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AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM

Volume IIA: Functional Analysis of Air Traffic Management

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FINAL REPORT

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16. Abstract

The Advanced Air Traffic Management System (AATMS) program is a long-range investigation of new concepts and techniques for controlling air traffic and providing services to the growing number of commercial, military, and general aviation users of the national airspace. This study of the applications of automation was undertaken as part of the AATMS program. The purposes were to specify and describe the desirable extent of automation in AATMS, to estimate the requirements for man and machine resources associated with such a degree of automation, and to examine the prospective employment of humans and automata as air traffic management is converted from a labor-intensive to a machine-intensive activity.

Volume II contains the analysis and description of air traffic management activities at three levels of detail - functions, subfunctions, and tasks. A total of 265 tasks are identified and described, and the flow of information inputs and outputs among the tasks is specified.

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PREFACE

This is the first of four books which together contain a detailed function analysis of air traffic management. The four books represent Volume II of a five-volume report describing work performed during Phase B of the Automation Applications Study for an Advanced Air Traffic Management System sponsored by the Transportation Systems Center of the Department of Transportation.

The first book describes the methodology employed and contains a description of the 17 generic air traffic management functions. It contains also, detailed descriptions of the subfunctions and tasks of Functions 1-4. The second book contains detailed descriptions of the subfunctions and tasks of Functions 5-8. The third book contains similar material for Functions 9-13 and the final book contains similar material for Functions 12-17.

Preface and reference material for the entire Volume can be found in the front of Volume IIA. The Table of Contents, List of Figures and List of Tables for this book follows.

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ACRONYMS

AATMS	Advanced Air Traffic Management System
ATC	Air Traffic Control
ATM	Air Traffic Management
COMM-NAV	Communication and Navigation System
CONUS	Continental United States
DOT	Department of Transportation
EFC	Expect further clearance
ETA	Estimated time of arrival
ETD	Estimated time of departure
ETOV	Estimated time over
FAA	Federal Aviation Administration
NOTAM	Notice to Airmen
OSEM	Office of Systems Engineering and Management (FAA)
PIREP	Pilot Weather Report
RDT&E	Research, Development, Testing and Evaluation
TSC	Transportation Systems Center

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ABBREVIATIONS

acft	aircraft
advis.	advisory
act.	actual
clear.	clearance
comm.	communication
det.	determine
devs.	deviations
emerg.	emergency
envir.	environment, environmental
equip.	equipment
exog.	exogenous
flt	flight
gnd	ground
info.	information
ident.	identify, identification, identity
juris.	jurisdiction, jurisdictional
mod.	modify
msg.	message
nav.	navigation
op.	operation, operational
pos.	position
prob.	probability
pres.	present
pref.	preference
qual.	qualification
res.	resolution
revs.	revisions
sect.	section
ser.	service
spec.	special
tel.	telephone
unaccept.	unacceptable

DEFINITIONS

1. Accepted flight plan - A flight plan which both the Air Traffic Management authority and the pilot have found acceptable.
2. Actual time-position profile - A series of x, y, h and t data points that describe the four-dimensional flight path that an aircraft has followed.
3. Approved flight plan - A flight plan which has been found acceptable to the ATM but has not received final pilot approval.
4. Clearance - Authorization to execute all, or a portion, of an approved flight plan. Since this represents a contract, acknowledgment from the aircraft is required.
5. Compiled flight plan - The output of the second stage in the preparation of a flight plan. It represents a preliminary flight plan which the pilot has checked against; and, if necessary, modified to make compatible with; operational, environmental and regulatory factors.
6. Conflict - The situation that exists when minimum allowable spacing between two aircraft is being violated. (See predicted conflict)
7. Conformance with clearance - Maintenance of the actual time-position profile within specified tolerances about an intended time-position profile.
8. Controller - A resource which manages air traffic; may be a person or an item of automation equipment.
9. Fix - a geographic position or point in the airspace.
10. Flight plan - A statement of intent to use airspace.
11. Flight plan tolerances - Acceptable deviations about an intended time-position profile. An aircraft within tolerances is maintaining conformance with its flight plan.
12. Flight profile - The four dimensional (x, y, h and t) "flight path" and aircraft has traveled. The same as actual time-position profile.

DEFINITIONS (CONTINUED)

13. Flow control - Establishment of the capacity of, and rate of movement of aircraft among, ATM jurisdictions and terminals. Flow control procedures attempt to match demand to capacity.

14. Flow control directives - A statement of system predicted capacity by ATM jurisdictions and terminals, and the input/thruput rates which will efficiently maintain traffic flow at or below capacity.

15. Flow control guidelines - Procedures and guidance for implementing flow control directives.

16. Intended time-position profile - A series of x, y, h and t data points that describe the four-dimensional flight path that an aircraft plans to follow. The intended time-position profile developed from the data in an accepted flight plan.

17. Intended future position - The x, y, and h point which an aircraft intends to occupy at a specified future time based on the accepted flight plan.

18. Intended position - An x, y, h and t data point which an aircraft intends to make good based on its accepted flight plan. (See also, intended present position and intended future position)

19. Intended present position - The x, y and h point that an aircraft would occupy at the present time if it were exactly on accepted flight plan.

