principal support is required from other organizations at JSC and the Rockwell/Space Division. This overall task has been accomplished by the Spacecraft Design Division on past programs. The significant sub-tasks are the development and evaluation of trainer functional requirements and specifications to meet the training requirements of the FOD, the technical management of the procurement of the trainers, and the configuration maintenance and operations of the trainers and trainer facility. Visibility and coordination of these activities are through contractor design reviews, program-wide specification coordination, and presentations to Shuttle management. Trainers are funded through the Rockwell Orbiter Contract.

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TRAINER DEFINITION DEVELOPMENT, AND OPERATION TASKS (PWBS 1.7.1.7)

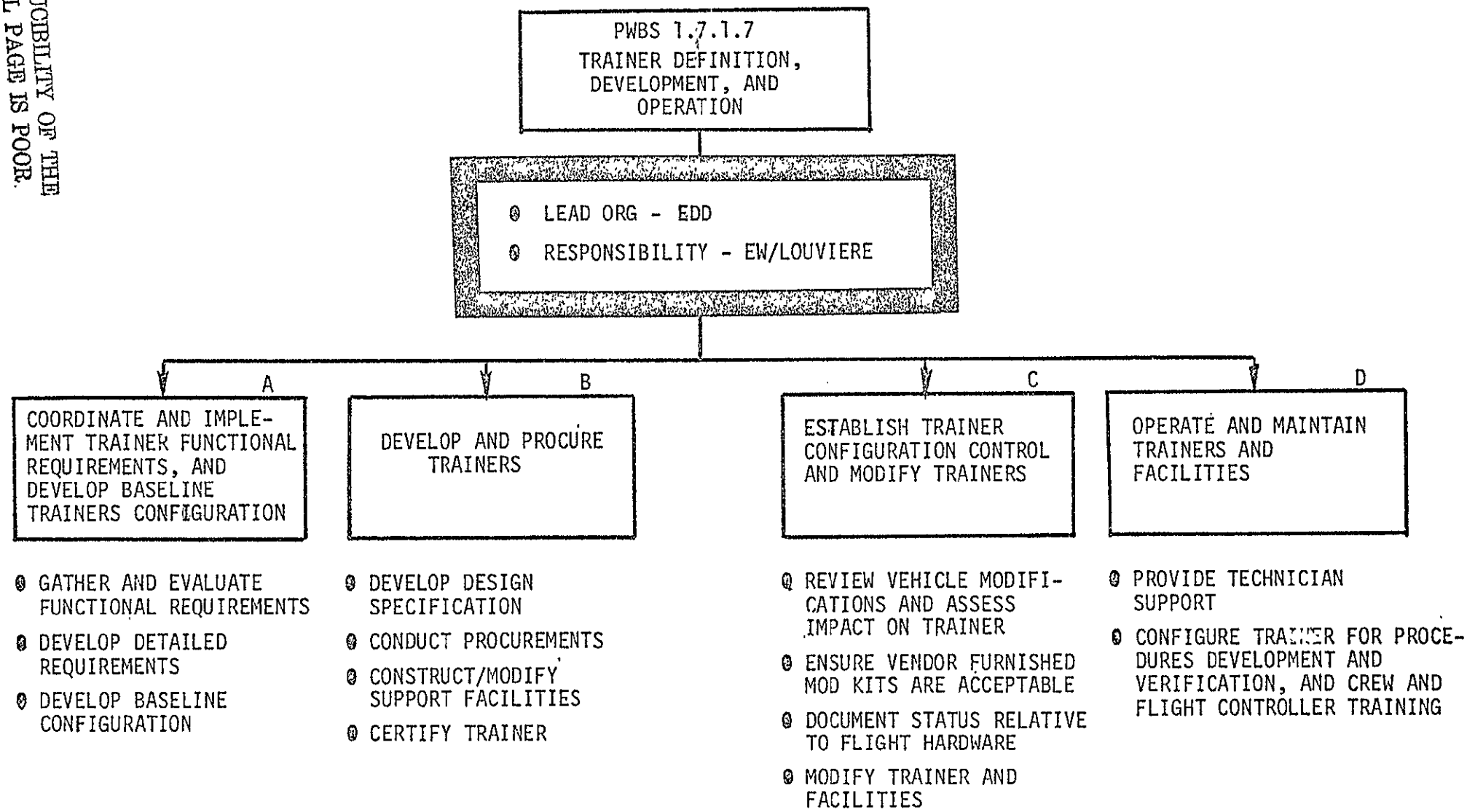

FIGURE 3.3.2-7

3.3.2.8 Flight Techniques and Software Integration (PWBS 1.7.1.8) - The Flight Operations Directorate has the lead responsibility for this task. Support is required from other JSC organizations, other Shuttle Program elements, and Shuttle contractors. This overall function has been accomplished via assignment of key operational personnel to a Program Office staff function in past programs. The significant sub-tasks are the definition and integration of the Orbiter software requirements which support flight techniques development, and the feedback interation from the implementation activities; the development, definition, and integration of the techniques required to accomplish flight objectives, particularly as they relate between crew interfaces with displays, software procedures, flight rules, and consumables management; and the integration of onboard and ground capabilities. Visibility and coordination of these tasks are through Software Working Groups, Flight Techniques Activities, Flight Operations Panel, Operations Integration Reviews, Software Design Reviews, and through publication of review drafts of the software requirements documents and the Flight Techniques Handbook. Contractor support, funded by the Shuttle Program Office, is provided by McDonnell Douglas.

FLIGHT TECHNIQUES AND SOFTWARE INTEGRATION TASKS (PWBS 1.7.1.8)

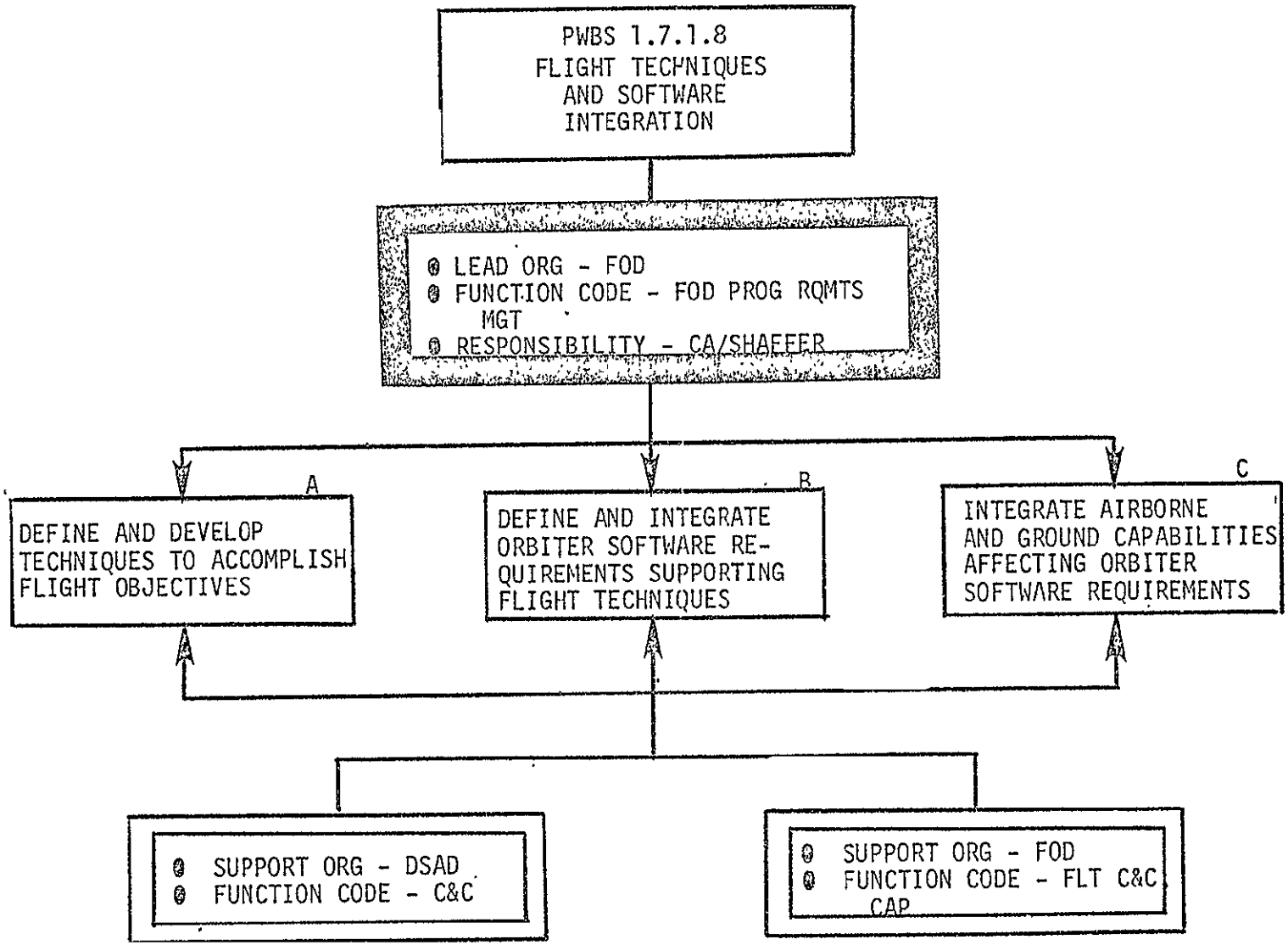

FIGURE 3.3.2-8

3.3.2.9 Space Shuttle Radiation Analysis (PWBS 1.7.1.9) - The Data Systems and Analysis Directorate has the lead responsibility for this task. Principal support is required from other organizations at JSC and the Rockwell/Space Division for Orbiter configuration information. The overall function has been accomplished by JSC Operations Organizations on previous programs. The significant sub-tasks are the development of a Shuttle analytical shielding model, and generation of projected radiation environments for the class of proposed Shuttle flights; performance of pre-mission dose calculation for both crews and radiation sensitive equipment; and the real time radiation analysis support to the Flight Operations teams. Written reports and updated computer models are products of this effort. Contractor support, funded by the Shuttle Program Office, is provided by Rockwell/Space Division.

SPACE SHUTTLE RADIATION ANALYSIS TASKS (PWBS 1.7.1.9)

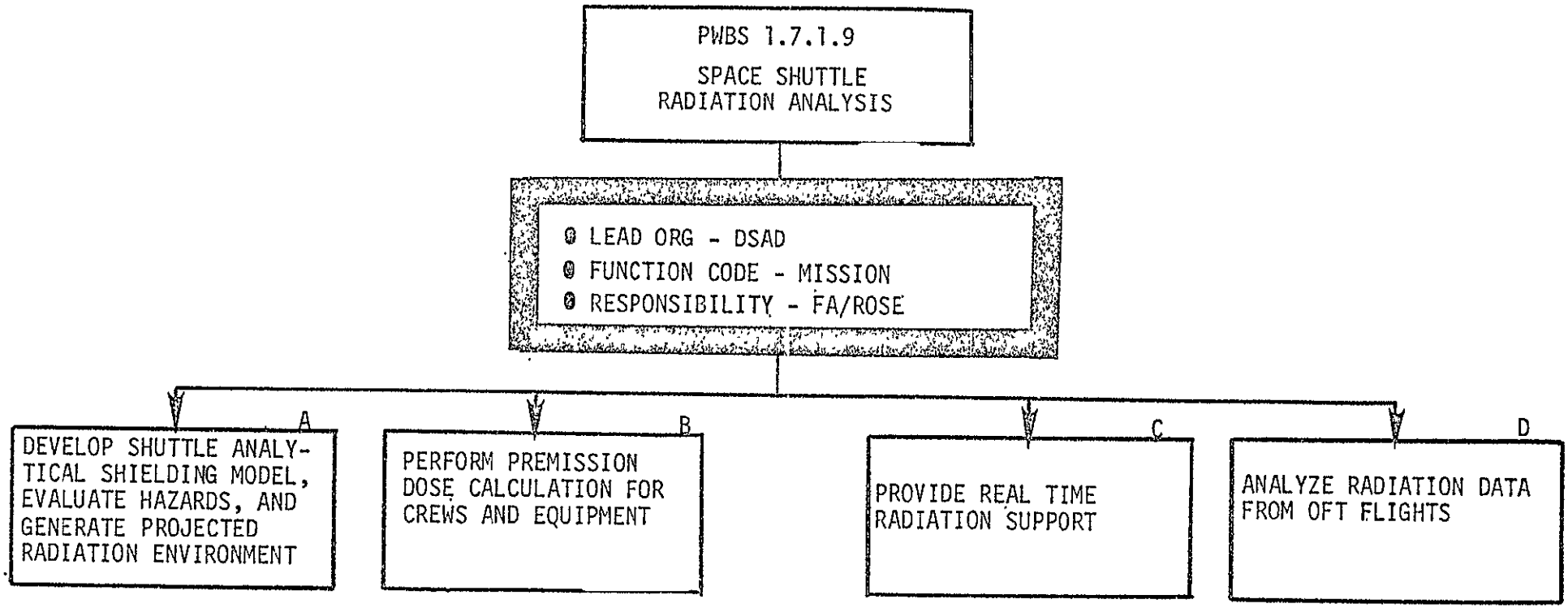

FIGURE 3.3.2-9

3.3.3 Operational Planning Analysis and Integration (PWBS 1.7.2) - The Operational Planning Analysis and Integration PWBS tasks have been established to ensure the accomplishment of those efforts necessary to the development of capabilities and facilities to conduct Shuttle flight operation planning and control activities; the development of required communication and data capabilities; coordination of interfaces and working relations between operating elements and related Shuttle elements and activities; coordination of efforts to develop NASA and DOD joint operating concepts, joint use of facilities, operating procedures and techniques; and supplementary task efforts necessary to obtain or provide support to the operating line organization.

Primary to the accomplishment of the above, is that effort associated with the development of concepts for conducting and controlling shuttle flights, the development and integration of requirements to provide a basis for design of the control capabilities, and the development of the basic facilities and associated software within the control facilities to accomplish the required planning and flight control. Associated with these tasks is the effort necessary to assure the existence and availability of lines of communication and data flow which provides the links between the control facilities and the orbiting vehicle, other ground based facilities, and payload control centers or users. Compatibilities of the onboard and ground based systems that provide these lines must be ensured. Coordination is accomplished between NASA and DOD to develop joint operating concepts, ensure compatibility of operating procedures and techniques, and the integration of respective requirements into the others facilities and operating plans.

The basic responsibilities of the operational planning analysis and integration tasks includes that effort necessary to ensure the definition of all data requirements, and the establishment of management techniques and reduction capabilities necessary for data handling and to satisfy user requirements. In addition there are a number of supporting tasks within the operational planning area consisting of activities necessary to define and integrate payload operating requirements, definition of crew functions, establishment and integration of EVA requirements and procedures, coordination of effort to define and document cartographic and program support requirements, and the development of operational flow and schedules. Carrier Aircraft operating concepts, operations plans, crew procedures and training and scheduling techniques will be developed to provide program post approach and landing test ferry operations.

1. Activities covered by PWBS 1.7.2.1, 1.7.2.2, are assigned to DSAD as the lead element. In the task graphics which follow, the sub-tasks for these PWBS are referenced to the appropriate DSAD function code.

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2. Activities covered by 1.7.2.3 are assigned to FOD and are similarly referenced to the appropriate FOD code structure.

3. PWBS 1.7.2.4 is assigned to POO.

4. PWBS 1.7.2.5, and 1.7.2.6 are retained in the Operational Planning Office. The task graphics which follow describe these functions in detail.

3.3.3.1 Command and Control Support Systems (PWBS 1.7.2.1) - The DSAD Ground Data Systems Division has the lead responsibility to accomplish this task. Primary activities associated with the effort consist of the review and integration of mission control center (MCC) user requirements, definition of a MCC design to satisfy these requirements, implementation of the control center design, and the development of the associated maintenance and operating procedures as well as development of a verification plan to test the MCC and network interface and operation. Documentation developed in connection with this task contain those MCC requirements generated as part of PWBS 1.7.2.3, Mission Control Concepts and Requirements.