20. Minimum separator standards - The minimum acceptable separation between aircraft (may be stated in terms of probability and imminence of conflict).

21. Paradigm - A pattern or set of instructions for accomplishing a task.

22. Path prediction profile - A profile of paths (series of x, y, h and t points) that an aircraft may follow with the associated probability of following each.

DEFINITIONS (CONTINUED)

23. Pilot - A resource which pilots an aircraft; may be a person or an item of automation equipment.

24. Position (aircraft position) - A four dimensional (x, y, h and t) point describing a past, present or future location of an aircraft.

25. Predicted conflict - The situation that exists when it is predicted that minimum allowable spacing between two aircraft will be violated.

26. Predicted time-position profile - A series of x, y, h and t data points that describe the four-dimensional flight path that it is predicted an aircraft will follow. The predicted time-position profile may or may not agree with the intended time-position profile. Two kinds of predicted time-position profiles are produced.

    - Short-range predictions - an extrapolation for which the inputs are derived from recent performance history (actual time-position profile)
    - Long-range predictions - an extrapolation for which speed of advance is derived from recent performance history, and course and altitude are derived from the intended time-position profile (accepted flight plan)

27. Preliminary flight plan - The output of the first stage of flight plan preparation. It reflects the pilot's intentions but is not necessarily consistent with operational, environmental and regulatory factors.

28. Submitted flight plan - The output of the Prepare Flight Plan function. The pilot has checked it for compatibility with operational, environmental, and regulatory factors and for internal consistency, and has submitted it for ATM approval.

SUMMARY

The present function analysis was carried out as part of an investigation of one of the major unresolved issues of the Advanced Air Traffic Management System (AATMS) - the appropriate level of automation. The objective of that investigation is to determine a man-machine combination that will perform air traffic management responsibilities safely, efficiently, and economically; and that will be acceptable to both airspace users and air traffic managers.

The purpose of the function analysis is to identify and describe generic air traffic management activities to a level of detail that they can be validly assigned to man or machine. Consequently, the analysis was carried through three iterations - function, subfunction and task. At the third iteration, the decisions and actions composing each task were examined to determine if they were sufficiently homogeneous that the entire task could be totally automated or totally manual. If not, that particular sequence of decisions and actions was further partitioned into two or more tasks.

Inputs to the analysis included data from earlier functional and similar studies; controller's handbooks, manuals and similar official publications; and the operational experience of former controller personnel who served on the analysis team.

The analysis was carried out in two phases. During Phase A, functions and subfunctions were identified and described. These results were then published and comments solicited from knowledgeable members of the air traffic management community.

At the beginning of Phase B, ten air traffic management services were defined in cooperation with representatives of the FAA and other interested organizations. These services are listed below and discussed in Section 2.0, pages 2.0-1 - 2.0-3.

- Airport/Airspace Use Planning
- Flight Plan Conformance
- Separation Assurance

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- Spacing Control
- Airborne, Landing and Ground Navigation
- Flight Advisory Services
- Information Services
- Record Services
- Ancillary Services
- Emergency Services

The functions and subfunctions developed in Phase A were then reorganized to be more directly relatable to these services. The resulting 17 functions and subfunctions became the basic input to the third iteration of the analysis. That iteration produced the 265 tasks that are listed by function and subfunction in Table S-I.

The 17 top-level functions are described briefly in Section 3.0 and in more detail in Section 3.3. The subfunctions and tasks are described in Section 4.0.

Table S-I. Generic ATM Functions, Subfunctions and Tasks

1.0 PROVIDE FLIGHT PLANNING INFORMATION

- 1.1 Receive Requests for Flight Planning Information
  - 1.1.1 Accept data link request
  - 1.1.2 Accept telephone request
  - 1.1.3 Enter request into system
- 1.2 Select Information to Service the Request
  - 1.2.1 Select preformatted reply
  - 1.2.2 Retrieve information requested
- 1.3 Format and Display the Requested Information
  - 1.3.1 Compile non-preformatted response
  - 1.3.2 Display information requested
  - 1.3.3 Transmit requested information via telephone

2.0 CONTROL TRAFFIC FLOW

- 2.1 Determine System Capacity
  - 2.1.1 Select terminal or jurisdiction and time period to be considered
  - 2.1.2 Determine effects of weather on capacity
  - 2.1.3 Determine effects of airspace restrictions on capacity
  - 2.1.4 Determine effects of ground equipment capability and status on capacity
  - 2.1.5 Determine effects of flight hazards on capacity
  - 2.1.6 Determine total effect on capacity
- 2.2 Determine System Demand
  - 2.2.1 Determine jurisdiction/terminal demand due to commercial schedules
  - 2.2.2 Process and store reservations
  - 2.2.3 Determine jurisdiction/terminal demand due to reservations
  - 2.2.4 Determine total jurisdiction/terminal demand
- 2.3 Determine and Resolve Capacity Overload Situations
  - 2.3.1 Compare capacity with demand
  - 2.3.2 Determine origins of demand in capacity overload situations
  - 2.3.3 Determine what number of aircraft are to be delayed for what period of time
  - 2.3.4 Determine where delays are to be absorbed
  - 2.3.5 Formulate flow control directives