COMMAND AND CONTROL SUPPORT SYSTEMS TASKS (PWBS 1.7.2.1)

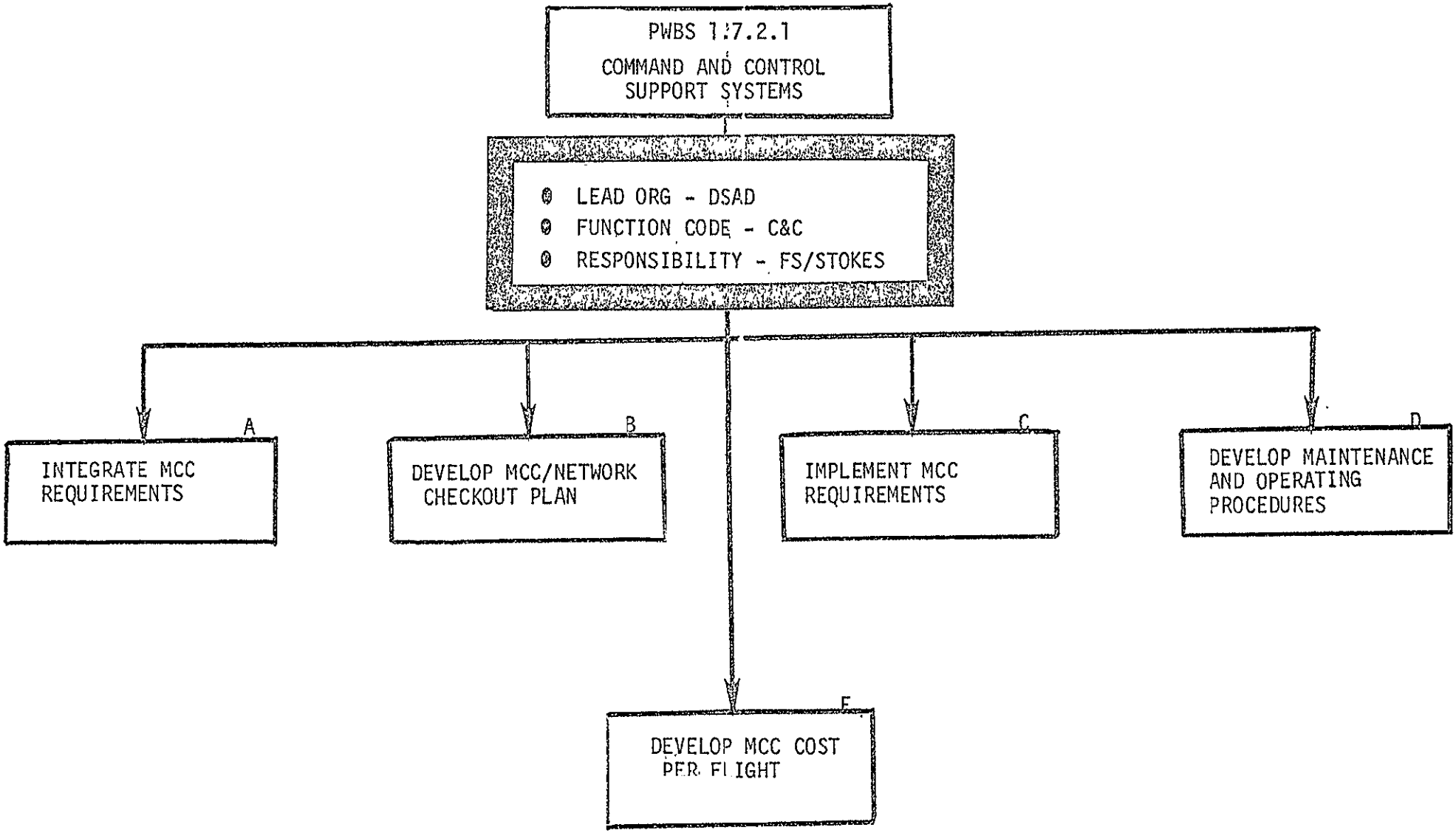

FIGURE 3.3.3-1

3.3.3.2 Communications and Data Systems Integration (PWBS 1.7.2.2) - The Data Systems and Analysis Directorate has the lead role for this task as delegated by Space Shuttle Program Management Directive Number 29. Principal support is required from other NASA centers and all elements of the Shuttle Program. The primary activities of this sub-task are directed to ensuring the review and integration of program communications and data requirements; definition, control and integration of shuttle-to-ground, shuttle-to-payload, and ground-to-ground communication interfaces; NASA/DOD network and facilities interfaces; and proper end-to-end (data source to user) communications and data systems performance (excluding design of on-board avionics hardware and related interfaces). Activities will include definition of integration testing, definition of the necessary interface documentation, and development and integration of network operations schedules. Much of the above activities are accomplished via the Communications and Data Systems Integration (CADSI) Panel which is chaired by DSAD, and includes activities contributing, supporting or interfacing with activities of PWBS 1.7.2.1 and PWBS 1.7.2.3. Contractor support, funded by the Shuttle Program Office is provided by Rockwell/Space Division.

COMMUNICATIONS AND DATA SYSTEMS INTEGRATION TASKS (PWBS 1.7.2.2)

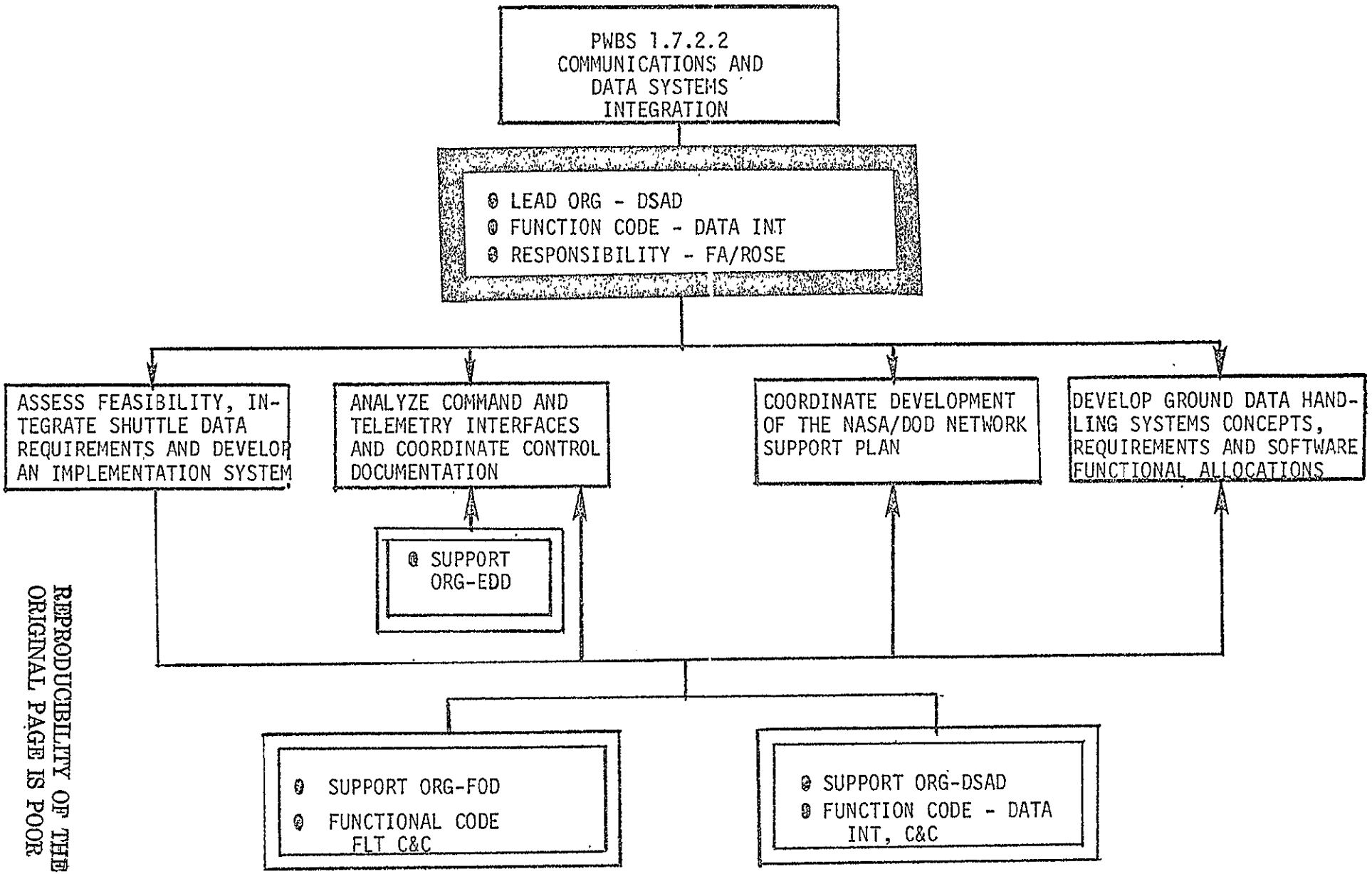

FIGURE 3.3.3-2

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3.3.3.3 Mission Control Concepts and Requirements (PWBS 1.7.2.3) - The FOD Flight Control Division has the lead responsibility for this task. Principal functions associated with this effort are the development of the concepts for conducting the Shuttle Program flights, and the required mission control center (MCC) capabilities needed in conducting the flights to include the requirements to interface with DOD networks and control facilities. In conjunction with this effort, the necessary procedural and mission documentation is developed, flight control data requirements are defined, and the relation with payload user, other NASA Centers, and Shuttle elements established. Activities of this task support an interface with those of PWBS 1.7.2.1 and PWBS 1.7.2.4.

MISSION CONTROL CONCEPTS AND REQUIREMENTS TASKS (PWBS 1.7.2.3)

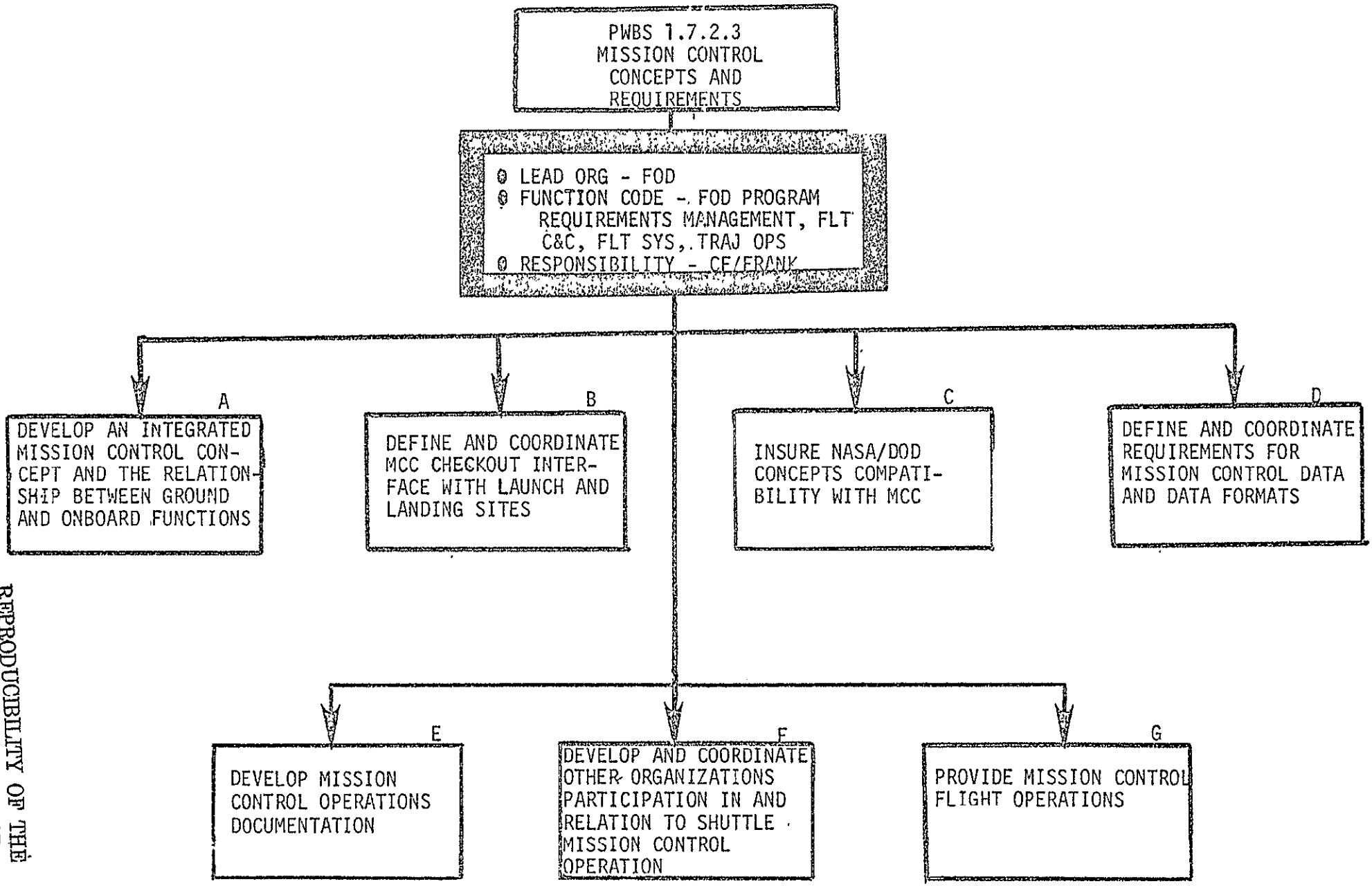

FIGURE 3.3.3-3

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3.3.3.4 Management of Post Flight Test Data for OFT (PWBS 1.7.2.4) - Lead responsibility for this task was delegated to the Test Division, Program Operations Office by Shuttle Program Directive Number 50. In support of this effort, the Division will establish the necessary procedures to ensure the collection and integration of data required for post flight engineering evaluation and scientific evaluation, provide the necessary overall management of these procedures, and accomplish the necessary coordination with users and support organizations to ensure the collection, processing, and distribution of the required data.

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MANAGEMENT OF POSTFLIGHT TEST DATA FOR OFT TASKS (PWBS 1.7.2.4)

PWBS 1.7.2.4
MANAGEMENT OF POSTFLIGHT TEST DATA FOR OFT

- LEAD ORG - POO
- RESPONSIBILITY - WT/COLONNA

A — COORDINATE AND MANAGE THE ASSEMBLY OF POST-FLIGHT DATA REQUIREMENTS

- ESTABLISH INTER-ORGANIZATIONAL POINTS OF CONTACT FOR COORDINATION OF DATA REQUIREMENTS
- MANAGE THE COLLECTION, DEFINITION, COLLATION AND COORDINATION OF SCIENCE AND ENGINEERING DATA USER REQUIREMENTS
- DEFINE DATA/DATA PROCESSING REQUEST PROCEDURES AND FORMS
- PROVIDE FOR PROGRAM OFFICE OVERVIEW AND OVERALL COORDINATION

B — COORDINATE POSTFLIGHT DATA PROCESSING AND HANDLING REQUIREMENTS

- COORDINATE THE INTEGRATION OF SCIENCE AND ENGINEERING DATA PROCESSING REQUIREMENTS
- ESTABLISH DATA COLLECTION AND PROCESSING PRIORITIES
- SUPPORT REQUIREMENTS DEFINITION AND DEVELOPMENT OF DATA PROCESSING AND INFORMATION MANAGEMENT SYSTEMS
- COORDINATE DATA PROCESSING AND ANALYSIS SUPPORT PLANS
- COORDINATE THE INTEGRATION OF APPLICABLE PRELAUNCH AND MISSION OPERATIONS DATA
- COORDINATE VOICE TRANSCRIPT, VIDEO, PHOTO AND OTHER COMMON USE DATA PROCESSING AND DISTRIBUTION REQUIREMENTS

C — SUPPORT DEFINITION OF DATA FORMATS REQUIRED BY USERS

- SUPPORT DEFINITION OF REQUIRED DATA FORMATS IN CONJUNCTION WITH USING ORGANIZATIONS
- ESTABLISH STANDARD DATA PRODUCT LISTS
- PREPARE USER'S GUIDES

D — DEVELOP POSTFLIGHT DATA MANAGEMENT PLANS (JSC AND INTEGRATED)

- ESTABLISH COMPATIBLE LINKS WITH OTHER CENTER DATA MANAGEMENT PLANS
- ESTABLISH DIVISION OF RESPONSIBILITY
- DEFINE METHODS FOR DATA EXCHANGE
- DEFINE METHODS FOR RESOLVING DATA RELATED PROBLEMS
- PROVIDE FOR SUPPORTING MISSION EVALUATION TEAM REQUIREMENTS
- ENSURE DISTRIBUTION OF DATA TO USER

E — DEVELOP POSTLANDING DATA AND SPECIMEN HANDLING PLAN

- DEVELOP ORBITER RETURNED DATA RETRIEVAL AND MANAGEMENT PLANS
- DEVELOP CREW LOGS AND COMMENTS DATA DISTRIBUTION PLANS
- COORDINATE SPECIAL HANDLING PROCEDURES AND CONSTRAINTS

FIGURE 3.3.3-4

3.3.3.5 Operations Integration Planning (PWBS 1.7.2.5) - The Operational Planning Office has retained the responsibility for a number of specific tasks grouped together under this overall task, which are within the operations area but do not fit into any previously defined operational task. The activity associated with the definition and documentation of program support requirements, and the development of acquisition of program cartographic support are operational sub-tasks with overall management and approval maintained by the program office, but which have been delegated to other center organizations for implementation. The definition of crew functions to support payload operations, and the integration of operational flows and schedules are subtasks which are inputs to other program activities. Information from these feed into scheduling activities of Orbiter crew stations design, crew procedures development, and definition of payload support activities timelines.