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

3.0 PREPARE FLIGHT PLAN

- 3.1 Develop Preliminary Flight Plan
  - 3.1.1 Specify desired destination and route information
  - 3.1.2 Specify aircraft and pilot information
  - 3.1.3 Specify type flight plan and special services desired
- 3.2 Assess Effects of Operational, Environmental, and Regulatory Factors
  - 3.2.1 Obtain operational, environmental, and regulatory information for desired route and destination
  - 3.2.2 Determine modifications required to make preliminary flight plan consistent with operational, environmental and regulatory information
  - 3.2.3 Determine effects of required modifications on flight intentions
- 3.3 Compile and Submit Flight Plan
  - 3.3.1 Compile flight plan
  - 3.3.2 Check flight plan for internal consistency
  - 3.3.3 Submit flight plan

4.0 PROCESS FLIGHT PLAN

- 4.1 Develop Intended Time-Position Profile
  - 4.1.1 Determine points for which ETOV's are to be computed
  - 4.1.2 Compute ETOV's/ETA
- 4.2 Review Flight Plan
  - 4.2.1 Compare flight plan with aircraft capability and status
  - 4.2.2 Compare flight plan with operational and environmental conditions
  - 4.2.3 Probe for conflicts among flight plans
  - 4.2.4 Compare flight plan with flow control directives and guidelines
  - 4.2.5 Compare flight plan with rules and procedures
  - 4.2.6 Compare flight plan with flight progress
  - 4.2.7 Compare flight plan with user class/pilot qualifications
  - 4.2.8 Compile list of discrepancies
  - 4.2.9 Determine flight plan priority
  - 4.2.10 Determine acceptability of flight plan

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

- 4.2.11 Identify flight plans that must be modified as a result of this approval
- 4.2.12 Inform pilot of flight plan approval
- 4.2.13 Determine special services required

4.3 Propose Modified Flight Plan

- 4.3.1 Determine changes required to make flight plan acceptable
- 4.3.2 Determine responsibility to modify the flight plan
- 4.3.3 Inform pilot of unacceptable flight plan
- 4.3.4 Compile modified flight plan

4.4 Determine Responsibility for Control and Communication

- 4.4.1 Receive and enter pilot's response
- 4.4.2 Cancel flight plan
- 4.4.3 Designate responsible jurisdictions
- 4.4.4 Designate communication links between ATM and aircraft

5.0 ISSUE CLEARANCES AND CLEARANCE CHANGES

5.1 Check Clearance Status

- 5.1.1 Determine if identification code assignment is required
- 5.1.2 Compare flight progress with clearance limit and EFC time
- 5.1.3 Determine pilot intentions following missed approach

5.2 Determine Clearance to be Issued

- 5.2.1 Assign identification code
- 5.2.2 Determine clearance tolerances
- 5.2.3 Determine clearance limit
- 5.2.4 Determine required clearance instructions

5.3 Compile and Issue Clearance

- 5.3.1 Compile clearance to be issued
- 5.3.2 Transmit clearance message
- 5.3.3 Receive acknowledgement of clearance

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

6.0 MONITOR AIRCRAFT PROGRESS

- 6.1 Determine Present Position
  - 6.1.1 Receive/enter correlated position and identification
  - 6.1.2 Receive/enter position
  - 6.1.3 Correlate position and identification
  - 6.1.4 Request aircraft identity
  - 6.1.5 Assign arbitrary aircraft identification
- 6.2 Compile Aircraft Time-Position Profile
  - 6.2.1 Initiate aircraft actual time-position profile
  - 6.2.2 Update aircraft actual time-position profile
- 6.3 Predict Future Positions/ETA's of the Aircraft
  - 6.3.1 Derive rate of change of position
  - 6.3.2 Compute short-range extrapolations
  - 6.3.3 Compute long-range extrapolations
- 6.4 Determine Aircraft Capability and Status
  - 6.4.1 Determine aircraft readiness
  - 6.4.2 Detect aircraft emergencies
  - 6.4.3 Determine nature of emergency
  - 6.4.4 Receive and enter aircraft status changes
  - 6.4.5 Update aircraft status
  - 6.4.6 Receive and enter reports of aircraft capability changes
  - 6.4.7 Update aircraft capability

7.0 MAINTAIN CONFORMANCE WITH FLIGHT PLAN

- 7.1 Detect Long-Term Conflicts Among Flight Plans
  - 7.1.1 Specify time period to be checked
  - 7.1.2 Construct pairs of flight plans to be compared
  - 7.1.3 Select relevant portion of each pair member's intended time-position profile
  - 7.1.4 Compare intended time-position profiles for intersections in x, y, h and t
  - 7.1.5 Propose revised flight plan to correct long-term conflicts among flight plans

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

- 7.2 Determine Current Deviations from Flight Plan
  - 7.2.1 Determine aircraft's intended present position
  - 7.2.2 Compute deviations between aircraft's intended and actual present position
- 7.3 Predict Deviations from Flight Plan
  - 7.3.1 Determine aircraft's intended future positions
  - 7.3.2 Compute short-range deviations (in x, y and h) from flight plan
  - 7.3.3 Compute long-range deviations (in t) from flight plan
- 7.4 Determine Appropriate Resolution of Deviations
  - 7.4.1 Compare deviations with tolerances
  - 7.4.2 Inform pilot of out-of-tolerance deviations
  - 7.4.3 Receive pilot's response concerning resolution of out-of-tolerance present and/or long-range deviations
  - 7.4.4 Develop flight plan revisions to correct out-of-tolerance deviations