OPERATIONS INTEGRATION PLANNING TASKS (PWBS 1.7.2.5)

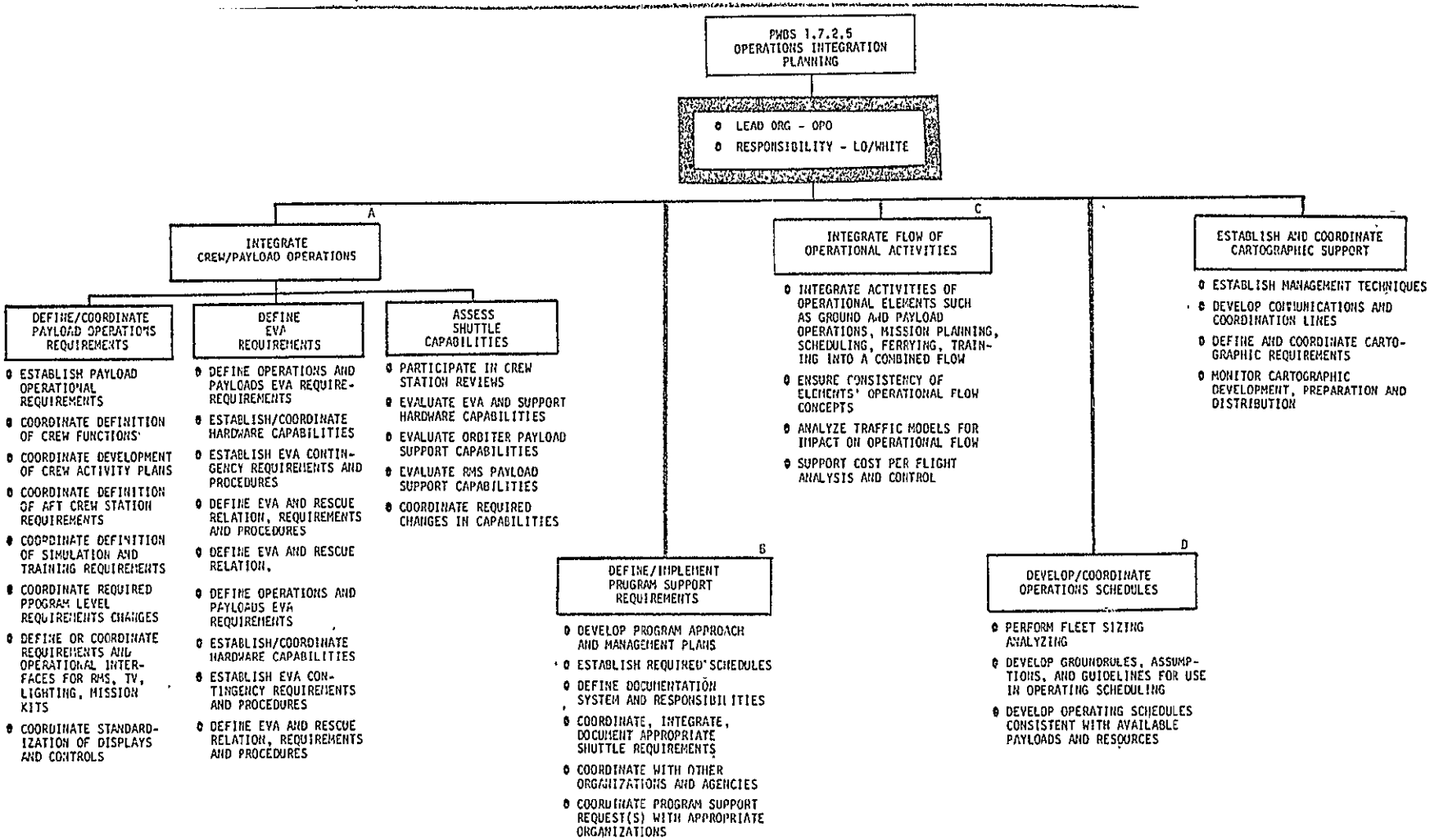

FIGURE 3.3.3-5

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3.3.3.6 Joint NASA/DOD Operations Planning (PWBS 1.7.2.6) - The Shuttle Operational Planning Office has the lead responsibility for this task. Support to accomplish this task is required from cognizant centerline organizations and the Shuttle Program elements. Effort associated with the task includes support to the STS Committee, development and coordination of joint operating concepts and agreements, overall coordination of operational planning, and negotiation necessary to define and implement each agency's requirements on the facilities and resources of the other agency. Generation, coordination and review of these requirements are accomplished via the DOD Shuttle System Requirements Review Panel. Results are documented in joint agreements, MOU's, requirements documents, panel minutes, and special study reports.

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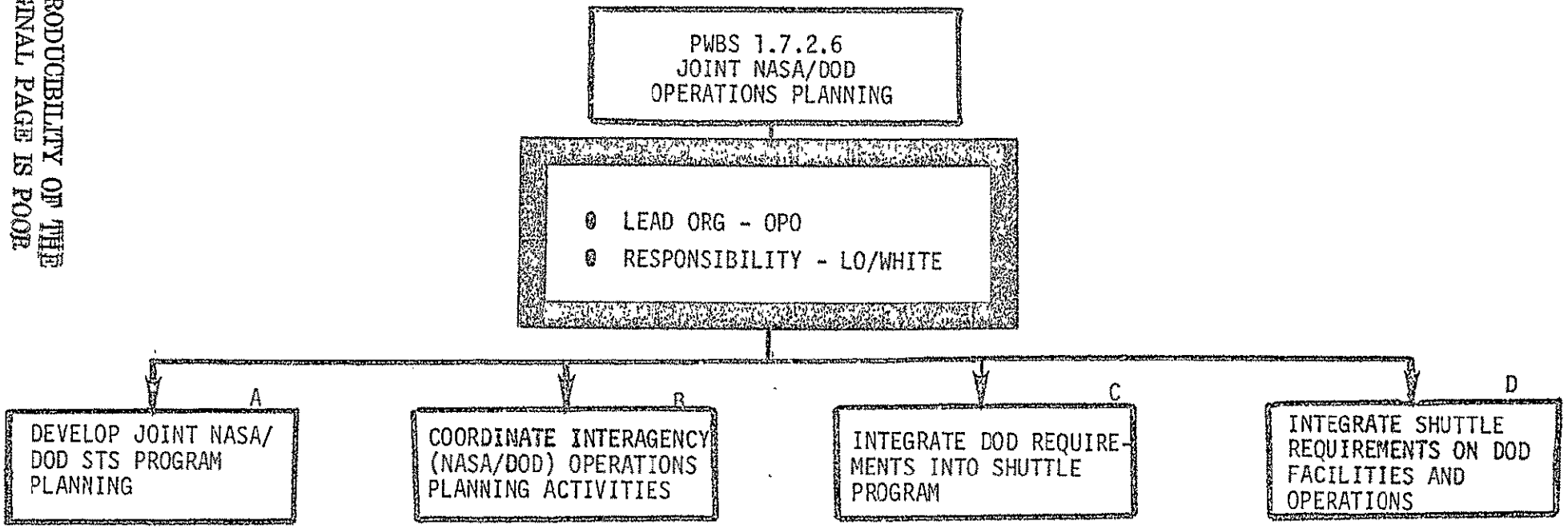
JOINT NASA/DOD OPERATIONS PLANNING (PWBS 1.7.2.6)



- DEVELOP JOINT NASA/DOD STS PROGRAM CONCEPT (STS COMMITTEE SUPPORT)
  - COORDINATE ISSUES
  - REVIEW COMMENTS
  - NEGOTIATE AGREEMENTS
- MANAGE AND COORDINATE SPECIAL STUDIES
  - NEAR TERM DOD OPERATIONS FROM MCC-H
- DEVELOP PROGRAMMATIC GUIDELINES AND POLICY FOR MANAGEMENT APPROVAL
- COORDINATE LEVEL II ACTIONS FOR RESOLUTION BETWEEN NASA PROJECTS AND DOD OFFICES

- DEVELOP OR REVIEW INTERAGENCY AGREEMENTS
- ENSURE AGREEMENT COMPLIANCE WITH ESTABLISHED POLICIES
- COORDINATE REVIEWS AND COMMENTS TO DOD SHUTTLE OPERATIONS STUDIES
- PROVIDE OVERALL COORDINATION OF JOINT OPERATIONS PLANNING ACTIVITIES

- RECEIVE, REVIEW, AND COORDINATE DOD SHUTTLE PROGRAM REQUIREMENTS
- REVIEW AND DISCUSS REQUIREMENTS AND IMPACT IN DOD SHUTTLE SYSTEM REQUIREMENTS REVIEW PANEL
- RECOMMEND OR NEGOTIATE RESOLUTION OR ASSIGN FOLLOW-ON ACTION TO RESOLVE CONFLICTING REQUIREMENTS
- MAINTAIN STATUS OF DOD REQUIREMENTS

- DEFINE, RECEIVE, AND INTEGRATE SHUTTLE REQUIREMENTS ON DOD OPERATIONS, FACILITIES AND RESOURCES
- COORDINATE SHUTTLE REQUIREMENTS WITH APPROPRIATE DOD OFFICE
- PARTICIPATE IN APPROPRIATE DOD REVIEWS TO ENSURE REQUIREMENTS ARE SATISFIED

FIGURE 3.3.3-6

3.3.3.7 Carrier Aircraft Operations (PWBS 1.7.2.7) - The Flight Operations Directorate has lead responsibility for this task. In this capacity, they will be responsible for developing the baseline documents to define the ground rules and guidelines for OFT Shuttle Carrier Aircraft operations, Orbiter and Payload transportation plans, contingency plans, crew requirements, maintenance operations, and overall carrier aircraft coordination.

CARRIER AIRCRAFT OPERATIONS TASKS (PWBS 1.7.2.7)

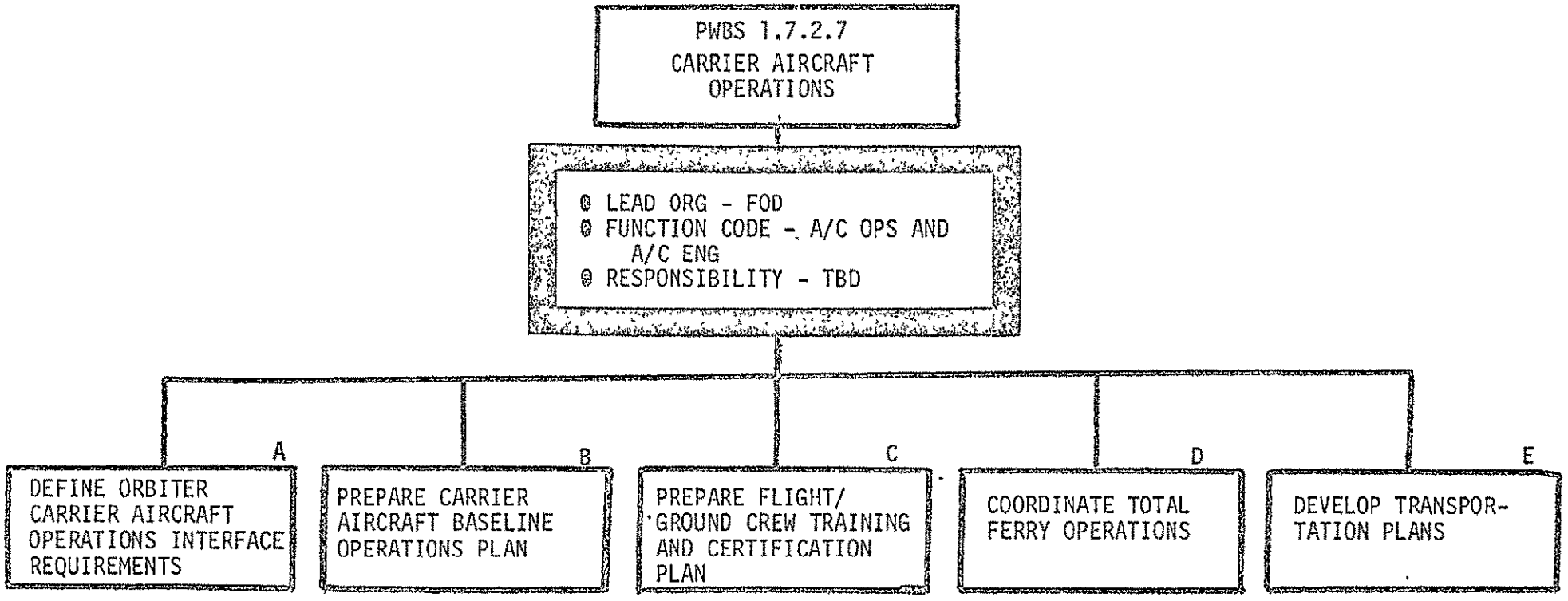


FIGURE 3.3.3-7

3.3.4 Simulation Planning, Analysis and Integration (PWBS 1.7.3) - The Simulation Planning, Analysis and Integration PWBS encompasses those Shuttle Program activities which are concerned with the establishment and maintenance of an overall integrated plan for the various simulations within the program. The primary means for focusing this activity is provided by Book 2, Volume XVIII of the JSC-07700 Level II Requirements which identifies each major simulation within the Shuttle program, and defines and controls the top level functions allocated to each simulation. Within the framework of this definition, additional tasks are concerned with reviewing and analyzing the planning of the various simulation projects to ensure an integrated Shuttle development. As an adjunct, a simulation math model coordination activity is conducted to promote the sharing and multiple utilization of simulation math models between simulation projects.

The lead responsibility for accomplishing these tasks is assigned to the Operations Integration Office. The Simulation Planning Panel serves as a primary mechanism used by the Operations Integration Office in the accomplishment of these tasks. Support of each organization which has direct management responsibility for implementation of a simulation within the Shuttle Program is obtained through their representation on this panel. Contractor support funded by the Shuttle Program Office is provided by McDonnell Douglas.

SIMULATION PLANNING ANALYSIS AND INTEGRATION TASKS (PWBS 1.7.3)

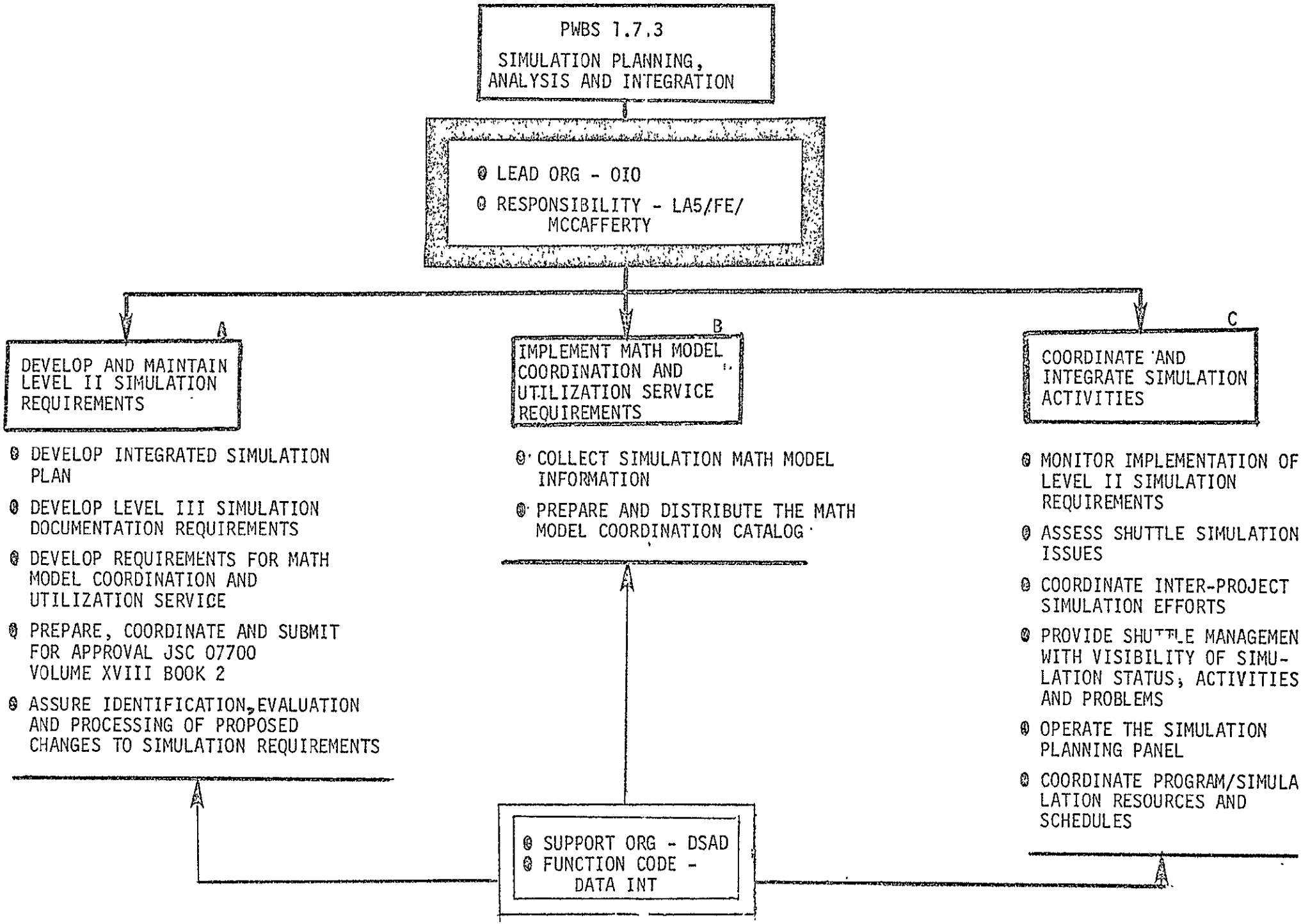
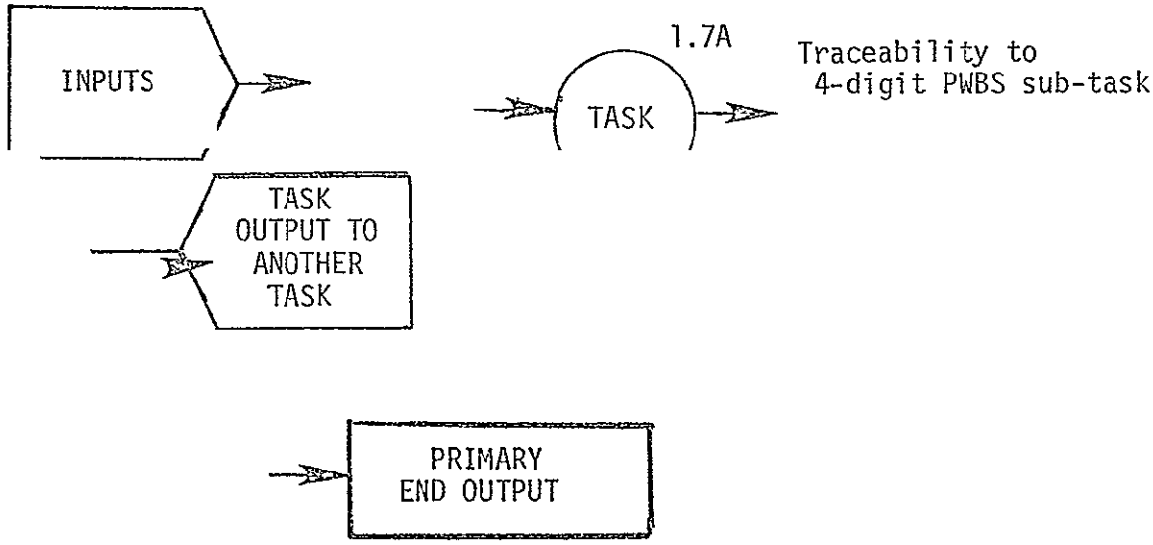


FIGURE 3.3.4-1

3.4 Task Activity Logic Flows

The task graphics in the previous section presented the major activities for each PWBS, and their inter-relation to products and subtasks. In addition to the graphic representation of these tasks, logic flows have been developed which graphically depict the task flows and constraining paths leading to major products of operations integration. Major products logic flows were selected rather than logic flows of individual PWBS' because in many cases the PWBS approach did not result in cohesive flows. In the logic flows which follow, traceability is provided to the task graphics of Section 3.3 by use of task coding. Use of the last two digits of the PWBS allocating the task, and a letter designating the specific sub-task provide this traceability. The three major product areas; training systems and operation, flight system design support and operations planning, and mission design, operations and control cut across most of the 4-digit PWBS'. The two other product areas; management of postflight test data for OFT, and carrier aircraft operations primarily depict tasks of PWBS 1.7.2.4 and 1.7.2.7, respectively.

3.4.1 Operations Integration Overview Logic - Figure 2.4-1 is repeated in this section as Figure 3.4.1-1 to provide the overview of the five (5) individual logic flows and to illustrate their interrelationship. The symbology used in the flows is defined below:



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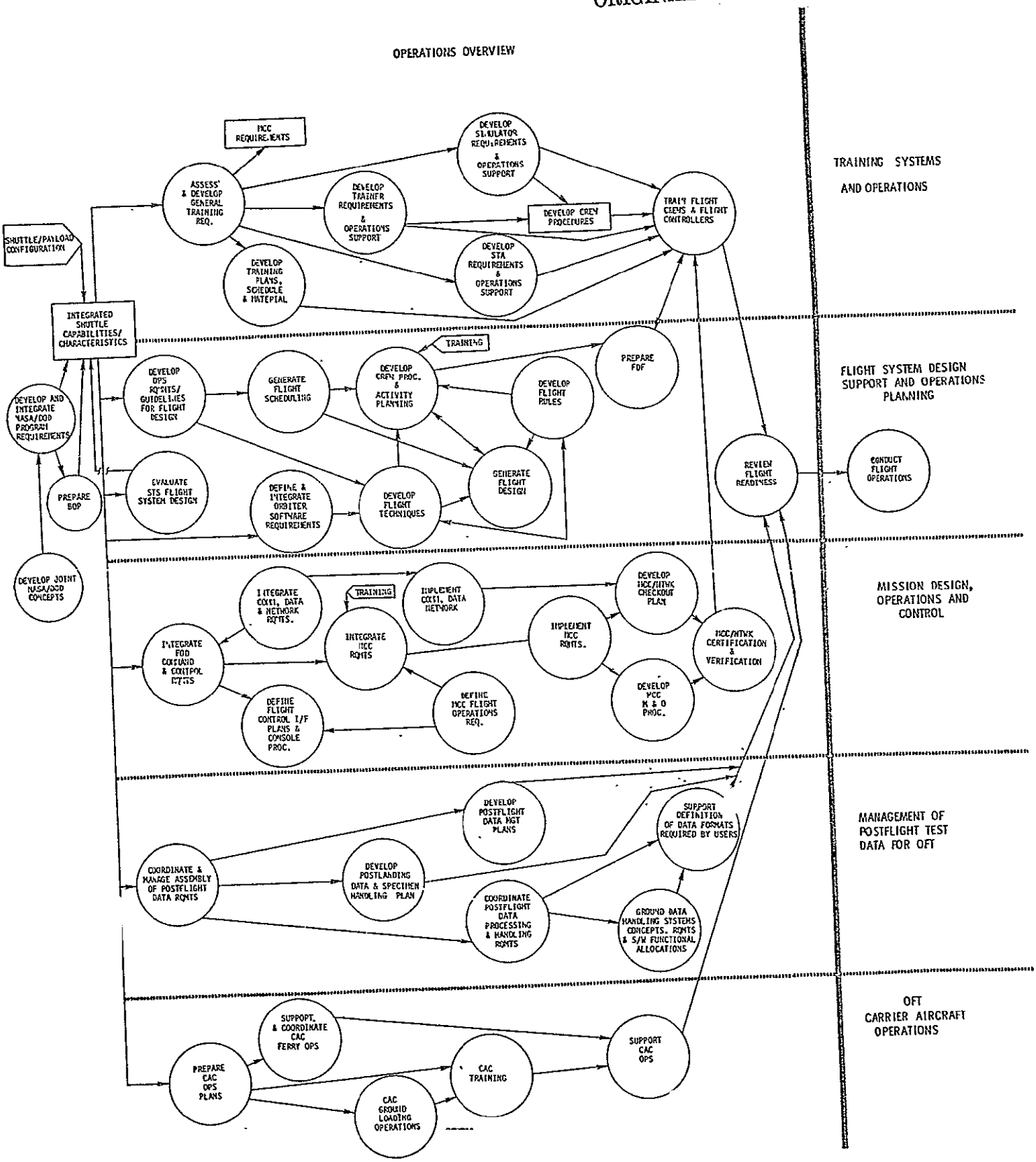

FIGURE 3.4.1-1

3.4.2 Training Systems and Operations - The overall task of developing trained flight crews and flight controllers can be viewed as three basic activities (1) training planning and preparation, (2) trainer/simulator development, and (3) actual training. The logic flow for these activities, shown in Figure 3.4.2.1 depicts the general activity flow, but not the specific relationships for each major phase of the Shuttle program. For example, in ALT, one-g trainers will not be available prior to ALT testing, but do not constrain ALT procedure development since engineering mockups, sled test units (for ejection seats), etc., will be utilized as substitutes.

The training planning and preparation activities include development of training management plans and review of detailed training requirements. The actual training material is constructed for several types of training: classroom, where theory of system/vehicle operation is taught; part-task, where actual operation of equipment/systems is taught in a "hands-on" mode; and simulated flight/mission training, which in its final phase, is an integration of flight crews and flight controllers.

The development of trainers and simulators starts with the definition of the functional requirements for each particular device. These requirements are assembled and reviewed, with detailed specifications formulated. The trainers/simulators developed serve specific purposes The STA is intended to provide "seat-of-the-pants" training for the later portion of the TAEM phase of a Shuttle flight. Mechanical type trainers (one-g, neutral buoyancy, RMS, etc.) provide a means of depicting the essential physical and mechanical interfaces, and simulators provide the audio/visual interfaces associated with the dynamic phases of a flight. Each simulator/training device is developed, modified (as required to reflect vehicle configuration), and ultimately certified as being representative of the actual vehicle. Operative trainers and simulators are required to complete, and in some cases to initiate, crew procedure development.

As discussed earlier, actual training is performed in several phases. The completion of training is constrained by the availability of the MCC, a developed (and validated) FDF, trainers/simulators, and training material. An assessment of overall training completeness is considered part of the flight readiness review.

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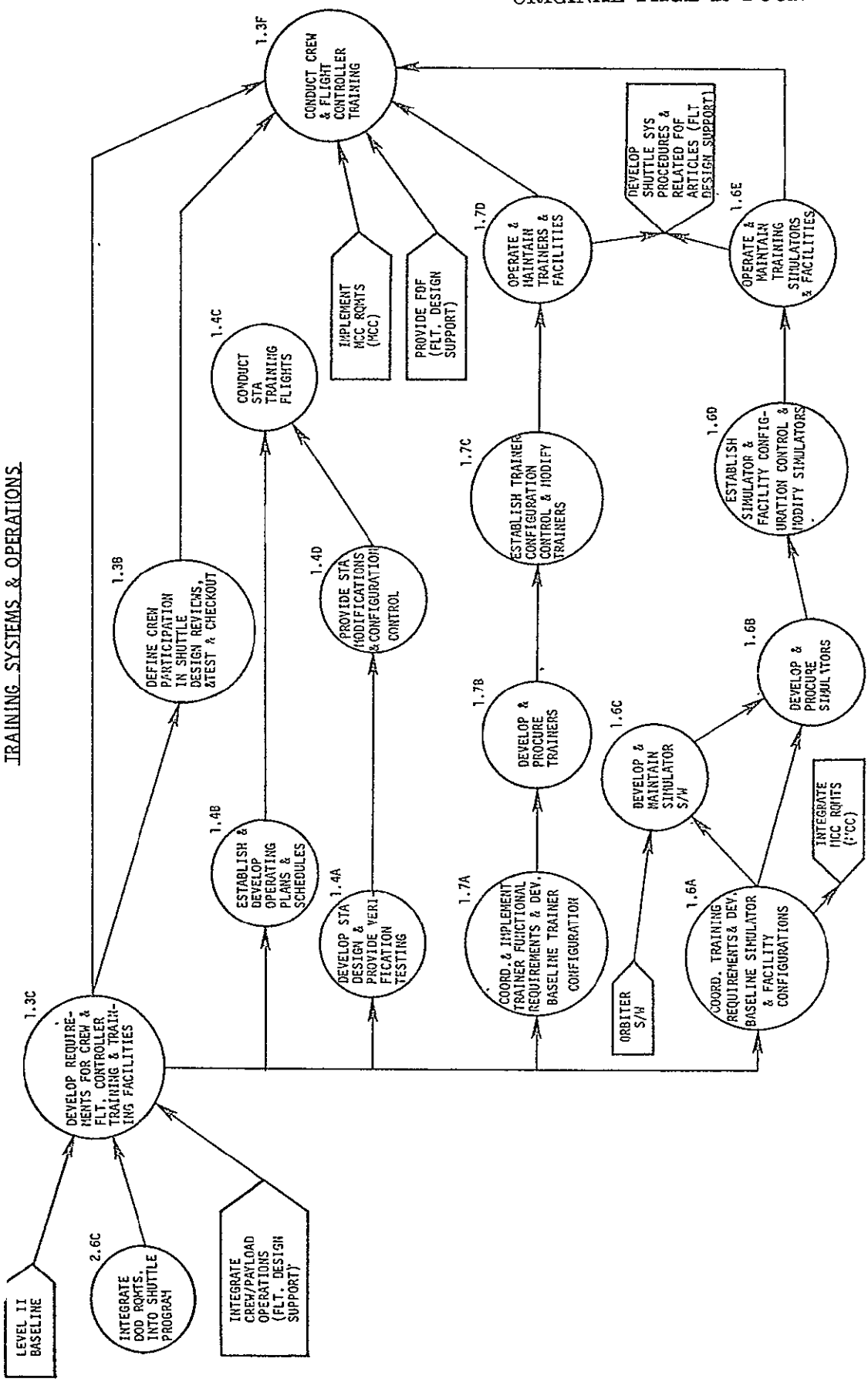

FIGURE 3.4.2-1

3.4.3 Flight System Design Support and Operations Planning - This major product begins with the integration of operational requirements for Shuttle hardware, software and NASA/DOD agreements. This effort results in the Baseline Operations Plan (BOP) which is prepared for ALT, OFT and operational Shuttle. The progression of major activities to the final flight ready operations plans is shown in Figure 3.4.3-1. This general flow is applicable for all Shuttle program phases (ALT, OFT, and OPS), even though some activities will require different levels of effort. The activities shown are primarily to support software design and operations development although operations feedback to hardware design is inherent in the planning process.