8.0 ASSURE SEPARATION OF AIRCRAFT

- 8.1 Predict Conflicts
  - 8.1.1 Select airspace volume and time frame
  - 8.1.2 Predict aircraft paths
  - 8.1.3 Identify path prediction profiles for the airspace and time frame
  - 8.1.4 Pair path prediction profiles for conflict comparison
  - 8.1.5 Determine conflict probability for each pair
  - 8.1.6 Determine conflict imminence for each pair
  - 8.1.7 Determine action required
  - 8.1.8 Monitor for unexpected deviations
  - 8.1.9 Determine if action classification has been updated
- 8.2 Resolve Conflicts
  - 8.2.1 Hypothesize performance changes
  - 8.2.2 Analyze performance change for conflicts
  - 8.2.3 Format performance change message
  - 8.2.4 Transmit performance change message to pilot
  - 8.2.5 Determine performance change status

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

9.0 CONTROL SPACING OF AIRCRAFT

- 9.1 Maintain Predicted Arrival/Departure Schedule for Each Airport
  - 9.1.1 Determine identity and ETA of arriving aircraft
  - 9.1.2 Determine identity and ETD of departing aircraft
  - 9.1.3 List arriving and departing aircraft by ETA/ETD
- 9.2 Determine Requirement for Spacing Control
  - 9.2.1 Determine airport capacity
  - 9.2.2 Analyze predicted schedule for alternating period of excess demand and slack
- 9.3 Establish Runway Configuration Schedule
  - 9.3.1 Analyze temporal distribution of arrivals and departures
  - 9.3.2 Allocate blocks of time for arrivals and departures
- 9.4 Determine Most Efficient Arrival and Departure Sequence/Schedule for Runway
  - 9.4.1 Compare predicted arrival and departure times with runway schedule
  - 9.4.2 Change ETA's and ETD's to be compatible with runway schedule
- 9.5 Initiate Implementation of Sequence/Schedule
  - 9.5.1 Select sequence/schedule change to be implemented
  - 9.5.2 Hypothesize performance change required to implement desired sequence/schedule
  - 9.5.3 Check proposed performance change for predicted conflict
  - 9.5.4 Assess control implications of performance required to implement sequence/schedule change
  - 9.5.5 Submit performance changes within existing flight plan to clearance function
  - 9.5.6 Propose revised flight plan to implement sequence/schedule change
  - 9.5.7 Submit revised flight plan for approval

10.0 PROVIDE AIRBORNE, LANDING AND GROUND NAVIGATION CAPABILITY

- 10.1 Produce and Transmit Enroute Navigation Signals
- 10.2 Produce and Transmit Landing Navigation Signals
- 10.3 Produce and Transmit Ground Navigation Signals

11.0 PROVIDE AIRCRAFT GUIDANCE

- 11.1 Initiate/Terminate Guidance
  - 11.1.1 Determine desired position
  - 11.1.2 Determine requirements for further vectoring

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

- 11.2 Compute Vector Requirements
  - 11.2.1 Measure course and distance
  - 11.2.2 Compute time interval
  - 11.2.3 Compute ground speed
  - 11.2.4 Compute altitude difference
- 11.3 Compute Air Vector
  - 11.3.1 Compute airspeed
  - 11.3.2 Compute vertical speed
  - 11.3.3 Compute heading
- 11.4 Compute Guidance Commands
  - 11.4.1 Compute heading command
  - 11.4.2 Compute airspeed command
  - 11.4.3 Compute vertical speed command
- 11.5 Compile and Transmit Guidance Instructions
  - 11.5.1 Compile vectoring instructions
  - 11.5.2 Transmit vectoring instructions to pilot
  - 11.5.3 Assess aircraft response

12.0 ISSUE FLIGHT ADVISORIES AND INSTRUCTIONS

- 12.1 Service Request for Information
  - 12.1.1 Receive pilot's request for information
  - 12.1.2 Acknowledge pilot's request for information
  - 12.1.3 Select applicable preformatted messages
  - 12.1.4 Retrieve information requested
  - 12.1.5 Compile special response to request
  - 12.1.6 Transmit preformatted advisory to pilot
  - 12.1.7 Transmit special response to pilot
- 12.2 Issue Flight Service Advisories and Instructions
  - 12.2.1 Evaluate advisory for data content
  - 12.2.2 Determine aircraft to which information applies
  - 12.2.3 Determine method of flight advisory distribution
  - 12.2.4 Determine distribution position for each identified aircraft
  - 12.2.5 Determine time of simultaneous distribution
  - 12.2.6 Prepare transmission schedule
  - 12.2.7 Correlate present position with distribution position

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

12.3 Notify Pilot of Imminent Encounter with Hazardous Weather Phenomenon

- 12.3.1 Determine endangered aircraft
- 12.3.2 Compile alert message
- 12.3.3 Transmit warning advisory to pilot
- 12.3.4 Receive pilot's response