FLIGHT SYSTEM DESIGN SUPPORT AND OPERATIONS PLANNING

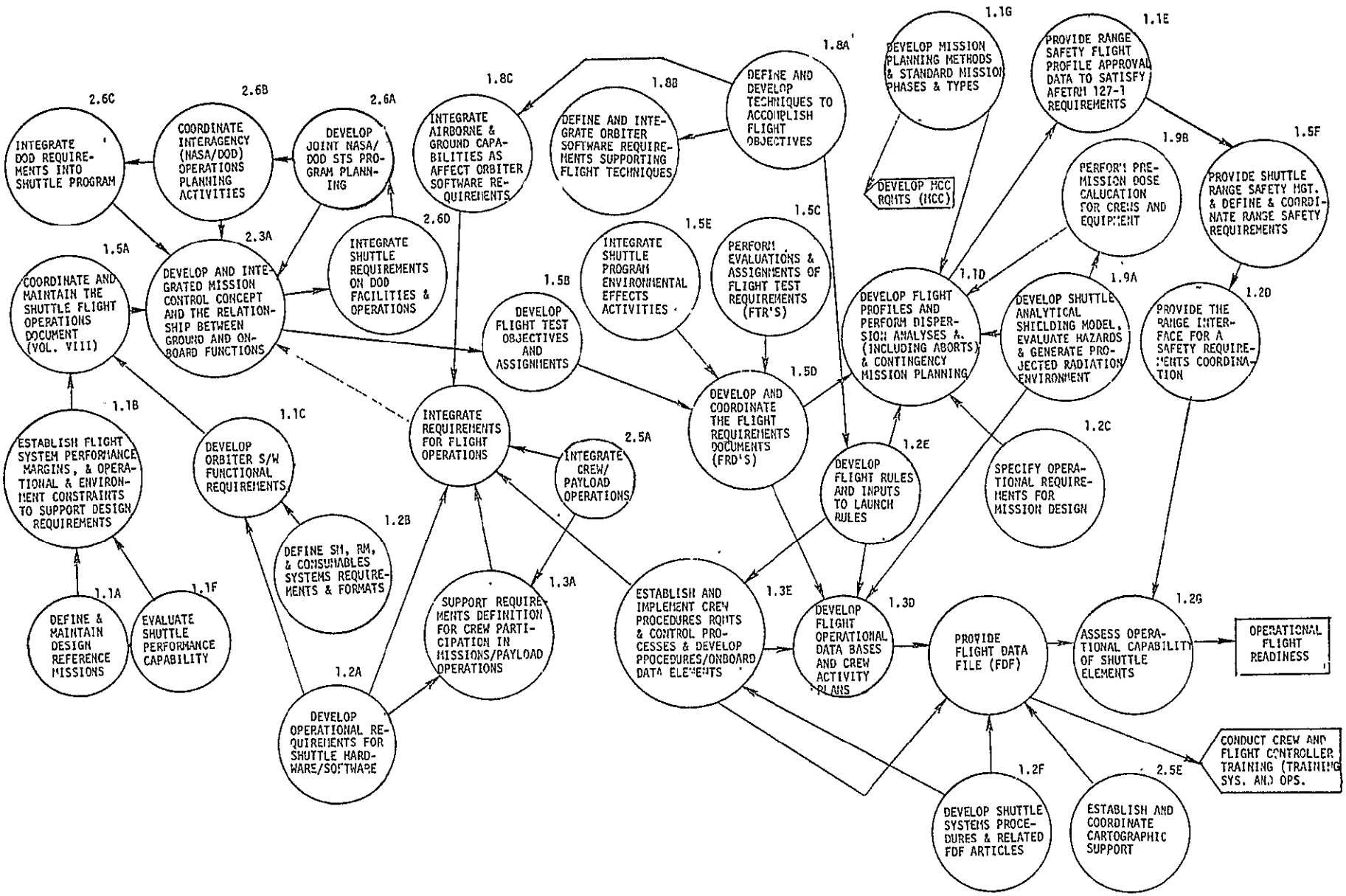

FIGURE 3.4.3-1

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3.4.4 Mission Design, Operations and Control - The tasks which must be implemented for development of the Mission Control Center (MCC), and their flow are shown in Figure 3.4.4-1 which presents an overview of MCC development.

Development of the MCC encompasses three separate PWBS tasks (1.7.2.1, 1.7.2.2, and 1.7.2.3) which are monitored by two panels, the Space Shuttle Flight Operations Panel (FOP) and the Space Shuttle Communications and Data Systems Integration Panel (CADSI), and which are implemented by divisions of two JSC Directorates, the Flight Operations Directorate (FOD) and the Data Systems and Analysis Directorate (DSAD).

The Flight Control Division (FCD) of FOD has lead responsibility for definition of MCC requirements as specified in PWBS 1.7.2.3. Requirements definition includes ensuring compatibility of NASA and DOD requirements, the development of Baseline Operations Plan (BOP) documents, the definition of MCC flight operations requirements, and the definition of communications, data and network requirements.

The Ground Data Systems Division (GDSD) of DSAD has lead responsibility for integrating the MCC requirements and implementing them as specified in PWBS 1.7.2.1. GDSD is also charged with development of MCC maintenance and operating procedures, development of an MCC/Network checkout plan, as well as final certification and periodic verification of the MCC hardware and software.

The Data Systems and Analysis Directorate has lead responsibility for the communications and data systems integration task (PWBS 1.7.2.2). This requires review of the data requirements from all users and determination of their feasibility within the capabilities and constnaints of the Shuttle program. The requirements are integrated and used to define ground data handling concepts and a system for implementing these concepts. The data requirements, ground data systems and vehicle data systems are reviewed to determine compatability between all data system elements and that all data requirements are being met.

FIGURE 3.4.4-1

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3.4.5 Management of Postflight Test Data for OFT - The postflight test data management tasks for OFT are shown in Figure 3.4.5-1. Postflight data consists of processed flight and test data in the form of telemetry, tracking, attitude, voice and video data, as well as orbiter returned data such as film, specimens and crew logs. These data are for the purpose of analyzing the performance of Space Shuttle systems and for the support and control of scientific investigations. Data required in real time or near real time for direct mission support and control are not considered postflight data even though the same processing systems may be utilized to furnish these data products.

The tasks which must be performed in the development of the postflight data management and handling capabilities are defined in PWBS 1.7.2.4 and PWBS 1.7.2.2. The overall postflight data user requirements integration (PWBS 1.7.2.4) will be performed by the JSC Test Division of the Program Operations Office. The integration activities include: coordinating and defining the requirements for the return of raw data, coordinating and defining requirements for the processing and distribution of data products, and providing Level II visibility.

The JSC Test Division will develop an integrated data management plan, a JSC data management plan, and a postlanding data and specimen handling plan. The integrated data management plan establishes the inter-center interface and coordination points-of-contact, requests data management plans from other centers and establishes the data exchange procedures. The JSC data management plan assigns intra-center responsibilities for handling and processing requirements definition, assigns responsibility for implementing requirements and furnishing data products, and establishes internal control procedures. The postlanding plan establishes the requirements and procedures for postlanding data handling by recovery organizations.

The Institutional Data Systems Division (IDSD) of the Data Systems and Analysis Directorate (DSAD) is responsible for implementing the data processing requirements and developing the necessary software and hardware systems under PWBS 1.7.2.2. IDSD will review all user data processing requirements, develop processing support plans, validation plans, interface formats, data management plans and provide standard products lists under the direction of the Science and Engineering Data Processing Subpanel of the Space Shuttle Communications and Data Systems Integration Panel.

MANAGEMENT OF POSTFLIGHT TEST DATA FOR OFT

USER DATA MANAGEMENT PLANS (INTER-ORG.)

2.4D

DEVELOP POSTFLIGHT DATA MGT. PLANS

2.4E

DEVELOP POSTLANDING DATA AND SPECIMEN HANDLING PLAN

2.4A

COORDINATE AND MANAGE THE ASSEMBLY OF POSTFLIGHT DATA REQUIREMENTS

USER REQMTS

2.4B

COORDINATE POSTFLIGHT DATA PROCESSING AND HANDLING REQUIREMENTS

2.4C

SUPPORT DEFINITION OF DATA FORMATS REQUIRED BY USERS

2.2D

DEVELOP GROUND DATA HANDLING SYSTEMS CONCEPTS, RQMTS, & S/W FUNCTIONAL ALLOCATIONS

FIGURE 3.4.5-1

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3.4.6 Carrier Aircraft Operations - The tasks and logic flow for development of Carrier Aircraft Operations are shown in Figure 3.4.6-1. A greater degree of detail has been included in this logic flow than in the others because PWBS 1.7.2.7 (Carrier Aircraft Operations) contains a coarser structure for the given tasks than other sections of the Operations Integration Plan.

The Carrier Aircraft logic flow shows the sequencing of tasks required for development of the operations. The identified tasks relate to operations described in PWBS 1.7.2.7 which will take place after the approach and landing test (ALT) time period. The Flight Operations Directorate will furnish technical support for the Shuttle carrier aircraft modifications and associated flight testing. The Ferry Qualification Program will be managed by the Flight Operations Directorate (Orbital Atmospheric Flight Test Office) in concert with their responsibilities for the management of the Approach and Landing Test Program. The overall management responsibility of the Shuttle carrier aircraft modification and ferry qualification rests with the Shuttle Carrier Aircraft Project Office, which has been established by the Manager of the Shuttle Systems Integration Office as the single point of contact for the various organizations supporting the Shuttle Carrier Aircraft Project. (Reference: Memo of Understanding, LA25-75-069, June 10, 1975).

Approach and landing test documents and other documents are referenced in the figure and data from them will be utilized in accomplishing the appropriate tasks.

CARRIER AIRCRAFT LOGIC NETWORK

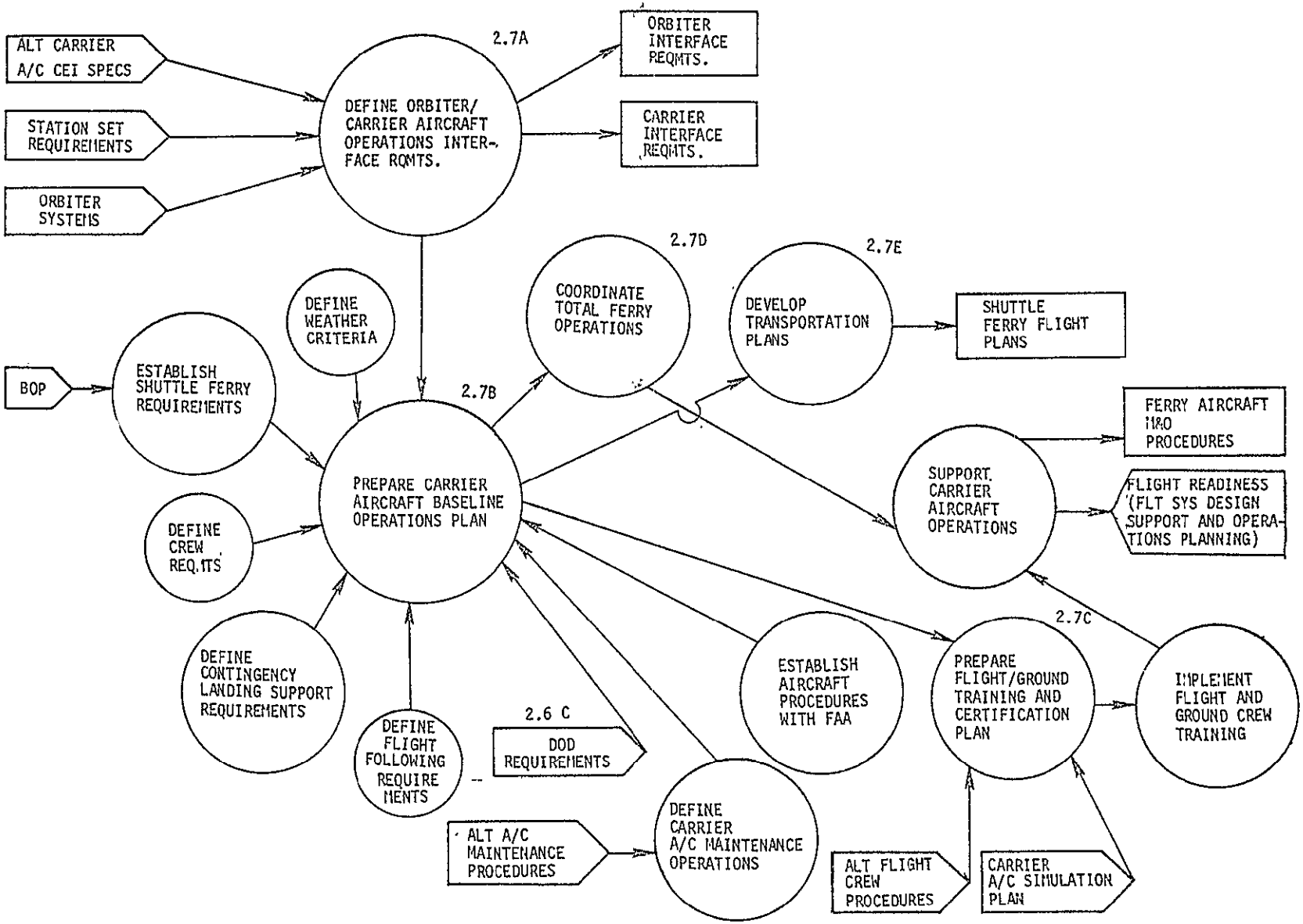

FIGURE 3.4.6-1

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3.5 Interfaces

The proper accomplishment of the operations integration function as described in the preceeding sections, and in the management documentation of the directorates require deliberate interfaces with other Shuttle Program activities. These involve interfaces between organizations as well as interfaces between panels, working groups, boards, etc. Identification of the required interface(s) is the responsibility of the organization and/or individuals responsible for the task function and associated panel, working groups, etc. Review and assessment of these interfaces for adequacy in supporting defined functions is the responsibility of the Manager, Operations Integration/LA5.

3.5.1 Organizational Interfaces - The organizational interfaces pertinent to operations integration can be categorized as primary and secondary. The primary interfaces are those which require the daily review, coordination, and management involvement for PWBS task accomplishment. The secondary interfaces are those which occur as a result of other Level II and III activities (i.e., panels, boards, working groups). These interfaces are listed below:

	Primary	Secondary
PROGRAM OFFICES	• JSC - Systems Integration Office, Payloads Coordination Office, Program Operations Office	• DOD/USAF: SAMSO Reusable Launch Vehicle System Office
PROJECT OFFICES	• JSC - Orbiter Project Office • KSC - Launch and Landing Office	• MSFC - ET, SRB, SSME
DIRECTORATES	• JSC - DSAD, EDD, FOD	• JSC - LSD, SAD
CONTRACTORS	• JSC - RI/SD, McDonnell Douglas • Downey - RI/SD	

3.6 Operations Integration Panels

The interfaces with boards, panels, and reviews that are utilized in accomplishing operations integration are extensive. For direct Level II interfaces requiring chairmanship and/or representation, LA5 personnel are assigned this responsibility. Where the interface is between and/or within the "lead" organizations, chairmanship is delegated to that lead by the PWBS. Active involvement by representatives of LA5, DSAD and FOD

ensures operational inputs are made to the appropriate primary and secondary organizations, and assures the Manager of Operations Integration that issues and evolving baselines include operational considerations. Figure 3.5.2-1 shows the Level II operations integration panels.