13.0 HANDOFF

13.1 Determine Handoff Responsibility Requirements

- 13.1.1 Correlate aircraft position with jurisdictional boundaries
- 13.1.2 Determine functions to be transferred
- 13.1.3 Correlate aircraft position with airspace structure boundaries
- 13.1.4 Receive pilot's request for transfer of responsibility
- 13.1.5 Determine acceptability to jurisdictions involved

13.2 Determine Communication Channel Assignment

- 13.2.1 Determine if communication channel change is required
- 13.2.2 Determine availability of appropriate channels
- 13.2.3 Designate channel to be used

13.3 Effect Transfer of Responsibility

- 13.3.1 Transfer responsibility for control
- 13.3.2 Compile required information for clearance function

14.0 MAINTAIN SYSTEM RECORDS

14.1 Prepare Operational Reports

- 14.1.1 Detect information requiring operational report
- 14.1.2 Retrieve applicable operational report format
- 14.1.3 Enter detected information
- 14.1.4 Determine necessity for additional information
- 14.1.5 Retrieve additional information

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

- 14.2 Compile and Store System Records
  - 14.2.1 Classify data elements
  - 14.2.2 Assign appropriate identifiers
  - 14.2.3 Determine if data transform/reformat is required
  - 14.2.4 Transform/reformat data element
  - 14.2.5 Enter data element into storage
- 14.3 Prepare and Maintain Statistical and Special Reports
  - 14.3.1 Determine if report format is available
  - 14.3.2 Retrieve format
  - 14.3.3 Develop format
  - 14.3.4 Retrieve required data
  - 14.3.5 Analyze data
  - 14.3.6 Compile report

15.0 PROVIDE ANCILLARY AND SPECIAL SERVICES

- 15.1 Determine Nature of Service Required
  - 15.1.1 Compile/update description of special service required
  - 15.1.2 Monitor progress of service
- 15.2 Initiate Action to Provide Service
  - 15.2.1 Determine requirement for special flight plan priority
  - 15.2.2 Establish area of restriction
  - 15.2.3 Determine guidance service required
  - 15.2.4 Determine special separation minima
  - 15.2.5 Determine advisories required
  - 15.2.6 Determine necessity for issuance of NOTAM(s)

16.0 PROVIDE EMERGENCY SERVICES

- 16.1 Describe Emergency Situation
  - 16.1.1 Determine adequacy of emergency description
  - 16.1.2 Request additional required information
  - 16.1.3 Compile description of emergency

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

16.2 Determine Required Response to Emergency
- 16.2.1 Determine required ground support assistance
- 16.2.2 Determine assistance required from other aircraft
- 16.2.3 Determine aircraft to provide assistance
- 16.2.4 Issue instructions to aircraft providing assistance
- 16.2.5 Determine required technical instructions to aircraft in emergency situation
- 16.2.6 Develop emergency flight plans
- 16.2.7 Determine requirement for use of emergency communication link
- 16.2.8 Inform pilot of change to emergency communication link
- 16.2.9 Determine required guidance assistance
- 16.2.10 Issue instructions to ground support facility

17.0 MAINTAIN SYSTEM CAPABILITY AND STATUS INFORMATION

17.1 Determine Current and Forecast Weather
- 17.1.1 Determine if weather observation report is required
- 17.1.2 Determine if supplemental data is required
- 17.1.3 Request PIREP
- 17.1.4 Receive supplemental data
- 17.1.5 Make weather observation report
- 17.1.6 Transmit weather observation report
- 17.1.7 Receive and enter weather information
- 17.1.8 Store weather information

17.2 Update Rules and Procedures Information
- 17.2.1 Determine data base item affected
- 17.2.2 Retrieve affected data base item
- 17.2.3 Determine required change to the data base item
- 17.2.4 Purge affected data base item
- 17.2.5 Format new data base item
- 17.2.6 Store data base item

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

17.3 Update Airspace Structure and Jurisdictional Boundary Information
- 17.3.1 Determine data base item affected
- 17.3.2 Retrieve affected data base item
- 17.3.3 Determine required change to the data base item
- 17.3.4 Purge affected data base item
- 17.3.5 Format new data base item
- 17.3.6 Store data base item

17.4 Update Route Information
- 17.4.1 Determine data base item affected
- 17.4.2 Retrieve affected data base item
- 17.4.3 Determine required change to the data base item
- 17.4.4 Purge affected data base item
- 17.4.5 Format new data base item
- 17.4.6 Store data base item

17.5 Update Airspace Restriction Information
- 17.5.1 Determine data base item affected
- 17.5.2 Retrieve affected data base item
- 17.5.3 Determine required change to the data base item
- 17.5.4 Purge affected data base item
- 17.5.5 Format new data base item
- 17.5.6 Store data base item

17.6 Update Hazards to Flight Information
- 17.6.1 Determine data base item affected
- 17.6.2 Retrieve affected data base item
- 17.6.3 Determine required change to the data base item
- 17.6.4 Purge affected data base item
- 17.6.5 Format new data base item
- 17.6.6 Store data base item

17.7 Determine Capability and Status of COMM-NAV System
- 17.7.1 Monitor COMM and NAV systems for status change
- 17.7.2 Activate standby equipment
- 17.7.3 Retrieve affected data base item
- 17.7.4 Format new data base item
- 17.7.5 Store data base item

Table S-I. Generic ATM Functions, Subfunctions and Tasks, Cont'd.

17.8 Determine Capability and Status of Ground Facilities
- 17.8.1 Monitor ground facilities for status change
- 17.8.2 Activate standby equipment
- 17.8.3 Retrieve affected data base item
- 17.8.4 Format new data base item
- 17.8.5 Store data base item

17.9 Maintain User Class Information
- 17.9.1 Receive and index user class information
- 17.9.2 Retrieve affected data base item
- 17.9.3 Determine change required
- 17.9.4 Purge affected user class data base item
- 17.9.5 Format user class data base item
- 17.9.6 Store user class data base item

17.10 Compile Traffic Summaries
- 17.10.1 Maintain tallies of active flight plans
- 17.10.2 Compile ETD's, ETOV's and ETA's
- 17.10.3 Store traffic data

17.11 Prepare Preformatted Data Modules
- 17.11.1 Determine requirement for preformatted data modules
- 17.11.2 Compile preformatted data modules

1.0 INTRODUCTION

This is Volume II of a three-volume report covering work done during Phase B of the Automation Applications Study for an Advanced Air Traffic Management System (AATMS). The study is sponsored by the Transportation Systems Center (TSC) of the Department of Transportation (DOT) through Contract Number DOT-TSC-512.

The study addresses one of the major unresolved issues in the development of AATMS--the appropriate level of automation for the system. Since automation provides a potential for sizable savings in operating costs, it is a significant factor in the development of a system to satisfy the demands imposed by the greatly increased level of air traffic projected for the end of this century. The basic premise of the study is that a level of automation can be specified which will define a man-machine combination that is: (1) appropriate for the requirements, (2) inherently highly-productive (and therefore economical), and (3) acceptable to both airspace users and air traffic managers.

Volume I of the present three-volume report summarizes the Phase B work in the areas of man-machine operations; functional failure mode analysis; action/information requirements; model development; model inputs preparation; model exercising; and tasks, duties, operational rules and procedures. It contains, also, initial estimates of manpower, data processing requirements and an RDT&E Plan for the system.

Volume III contains a detailed description of the methodology employed in making man-machine allocations. It contains, also, the actual allocations at five different levels of automation.

This volume, Volume II, consists of three books which contain a detailed functional analysis of Air Traffic Management. The function and subfunction level analysis developed during Phase A is updated and extended to the next, or third, level of detail. Two hundred and sixty-five tasks are identified and described and the flow of information among them is traced.

The objective of the functional analysis is to describe the generic air traffic management activities to the level of detail required for allocation of those activities to man or machine. "Generic" as used here, means independent of hardware implementation and, to the extent possible, independent of system concept. The functional analysis is structured to produce information about each activity in a form that can be related to allocation criteria so as to provide reasonable and defensible man/machine allocations.

In order to meet the objective stated above, three levels of analysis have been performed. These levels (from the top down) are referred to as (1) function, (2) subfunction, and (3) tasks. At the task level the individual decisions and actions that make up each task are identified. The essential characteristics of a task, as the term is used here, is that it must consist of a sequence of activities (decisions and/or actions) that are sufficiently homogeneous that it can be totally automated or totally manual. If some of a sequence of activities should be assigned to man and others to a machine, that sequence must be further partitioned into more than one task.

A number of air traffic control investigations have developed functional information. That information is characterized by varying degrees of completeness and levels of detail, and by the absence of a consistent terminology. In an effort to avoid duplication of effort and achieve completeness, the results of as many of these studies as could be acquired were used as inputs for the present effort. Other inputs included controller's handbooks, manuals and similar official publications.

Each system activity listed in any input source was copied onto an index card. At that time, no effort was made to distinguish between different levels (function, subfunction, task) of activity. This effort produced almost two thousand cards which were then sorted by phase of flight. The phases were:

- Preflight planning
- Preflight taxi
- Takeoff
- Departure

- Transition to en route (later merged into the en route phase)
- En route
- Transition to arrival (later merged into the arrival phase)
- Arrival
- Final approach and landing
- Missed approach
- Post-flight taxi

The cards in each phase of flight were then sorted into "categories which belonged together".

Meanwhile, a flow chart of an "IFR flight" was prepared showing the interactions between "pilot" and "controller", the activities carried out by each, and the inputs required for those activities. Thus, both those activities within the main flow of pilot-controller interaction and those that, although not a part of the main flow, must be performed to provide required inputs were identified. The categories of activities determined by sorting the cards were then mapped onto the flow chart. Information from both sources was carefully cross-checked and the indicated additions and modifications were made. The result was a list of functions to be performed during each phase of flight. These were then compiled into a list of generic air traffic management functions.

At this point, the analysis of each function proceeded using the standard "from-the-top-down" analysis techniques supplemented by the information collected previously and the ATM experience of members of the analysis team.

A functional analysis must be concerned with both the interrelationships among processes (e.g., tasks) and the description of those processes. At each level, the processes, the inputs and outputs of each process, the sources of the inputs, and the destinations of the outputs must be diagrammed to assure completeness and continuity. Therefore, at each level, function analysis data consists of process descriptions and the diagrams. These data represent the main body of this report.