3.6.1 Other Panels, Working Groups, and Boards - As panels, working groups, boards, and review activities related to the Space Shuttle Program and/or operations integration are established by direction of the Space Shuttle Program Manager or by the Operations Integration Manager, personnel from LA5, FOD and DSAD are assigned as representatives. Specific of these activities are assigned to the operations integration function by Space Shuttle Program Management Directives (SSPMD), and are then allocated by the Operations Integration Manager to lower level PWBS'. Figure 3.6.1-1 illustrates the PWBS 1.7 organizational relationship of panels and working groups. The purpose, responsibility, scope, and membership defined by the Program Directive of the operations integration panels chartered by SSPMDs, are summarized below.

OPERATIONS INTEGRATION PANELS

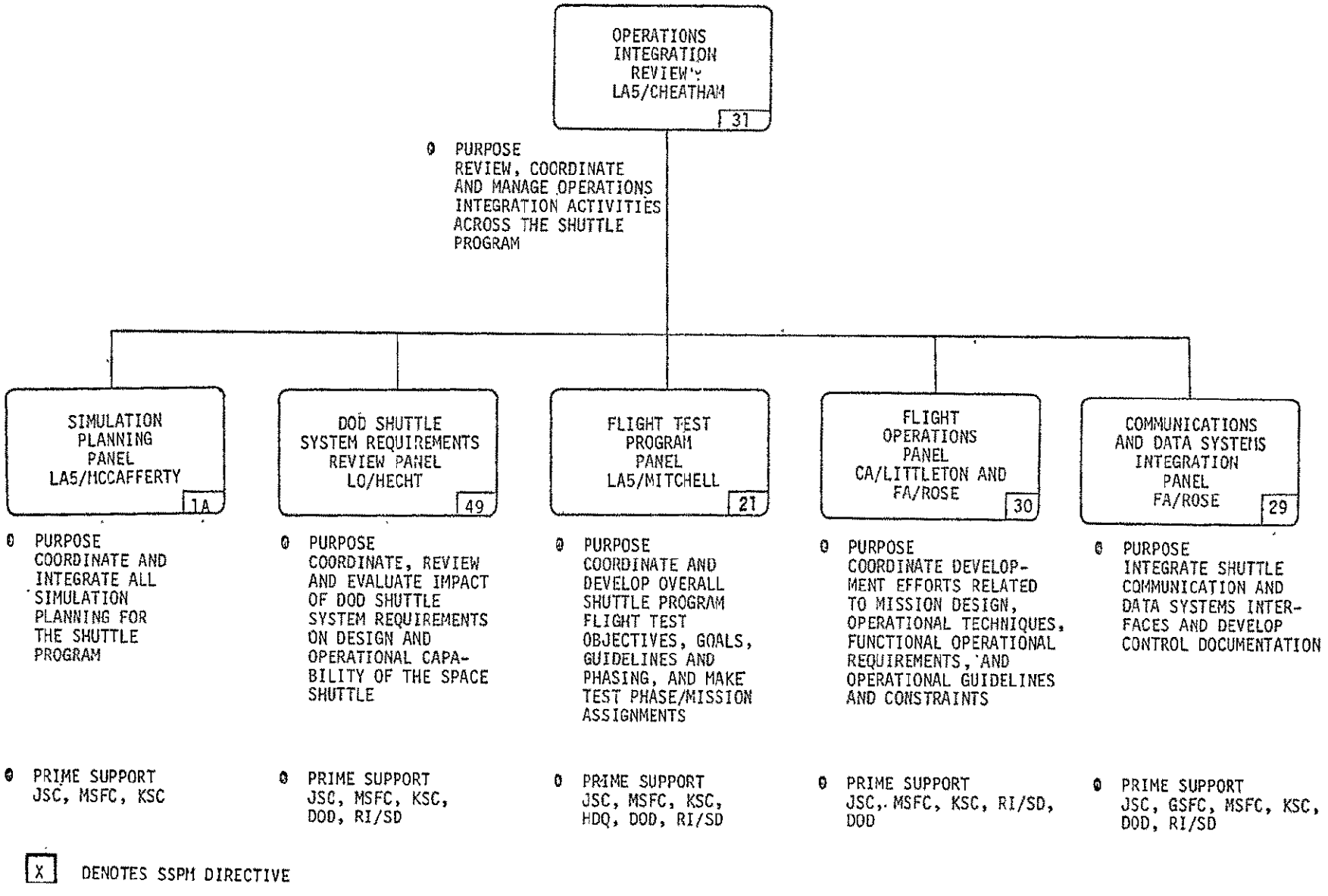

FIGURE 3.5.2-1

OPERATIONS PANELS, BOARDS, AND WORKING GROUPS ASSIGNED TO PWBS 1.7

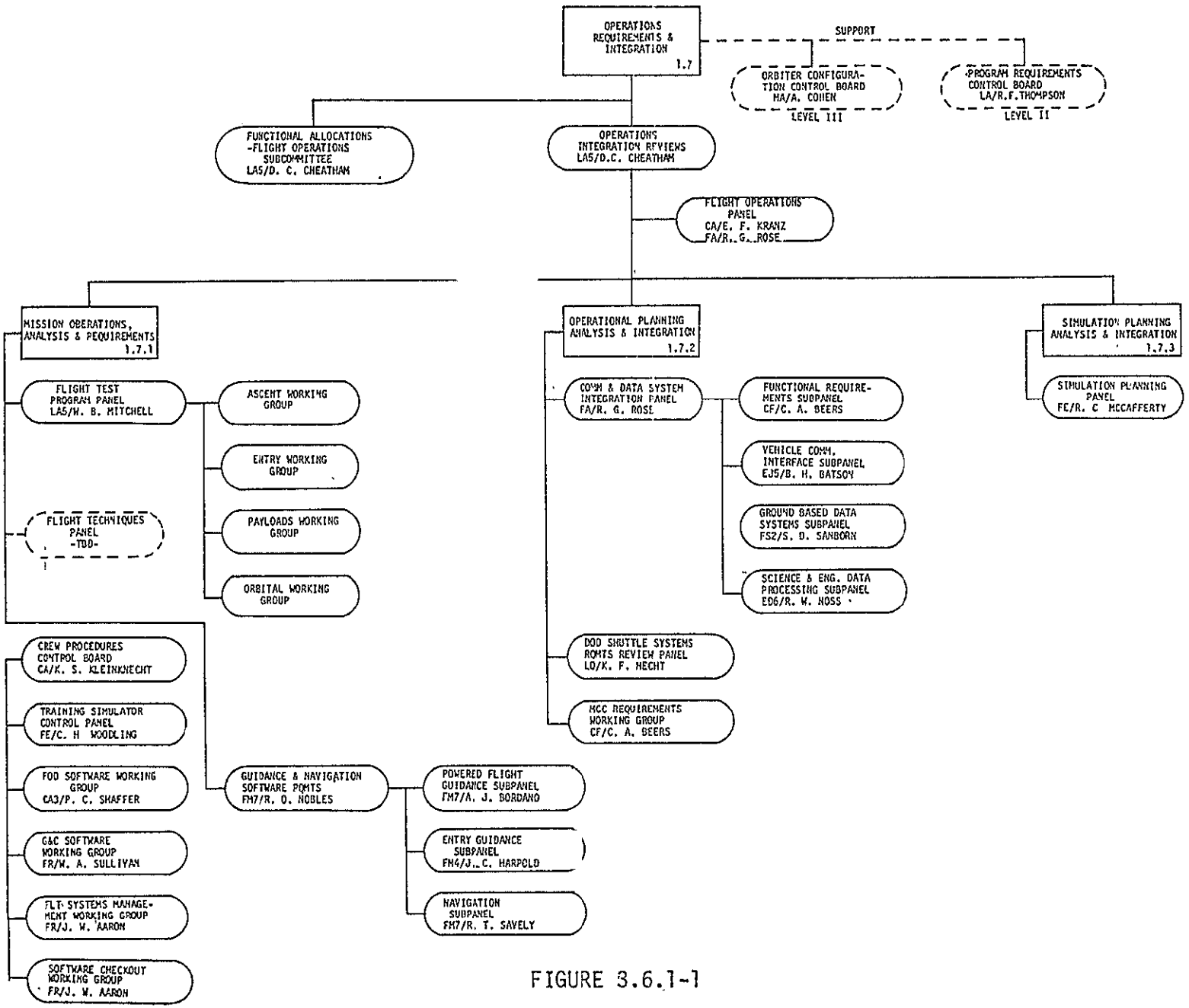

FIGURE 3.6.1-1

3.6.1.1 Operations Integration Review

- Purpose - The Operations Integration Review (OIR) is a means to review, coordinate, and manage certain specific areas of activity related to Level II Operations Integration of the Space Shuttle Program

- Responsibility - The Manager, Operations Integration Office will chair the OIR and be responsible for the implementation of the following activities:

  - Review and coordinate development of design reference missions, operations guidelines and constraints, and establishment of ground and flight operations techniques

  - Monitor definition and control, and insure the integration of communications and data requirements for all elements of the Shuttle Program

  - Ensure operations-related support to other programs functions

  - Ensure definition of operations support requirements and implementation by KSC Launch Center, JSC Mission Control Center, and Shuttle communications and data network

  - Ensure accomplishment of the NASA and DOD joint planning for Shuttle operational phase

  - Ensure definition of requirements and development and implementation of overall simulation integration planning for program

  - Ensure coordination of ETR range safety requirements between program engineering and operational elements and the range.

- Scope - The OIR will coordinate and review the activities of all Space Shuttle Program project elements and Center organizations performing Shuttle support tasks to insure accomplishment of (1) operational requirements as established in Level I and II documentation; and (2) program functions defined within PWBS 1.7, Operational Requirements and Integration.

- Membership - The chairman of the Operations Integration Review receives key support from the co-chairmen of the Flight Operations Panel and the CADSI panel, and the chairmen of the Flight Test Program Panel, Simulation Planning Panel, Crew Procedures Control Board, and the DOD Shuttle System Requirements Review Panel.

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In addition, representatives from the following organizations participate: Systems Integration Office/LA2; Management Integration Office/LA3; Program Resources and Schedules Integration Office/LA4; EDD; DSAD; FOD, MSFC Space Shuttle Project Office; KSC Space Shuttle Project Office; DOD - USAF Space Shuttle Program Support Division; Headquarters Systems Operation Directorate; Orbiter Project Office; and RI/Space Division.

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3.6.1.2 Flight Operations Panel

- Purpose
  - This panel will provide a focal point to coordinate the efforts contributing to the development of mission design, operational guidelines and constraints, the establishment of ground and flight operational techniques, and the definition of functional operations inputs to flight and ground systems requirements.
- Responsibility
  - Responsibility to direct the panel activities is vested in co-chairmen to be appointed by the directors of Flight Operations and Data Systems and Analysis with the concurrence of the Shuttle Program Manager.
- Scope
  - The responsibilities of this panel shall include those activities related to the development of mission operational requirements and plans. These activities shall include:
    - Review and coordinate the mission plans and mission constraints for all phases of Shuttle flight and insure planning satisfies requirements in the Master Flight Test Assignments Document and the Flight Requirements Document.
    - Evaluate and coordinate all mission control functional requirements for operations, ground systems and networks.
    - Definition and coordination of the requirements and facilities for MSFC, KSC, and contractor support of mission control operations and preparations.
    - Coordinate and integrate all procedures and documentation required for mission control operations.
- Membership

  Representatives from the following organizations participate in the FOP: DSAD; FOD; Orbiter Project Office; Operations Integration Office; Systems Integration Office; MSFC Engineering Management Office; KSC Launch and Landing Project Office; DOD/USAF SAMSO Reusable Launch Vehicle System Program Office; and RI/SD.

3.6.1.3 Flight Test Program Panel

- Purpose

  - This panel will provide a focal point to coordinate and develop the overall Space Shuttle program flight test objectives, goals, guidelines and phasing, and the necessary test phase/mission assignments to carry out these objectives.

- Responsibility

  - The responsibility for the development and documentation of the overall flight test program objectives and requirements, and for the panel activities established herein, is vested in the Operations Integration Office, SSPO.

- Scope

  - The responsibility of this panel shall include those actions related to supporting the development and documentation of an overall integrated flight test philosophy. These activities shall:

    - Define overall flight test objectives
    - Evaluate and assign test phase/mission objectives to achieve program goals in a progressive manner
    - Study impact of systems delivery/crew readiness/ ground systems capabilities planning on the proposed flight test sequences
    - Compare candidate payloads to flight test program objectives and assign payloads requirements in accordance with flight test plans/systems/crew compatibility
    - Document the Flight Test Program objectives, assignments and phasing for approval of the program manager
    - Provide continuing review of program/flight test progress and develop and recommend necessary changes to flight test phasing
    - Coordinate with other Space Shuttle program panels

- Membership

  The chairman of the Flight Test Program Panel is supported by representatives of the following: Operations Integration Office; Orbiter Project Office; Systems Integration Office; Payloads Coordination Office; Resources and Schedule Integration Office; DSAD, FOD, MSFC Space Shuttle Program Office; KSC Shuttle Program Office and Orbiter Project Office; Headquarters Space Shuttle Program Systems Operations Office; DOD USAF/STS Group Representative; and RI/SD.

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3.6.1.4 Crew Procedures Control Board

- Purpose
  - The purpose of this Board is to provide the overall management for the coordination and direction of efforts relating to the development and control of crew procedures and flight data files (FDF)
- Responsibility
  - Responsibility to direct the Board activities is vested in a chairman to be appointed by the director of Flight Operations with the concurrence of the Shuttle Program Manager.
- Scope
  - The scope of responsibility for this Board shall include all activities directly related to the development, validation and control of Shuttle crew procedures and the FDF. Specifically, these responsibilities shall include the following:
    - Development and maintenance of schedules for all significant elements involved in crew procedures development
    - Coordination of interactions between Shuttle Elements Hardware contractors and the Crew Procedures Development process including assuring that provisions exist
    - Coordination of crew procedures development with other program activities such as engineering simulations, SAIL and SDL Operations, and major hardware tests
    - Definition and implementation of the requirements and procedures for maintaining configuration management of crew procedures and the FDF
    - Preparation and maintenance of the Crew Procedures Management Plan
- Membership

  The chairman of the CPCB is supported by representatives from the following: FOD; DSAD; Orbiter Project Office; SAD; LSD; EDD; SR&QA; Astronaut Office; Operations Integration Office; MSFC Engineering Management Office; USAF Reusable Launch Vehicle Office; and RI/SD.

3.6.1.5 Simulation Planning Panel

- Purpose
  - The purpose of this panel is to integrate the planning efforts for simulations across the Shuttle Program
- Responsibility
  - Mr. Riley D. McCafferty, key personnel assignment to the Operations Integration Office, Shuttle Program Office, is assigned responsibility to chair the panel.
- Scope
  - Overall Shuttle simulation program planning activities as required to assure that all simulation efforts within the Shuttle program are properly coordinated and consolidated to provide an efficient cost-effective simulation program. The responsibilities shall include the following, to:
    - Develop and document the key functional requirements and the assignment or allocation of implementation responsibilities among the projects
    - Identify major relationships or interfaces between different simulations
    - Assure that simulation planning and overall program resources and schedule planning are consistent
- Membership

The chairman of the SPP is supported by representatives of the following: Operations Integration Office; Orbiter Project Engineering Office; Engineering Analysis Division of EDD; FOD/CTPD; EDD; DSAD/FSD; MSFC Engineering Management Office; KSC Launch and Landing Project Office; and RI/SD.

3.6.1.6 DOD Shuttle Systems Requirements Review Panel

- Purpose

  - This panel will provide a coordinating activity for reviewing and evaluating the impact of DOD Shuttle System requirements on the design and operational capability of the Space Shuttle.

- Responsibility

  - Responsibility for coordination of the review, evaluation and reporting activities associated with the DOD requirements is vested in the Operations Integration Office (LA5). The effort involved in reviewing, evaluating and reporting upon the issues is a joint responsibility of the Space Shuttle Program Office (SSPO) and those organizations providing direct support to the Space Shuttle Program.

- Scope

  - This panel is responsible for the following functions:

    - Reviewing the DOD requirements and identifying incompatibilities with respect to JSC 07700.

    - Assessing the impact of incorporating changes to the NASA requirements to satisfy DOD requirements that are determined to be incompatible with design or operational capability of the Shuttle

    - Advising the DOD of the potential impact of incompatible requirements and working with Space and Missile Systems Organization (SAMSO) personnel to recommend revisions to DOD documentation for resolution of the issues.

- Membership

  The chairman of the DOD SSRR Panel is supported by representatives of the following: Orbiter Project Office; Operations Integration Mission Office; Payloads Coordination Office; Systems Integration Office; Orbiter Project Engineering Office; FOD; DSAD; EDD; SR&QA; MSFC; KSC; DOD and RI/SD.

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3.6.1.7 Shuttle Communications and Data Systems Integration Panel

- Purpose

  - The purpose of this panel is to integrate all Shuttle Communications and Data Systems Interfaces by ensuring that interface functions are defined and understood, adequate interface documentation is provided and maintained, and interface problems are surfaced and resolved

- Responsibility

  - The chairman, Rod Rose, appointed by the Data Systems and Analysis Directorate with the concurrence of the Shuttle Program Manager, will direct the panel activities

- Scope

  This panel shall include the following communications and data systems interfaces:

  - Shuttle Vehicle to, Ground Network (NASA USAF), NASA TDRSS, Payloads, Approach & Landing Test Facilities

  - NASA Control Center to Launch Facility (NASA and USAF) Ground Network (NASA and USAF), USAF Control Center, Approach & Landing Test Facilities, Payload Controller/ User

  - USAF Control Center to, NASA Ground Network

- Membership

  The chairman of CADSIP is supported by representatives of the following: FOD; DSAD; EDD; Operations Integration Office; Systems Integration Office; Orbiter Project Office; Program Operations Office; GSFC Network Directorate; Payload Operation Control Center; MSFC Engineering Management Office; KSC Launch and Landing Project Office; DOD SAMSO/LVRS-PSD; JPL; ARC; LeRC FRC; Headquarters; and RI/SD.

3.6.1.8 Training Simulator Control Panel

- Purpose
  - To accomplish the configuration management and change review, control, and approval for Shuttle Training Simulations.
- Responsibilities
  - The responsibility for implementing the objectives of the panel has been delegated to the Flight Simulation Division. The panel will be chaired by the Flight Simulation Division Chief, or his Deputy.
- Scope
  - The Training Simulator Control Panel has the responsibility for the configuration management of Shuttle training simulations. Specific functions include:
    - Provide mechanisms for collecting, reviewing, and defining status of proposed and approved changes.
    - Review and disposition proposed changes to simulator configuration
- Membership

The chairman of the TSCP is supported by representatives of the following: Operations Integration Office; FOD-CTPD, FCD, AED, Astronaut Office; and Orbiter Project Engineering Office.

3.7 POP Activities

An important facet of the operations integration function is the fiscal management dealing with Program expenditures. The Operations Integration Office has an active involvement in POP activities which deal with resource allocation and expenditures. The operations oriented POP activities are summarized below:

- Transmit and interpret groundrules and guidelines to the participating center elements for those portions of the POP call which pertain to Shuttle Program funded activity.

- When requested, validate the requirements submitted by center elements for facility and institutional money when the justification for those requests is based on Shuttle Program needs.

- Perform a detailed review of those POP submissions by the center operational and engineering elements which pertain to the Operations Integration area of responsibility, and which represent requirements of Shuttle Program funding.

- Participate in the presentation of the integrated requirements of the center operations and engineering elements to the center management and to the staff of the Program Director at NASA Headquarters.

4.0 OPERATIONS FEEDBACK

Operations people are responsible for many aspects of design and not just contributors. Examples of these responsibilities include:

- system operating requirements,
- software requirements,
- onboard software management,
- system monitoring for flight control, and
- guidance and navigation for rendezvous, entry, approach, and landing

Operations people have the responsibility for the MCC/network development, communications and data integration, training facility development and training conduct, flight control, and etc. These responsibilities require that operations personnel share in the responsibility for Interface Control Document development, communication system design requirements, and redundancy management provision.

The overall process of operations feedback to the design goes beyond the operations integration WBS areas. Specialized management techniques and tools, and effective procedures and reporting systems are applied. Daily participation by operations people in all PDRs, almost every technical panel associated with subsystem design (chairing some), all integration panels, all CCBs, and all program content reviews ensures that operations expertise is fed directly into the Shuttle system hardware and software design. Because of this approach, operations are not isolated from the design and development and vice versa.

In order to achieve a thorough understanding of the extent of operations integration, all PWBS and PSIP documentation must be reviewed. The Program Office and Lead Directorate's management plans, techniques, and tools were discussed in Section 3.2. The primary operations integration interfaces and panels were discussed in Section 3.5 and 3.6. Avionics software interfaces were discussed in the Avionics Integration Plan. Brief summaries of the operations feedback resulting from daily interfacing of operations personnel with designers, flight techniques development, and the reporting techniques of these activities are discussed below. Figure 4.0-1 presents an overview of operations feedback to Shuttle hardware and software design.

4.1 Daily Interfacing of Operations Personnel With Designers

As design baselines evolve, system analysis is conducted by operations and design personnel. System performance is compared to pre-established requirements and limits, and tradeoffs are conducted between system or

OPERATIONAL FEEDBACK - SHUTTLE ORBITER SOFTWARE/AND HARDWARE

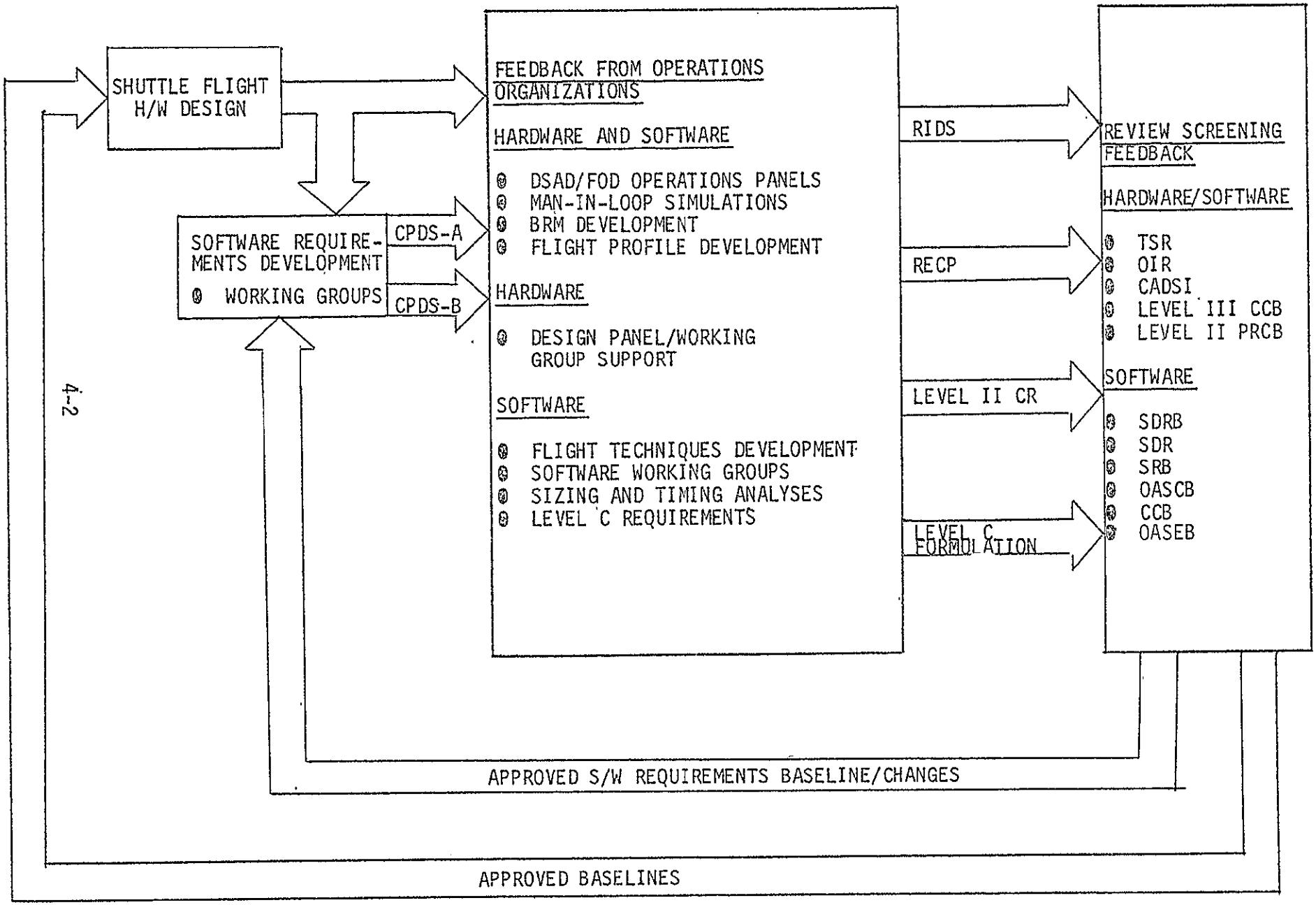

FIGURE 4.0-1

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subsystem characteristics or interfaces. Operational conditions and parameters are established which will influence the results of these analyses, and which are considered necessary to ensure meeting mission and flight objectives. Telecons are held between operations personnel and hardware/software designers, data is exchanged, and study results are verified by all parties involved. Results of these studies which require changes to baselines are input to the system via the formal change boards. Examples of these studies include Carrier Aircraft/Orbiter separation, RCS thruster cant angle modification, Orbiter Flight Control System evaluations using crew-related evaluation simulators, mass memory size reduction, etc.

Operational documentation is developed which can be used as guidelines for hardware/software design to include operational feedback from previous programs. These documents can be used by operations planners and designers, suppliers, and/or users to determine the compatibility of their concepts with operational capabilities.

Flight crew inputs are also fed back into hardware and software design daily as evaluations are conducted using simulators, and as reviews of control and display, and overall crew compartment configurations are studied. Walk-thru scripts are developed for crewman use at design reviews. These scripts enable the crewmen to evaluate crew related configurations in operational-oriented sequences and simulated environments.

4.2 Flight Techniques Development

One of the principal activities which includes a "check and balance" process involving operations expertise, is Flight Techniques Development. The formal activity will center around a panel that will be chartered by a SSPM Directive, and responsibility for the activity delegated to the Flight Operations Directorate. This activity is allocated by PWBS 1.7.1.8. The Flight Techniques Panel will serve as a focal point to coordinate the efforts contributing to the development of flight techniques and procedures, and the definition of functional requirements for crew-related Orbiter software.

The flight techniques coordination activities has evolved from Gemini (Trajectory and Orbit Coordination), to Apollo-Skylab-ASTP (Mission Techniques coordination), to Shuttle Flight Techniques Coordination. A Flight Techniques Handbook is used as the prime tool for this panel's check-and balance activities. This handbook includes the integration of airborne and ground operations principally in areas of trajectory, attitude control, avionics system management, and experiments involving external targets. The handbook also defines the responsibility for airborne and ground software allocation relative to flight techniques and flight rules development.

Input/output relationships which are defined by the handbook, include vehicle hardware configuration, airborne software requirements, ground capabilities, flight rules, crew activity plans, consumables management and crew procedures.

4.3 Reporting and Statusing Procedures

Reporting and statusing of operational integration activities is an effective management procedure used by the Program Office and by DSAD and FOD. Oral and written briefing is provided across and within the organizations to identify and disposition issues, and to provide statusing and continuity of tasks and products accomplishment. All of the activities discussed above are documented and statused in various ways. Inputs to formal reviews and boards (PRR, PDR, CDR, SCB, CCB, PRCB, etc) are documented by change requests (CR) or review item dispositions (RID). Actions resulting from panels, working groups, reviews and boards are documented in minutes of the activity, and tracked by logs of the action and their disposition. Suspense dates for item disposition are established and followed up for closeout by the appointed secretary. The following table summarizes the level, type, and frequency of reporting which provides management assurance of goal accomplishments.

MANAGEMENT REPORTING

- Program Director
  - Program Director's Review (Monthly)
  - Shuttle Element Review (Quarterly)
- Program Office
  - Space Shuttle Staff Meeting (Weekly)
  - Program Status Review (Weekly)
  - Level II PRCB/Systems Review (Monthly)
  - SSEOS Management Review (Monthly)
  - SIMR Review (Monthly)
  - Orbiter CCP Review (Weekly)
  - System Integration Reviews (Bi-weekly)
  - Computer System Integration Review (Bi-weekly)
  - Program Manager's Integration Review (Monthly)

- Operations Integration Office
  - Flight Operations Panel (Monthly)
  - Operations Integration Review (Bi-monthly)
  - CADSI Review (Monthly)
  - Operations Integration Office Staff Meetings (Weekly)
  - Flight Test Program Panel (As Required)
- Lead Organizations Outside The Program Office

  FOD
  - Directorate Staff Meetings (Weekly)
  - Manpower Utilization Report (MUR) (Weekly)
  - Product, Task Plan and Schedule Summary (Bi-monthly)

  DSAD
  - Directorate Staff Meetings (Weekly)
  - DSAD Schedule Summary (Monthly)

SPACE SHUTTLE
OPERATIONS INTEGRATION PLAN
APPENDIX A
ACRONYMS AND ABBREVIATIONS

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ACRONYMS AND ABBREVIATIONS

A/C	-	Aircraft
AED	-	Aircraft Engineering Division
AFETRM	-	Air Force Eastern Test Range Manual
ALT	-	Approach and Landing Test
AOD	-	Aircraft Operations Division
ARC	-	Ames Research Center
ASTP	-	Apollo Soyuz Test Program
BLDG	-	Building
BOP	-	Baseline Operations Plan
BRM	-	Baseline Reference Mission
CAC	-	Carrier Aircraft
CADSI	-	Communication and Data System Integration
CAP	-	Crew Activity Planning
C&C	-	Command and Control
CCB	-	Configuration Control Board
CCP	-	Configuration Change Proposal
CDR	-	Critical Design Review
CEI	-	Contract End Item
CFP	-	Conceptual Flight Plan
COMM	-	Communications
COS	-	Crew Operations Support
CPCB	-	Crew Procedures Control Board
CPDS	-	Computer Program Development Specification
CPES	-	Crew Procedures Evaluation Simulator
CR	-	Change Request

ACRONYMS AND ABBREVIATIONS (Cont'd)

CTPD	-	Crew Training and Procedures Division
DDT&E	-	Design, Development, Test and Evaluation
DOD	-	Department of Defense
DRC	-	Data Reduction Center
DRM	-	Design Reference Mission
DSAD	-	Data Systems and Analysis Directorate
DTO	-	Detailed Test Objective
EAD	-	Engineering Analysis Division
EDD	-	Engineering and Development Directorate
ET	-	External Tank
ETR	-	Eastern Test Range
EVA	-	Extravehicular Activity
FAA	-	Federal Aviation Administration
FCD	-	Flight Control Division
FDF	-	Flight Data File
FLT	-	Flight
FMOF	-	First Manned Orbital Flight
FOD	-	Flight Operations Directorate
FOP	-	Flight Operations Panel
FPS	-	Flight Planning System
FRC	-	Flight Research Center
FRD	-	Flight Requirements Document
FSD	-	Flight Simulation Division
FSSR	-	Functional Subsystem Software Requirements
FTP	-	Flight Test Panel

FTR	-	Flight Test Requirement
GDSD	-	Ground Data Systems Division
GFE	-	Government Furnished Equipment
GN&C	-	Guidance, Navigation and Control
GSE	-	Ground Support Equipment
GSFC	-	Goddard Space Flight Center
HDQ, HDQTRS	-	Headquarters
H/W	-	Hardware
IBM	-	International Business Machines
ICD	-	Interface Control Document
IDSD	-	Institutional Data Systems Division
IMS	-	Information Management System
INT	-	Integration
IUS	-	Interim Upper Stage
IUSS	-	Interim Upper Stage Simulator
IVA	-	Intravehicular Activity
JPL	-	Jet Propulsion Laboratory
JSC	-	Johnson Space Center
KSC	-	Kennedy Space Center
LeRC	-	Lewis Research Center
LPS	-	Launch Processing System
LRC	-	Langley Research Center
LSD	-	Life Sciences Directorate
LVRS-PSD	-	Launch Vehicle Reusable System - Program Systems Division
MCC	-	Mission Control Center
MFTAD	-	Master Flight Test Assignments Document