Air traffic management functions, like those of all systems, use inputs that come from other systems as well as those produced within the system. The functions use three kinds of inputs produced within the ATM

system: (1) information produced by other functions, (2) information produced by off-line activities (e.g., procedures, algorithms, etc.), and (3) raw data from the system sensors. In the function, subfunction, and task description sheets, the source of an input from another function, subfunction, or task is identified by the number and title of the function, subfunction, or task that produces the input. In the diagrams which show information flow, function, subfunction or task numbers are used to identify the source of an input or the destination of an output. In both description sheets and diagrams, other input sources and destinations are identified as "exogenous", "aircraft" or "pilot". "Aircraft" is used to indicate that information comes from, or goes to, a sensor or a pilot onboard an aircraft interacting with the ATM system. "Pilot" is used when the system is interacting with a pilot who is not necessarily onboard an aircraft (e.g., during preflight planning). "Exogenous" refers to any other source outside the operational ATM system, including off-line and administrative ATM activities.

A number of words used in this analysis have specific meanings within the ATM community as a result of their use in conjunction with the present ATC system. They imply a way of implementing an item or activity because it is presently implemented in that fashion. In many instances, there is, unfortunately, no other word which will both adequately describe the item or activity, and not carry implications for implementation. In such cases, the familiar word is used in this study. However, it is used to mean the generic item or activity, only. It is <u>not</u> intended to imply <u>any</u> method of implementation. (For example, the words "flight plan" immediately calls to mind a document similar to that presently in use. However, in this study, flight plan is used to mean a formulation of intention to use some portion of the airspace, no particular format or implementation is implied.) Lists of definitions, acronyms and abbreviations used in the report are included in the front of Book One.

The main body of this volume of the report consists of three parts. ATM services are identified and defined in Section 2.0. Section 3.0 contains a top-level analysis of the generic ATM system. Seventeen functions that provide the ATM services are identified and described. Section 4.0 contains the next two levels of the analysis. The 17 functions are

partitioned into 60 subfunctions, and these, in turn, into 265 tasks. Thus readers who wish a top-level discussion of the analysis need read only Sections 2.0 and 3.0. Those desiring more detailed information should read Section 4.0, also.

Book One contains Sections 1 through 3 and that part of Section 4 which contains the detailed descriptions of Functions 1 through 4. Book Two contains the detailed descriptions of Functions 5 through 11, and Book Three the detailed descriptions of Functions 12 through 17.

2.0 ATM SERVICES

Comments regarding the Phase A report emphasized that ATM functions should be traceable to the ATM services now being, and/or to be, provided to airspace users. Consequently, a working meeting of interested parties was held to define those services. The meeting convened at TRW's Washington Operations in January of 1973. Participants included representatives of FAA (OSEM) TSC, MITRE, TRW, and Planar. Ten categories of services were identified and described. They are:

(1) Airport/Airspace Use Planning - This is the strategic or long-range control service concerned with the establishment and modification of plans for airspace and airport use. It is related to both safety and efficiency, and involves an agreement between the user and the control authority. It includes such things as:

- The flight planning process
- Flow control, both national and local
- Conflict prevention by planning
- Promotion of efficiency by planning
- The clearance process

The outputs to the user are clearances and advisories.

(2) Flight Plan Conformance - This is the strategic or long-range service that promotes implementation of the plans developed above. It includes:

- Monitoring to determine deviations from plan
- Corrections back to plan, or
- Modifications to the plan
- Monitoring for conflicts within the plan
- Resolution of those conflicts

The outputs to the user are corrections to keep him on flight plan, and changes to his flight plan.

(3) Separation Assurance - This is a short-term service related to safety. It consists of both short-term conflict prevention (tactical conflict detection and resolution) and tactical collision prevention.

Short-term conflict prevention includes:

- Monitoring for predicted violations of the airspace volume reserved about an aircraft
- Resolution of predicted violations

Tactical collision prevention includes:

- Monitoring for actual violation of reserved airspace volume
- Resolution of actual violations

In either case the output to the user is instructions to resolve the conflict. The resolution instructions do not represent a flight plan change but may generate the need for a flight plan change after resolution has been effected.

(4) Spacing Control - This is a short-term service related to efficiency. It includes:

- Runway configuration scheduling - allocation of "slots" of runway time for takeoff and landing traffic
- Sequencing - ordering of aircraft enroute as well as into the takeoff and landing slots provided by scheduling
- Spacing - adjustment of inter-aircraft spacing to promote efficiency

(5) Airborne, Landing, and Ground Navigation - This is the service that provides position location capability. As defined, it does not include the process of getting from present position to a desired position. Therefore, vectoring and GCA are not a part of this service.

(6) Flight Advisory Services - This is the service that provides information to the pilot during all flight phases except preflight planning. It provides weather and traffic information and includes the present Automatic Terminal Information Service.

(7) Information Services - This service is similar to the preceding one except that the information is provided during the preflight planning phase. It provides information about weather, traffic, facilities, routes, obstructions, regulations and procedures.

(8) Record Services - This service provides the required "permanent records" of operations and events.