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ACRONYMS AND ABBREVIATIONS (Cont'd)

MGR	-	Manager
MGT	-	Management
M&O	-	Management and Operations
MMUS	-	Manned Mobility Unit Simulator
MOU	-	Memorandum of Understanding
MPAD	-	Mission Planning and Analysis Division
MSFC	-	Marshall Space Flight Center
MUR	-	Manpower Utilization Report
NASA	-	National Aeronautics and Space Administration
NASCOM	-	NASA Communications Network
NTWK	-	Network
OAFTO	-	Orbiter Atmospheric Flight Test Office
OAS	-	Orbiter Aero Simulator
OASCB	-	Orbiter Avionics Software Control Board
OASEB	-	Orbiter Avionics Software Engineering Board
OFP	-	Operational Flight Plan
OFT	-	Orbital Flight Test
OIO	-	Operations Integration Office
OIP	-	Operations Integration Plan
OIR	-	Operations Integration Review
OMS	-	Orbital Maneuvering System
OMSF	-	Office of Manned Space Flight
OPO	-	Orbiter Project Office, Operational Planning Office
OPR	-	Office of Prime Responsibility
OPS	-	Operations

ACRONYMS AND ABBREVIATIONS (Cont'd)

OS	-	Operational Shuttle
PDR	-	Preliminary Design Review
PICRS	-	Program Information Control and Review Service
P/L	-	Payload
PMP	-	Preliminary Mission Plan
PO	-	Project Office
POCC	-	Payload Operations Control Center
POO	-	Program Operations Office
POP	-	Program Operating Plan
PRCB	-	Program Requirements Control Board
PROG	-	Program
PROJ	-	Project
PRR	-	Preliminary Requirements Review
PSIP	-	Program Systems Integration Plan
PWBS	-	Program Work Breakdown Structure
RCS	-	Reaction Control System
RECP	-	Request For Engineering Change Proposal
RFP	-	Reference Flight Plan
RI	-	Rockwell International
RI/SD	-	Rockwell International/Space Division
RID	-	Review Item Disposition
RLVD	-	Reusable Launch Vehicle Office
RM	-	Redundancy Management
RMS	-	Remote Manipulator System
SAD	-	Science and Applications Directorate

ACRONYMS AND ABBREVIATIONS (Cont'd)

SAIL	-	Shuttle Avionics Integration Lab
SAMSO	-	Space and Missile Systems Organization, USAF
S/C	-	Spacecraft
SCAPO	-	Shuttle Carrier Aircraft Project Office
SCB	-	Software Control Board
SDL	-	Software Development Lab
SDR	-	Systems Design Review, Software Design Review
SDRB	-	Software Design Review Board
SEB	-	Source Evaluation Board
SIMR	-	Shuttle Information Management Review
SIM	-	Simulation(s), Simulator
SOW	-	Statement of Work
SM	-	Systems Management
SMS	-	Shuttle Mission Simulator
SPEC	-	Specification
SPIMS	-	Shuttle Program Information Management System
SPO	-	Shuttle Project Office
SPS	-	Shuttle Procedures Simulator
SRB	-	Solid Rocket Booster, Software Review Board
SR&QAD	-	Safety, Reliability and Quality Assurance Directorate
SSD	-	Spacecraft Software Division
SSEOS	-	Space Shuttle Engineering and Operations Support
SSME	-	Space Shuttle Main Engine
SSP	-	Space Shuttle Program

ACRONYMS AND ABBREVIATIONS (Cont'd)

SSPM	-	Space Shuttle Program Management
SSPMD	-	Space Shuttle Program Management Directive
SSPO	-	Space Shuttle Program Office
SSRRP	-	Shuttle Systems Requirements Review Panel
STA	-	Shuttle Training Aircraft
STDN	-	Space Tracking and Data Network
STS	-	Space Transportation System
S/W	-	Software
SYS	-	System
TAEM	-	Terminal Area Energy Management
TDRSS	-	Tracking and Data Relay Satellite System
TMDR	-	Telemetry Data Retrieval
TRAJ	-	Trajectory
TRNG	-	Training
TSCP	-	Training Simulator Control Panel
TSR	-	Technical Systems Review
USAF	-	United States Air Force
WBS	-	Work Breakdown Structure

SPACE SHUTTLE

OPERATIONS INTEGRATION PLAN

APPENDIX B

DEFINITIONS

DEFINITIONS

The definitions which follow are included to provide the user with an understanding of Shuttle terms and phrases which have had other meanings on previous programs. Acronyms and abbreviations are included in Appendix A. The Shuttle term to be defined appears first, with the traditional or previous program usage in parenthesis. The reference documentation source for the definitions is also included. Figure B-1 illustrates the relationship of the two principal terms, flight and mission.

Crew Activity Planning (Flight Planning) - The analysis and development of activities to be performed by the crew inflight; results in a timeline of these activities with the necessary procedures and crew execute data to accomplish a flight (Reference 1).

Crew Activity Plan (Flight Plan) - A schedule of activities used by the crew and/or ground support team to conduct the flight and accomplish the flight objectives (Reference 3).

Crew Procedure (Procedure) - The steps which a crewman follows to logically, safely, and efficiently accomplish a task occurring between prelaunch checkout and post landing crew egress (Reference 1).

Flight (Flight, Mission) - That portion of a mission(s) encompassing the period from launch to landing; or launch to termination of the active life of a spacecraft. The term Shuttle "flight" means a single Shuttle round trip - its launch, orbital activity, and return. One flight might deliver more than one payload. Several flights might be required to accomplish one mission. (Reference 2).

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TERMINOLOGY - FLIGHT AND MISSION COMPARED

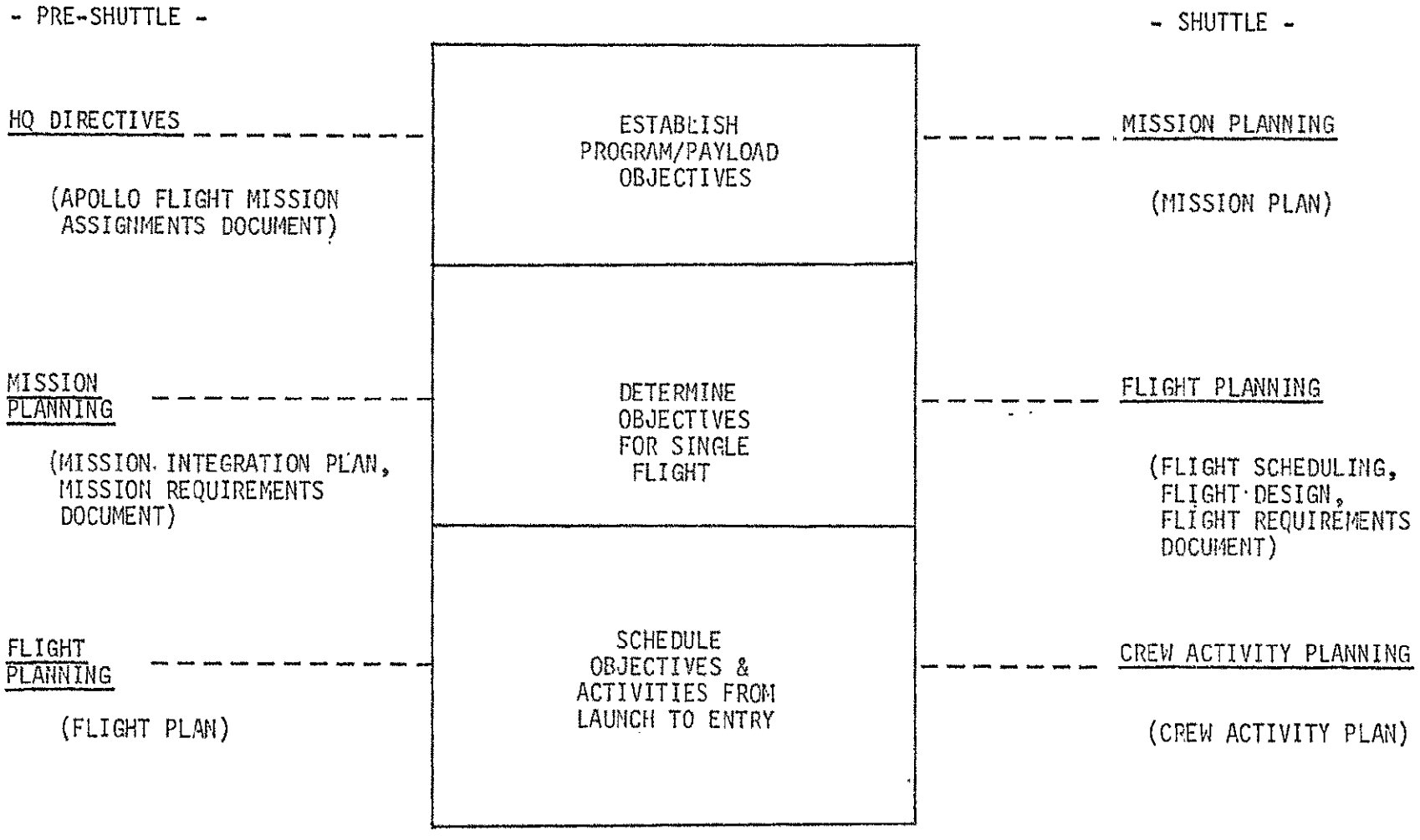

FIGURE B-1

Flight Planning (Mission Planning) - The iterative process of integrating the three major activities of Flight Scheduling, Flight Design and Analysis, and Ground/Flight Crew Activities Planning into a STS flight schedule and the related detailed STS crew activity plans (Reference 2).

Flight Scheduling (Mission Planning) - The process of committing a specific cargo manifest to specific STS resources during a given time frame. The product of this process is the flight assignment. An integral part of this process is the development of valid flight profiles and activities timelines that are compatible with: payload mission plan(s); system payload constraints; payload/STS vehicle constraints; network constraints; launch/landing constraints; and STS resource availability (Reference 2).

Flight Design (Mission Planning) - The process of merging the payload mission objectives and requirements, the crew activities timeline constraints, and the vehicle constraints into a feasible trajectory plan. (Includes the development and analysis of the trajectory profile, separation profile, attitude profile, and consumables profile for nominal, alternate and contingency flight modes) (Reference 2).

Flight Simulator (Mission Simulator) - A software and hardware system designed to present spacecraft flight dynamics and systems parameters in a real time environment (Reference 2).

Mission (N/A) - The performance of a coherent set of investigations or operations in space to achieve STS user goals. (Examples: measure detailed structure of Sun's chromosphere; survey mineral resources of North America (Reference 2).

Mission Planning (Mission Office Planning) - Definition of overall mission objectives and requirements by the STS user (Reference 2).

Mission Requirements (Mission Requirements) - Characteristics of the mission, either collectively or in time sequence, which enable the mission objectives to be accomplished. Characteristics include trajectory considerations, time dependent factors, and other performance or operational characteristics. (Note: A set of characteristics for a specific or single flight are called Flight Requirements) (Reference 2).

STS Space Transportation System (N/A) - An integrated system used in the Space Shuttle Program which is comprised of the following: Orbiter, external tank, solid rocket boosters, upper stage (IUS or Tug), Spacelab, and associated flight hardware (manned maneuvering unit, extravehicular mobility unit, other crew equipment) and software (Reference 1).

Reference Source for Definitions

Reference	Source
1	Basic Crew Procedures Development Plan, JSC-09103, 29 August 1975
2	Draft Glossary of Terms, Definitions, and Personnel Functions Associated with STS/Payload Operations Functional Flows, November 1974
3	Preliminary Shuttle Crew Activity Planning Techniques, JSC-09301, 1 September 1975

SPACE SHUTTLE

OPERATIONS INTEGRATION PLAN

APPENDIX C

DOCUMENTATION OVERVIEW

OPERATIONS DOCUMENTATION PRODUCT OVERVIEW - CATEGORIES AND RESPONSIBILITIES

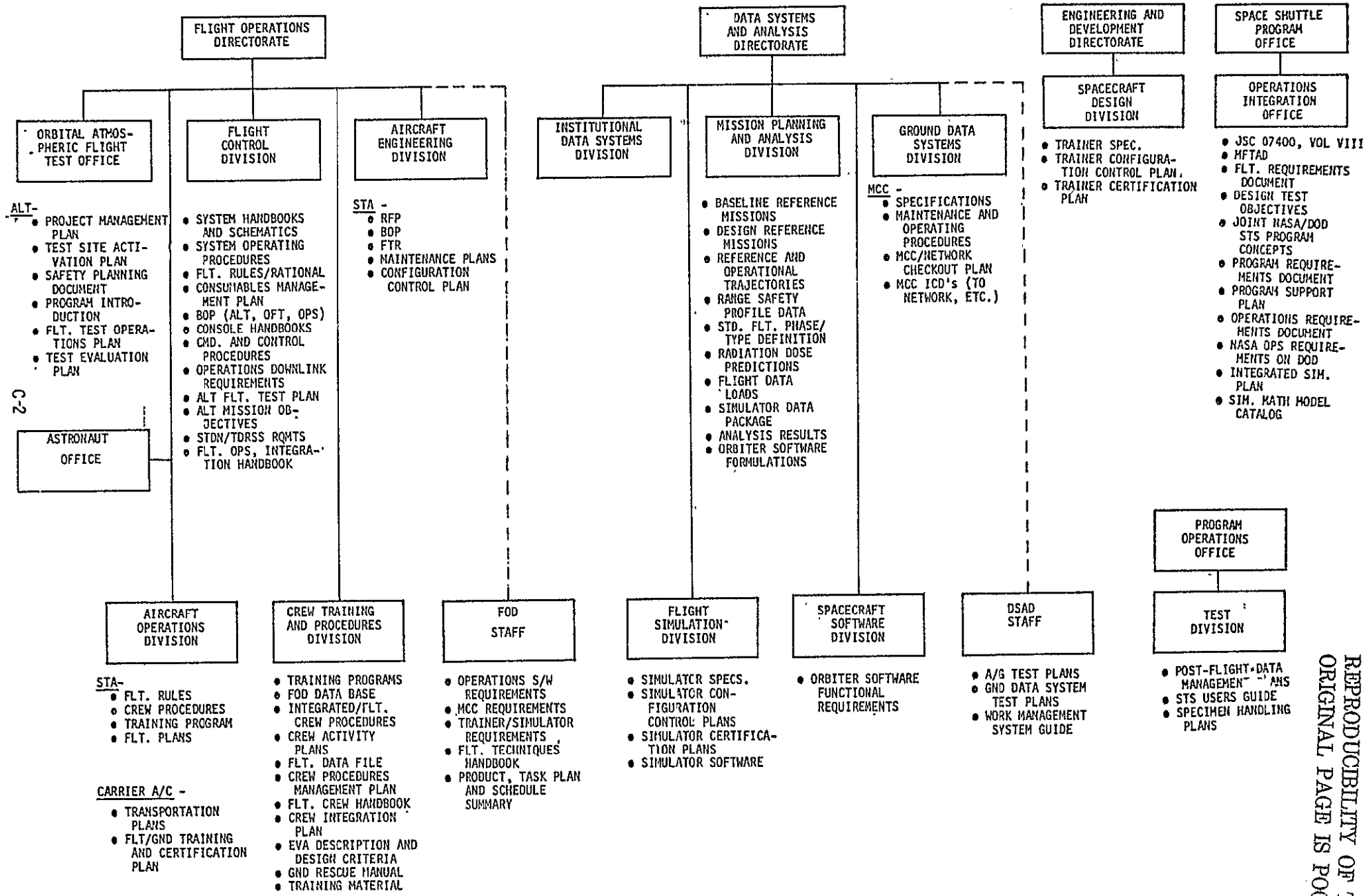

FIGURE C-1

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SPACE SHUTTLE

OPERATIONS INTEGRATION PLAN

APPENDIX D

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