(9) Ancillary Services - This service provides the special services listed in the present controller's manuals. It includes such things as:

- Weather observation
- Military flight handling
- Transborder flight handling
- Search and rescue coordination

(10) Emergency Services - These are services provided in response to air failures. The services are provided in the event of either:

- Controllable emergencies - those during which the aircraft can respond to control instructions, or can carry out established procedures applicable to the emergency situation.
- Uncontrollable emergencies - those during which neither control instructions nor established procedures can be implemented.

3.0 TOP-LEVEL FUNCTIONS

During Phase A, 15 ATM functions and 53 subfunctions were identified and described. Attempts to map those functions and subfunctions onto the services listed in the preceding section revealed that; although it could be done, certain redrawing of the functional lines would provide a much cleaner relationship. Consequently, the functional information was re-ordered into 17 functions and 60 subfunctions.

The 17 functions resulting from the reordering are described in this section of the report. They are:

- Function 1.0: Provide Flight Planning Information - provides requested information to the pilot to be used in the preliminary planning for a flight. (Similar information is also provided during the development of a flight plan - see Prepare Flight Plan)
- Function 2.0: Control Traffic Flow - matches system demand to system capacity and resolves capacity overload situations.
- Function 3.0: Prepare Flight Plan - accepts a preliminary flight plan from the pilot, assists him in assessing the effects of current operational, environmental and regulatory factors on his intentions, and in compiling a flight plan to submit for approval.
- Function 4.0: Process Flight Plan - reviews the flight plan developed in Function 3 and accepts, rejects, or modifies it appropriately.
- Function 5.0: Issue Clearance and Clearance Changes - issues appropriate clearances and clearance changes to controlled aircraft.
- Function 6.0: Monitor Aircraft Progress - maintains a continuous record of aircraft position and capability; predicts future positions and ETAs of the aircraft.
- Function 7.0: Maintain Conformance with Flight Plan - checks for actual and predicted deviations from flight plan and resolves them; detects and resolves long-term conflicts among flight plans.
- Function 8.0: Assure Separation of Aircraft - predicts and resolves short-term conflicts between aircraft.

- Function 9.0: Control Spacing of Aircraft - provides sequencing and scheduling of aircraft to promote efficient use of airspace and facilities.

- Function 10.0: Provide Airborne, Landing, and Ground Navigation Capability - provides signals or other detectable phenomena that can be used for onboard determination of the aircraft's position.

- Function 11.0: Provide Aircraft Guidance - vectors the aircraft to some intended position.

- Function 12.0: Provide Flight Advisories and Instructions - provides information to the pilot during all flight phases except preflight planning.

- Function 13.0: Handoff - effects transfers of responsibility for the performance of ATM functions between ATM jurisdictions or between an ATM jurisdiction and an aircraft.

- Function 14.0: Maintain System Records - compiles and stores system records; prepares operational, statistical and special reports.

- Function 15.0: Provide Ancillary and Special Services - provides the non-routine or special services presently listed in the controller's manuals.

- Function 16.0: Provide Emergency Services - provide appropriate services in response to air failures.

- Function 17.0: Maintain System Capability and Status Information - maintain, for use by other system functions, an up-to-date body of information regarding the status of the airspace and the capability and status of the ATM system.

3.1 SERVICES-FUNCTIONS RELATIONSHIPS

In some cases there is a direct, and readily apparent, relationship between a function and a corresponding service. For example, Function 1.0, Provide Flight Planning Information and Service 7, Information Services, or Function 14.0, Maintain System Records and Service 8, Record Services. In other cases the relationship is not so obvious.

The relationships between services and functions is shown in Table 3.1-I. Services are listed along the abscissa of the matrix and functions along the ordinate. If a function supports a service, this fact is indicated by one or more of the following symbols in the appropriate cell.

- I - the function produces information needed to provide the service
- D - the function produces decisions needed to provide the service
- A - the function produces actions by which the service is implemented.

In only one case is a service wholly provided by only one function. That case is Service 5, Airborne, Landing and Ground Navigation, which is served by Function 10, Provide Airborne, Landing and Ground Navigation Capability. However, seven of the seventeen functions contribute to only one service. These are:

- Function 2, Control Traffic Flow, which supports Service 1, Airport/Airspace Use Planning
- Function 7, Maintain Conformance with Flight Plan, which supports Service 2, Flight Plan Conformance
- Function 8, Assure Separation of Aircraft, which supports Service 3, Separation Assurance
- Function 9, Control Spacing of Aircraft, which supports Service 4, Spacing Control
- Function 10, Provide Airborne, Landing, and Ground Navigation Capability, which supports Service 5, Airborne, Landing and Ground Navigation
- Function 13, Handoff, the requirement for which is imposed by the ATM system organization rather than any of the services, really supports no service although handoff information is provided to Service 8, Record Services

Table 3.1-I. Function Performance Required to Provide ATM Services

FUNCTIONS \ SERVICES	1. Airport/airspace use planning	2. Flight plan conformance	3. Separation assurance	4. Spacing control	5. Airborne, landing and ground nav.	6. Flight advisory services	7. Info services (flight planning)	8. Record services	9. Ancillary services	10. Emergency services
1. Provide flight planning information							IDA	I		
2. Control traffic flow	IDA	I		I						
3. Prepare flight plan	I						I		I	
4. Process flight plan	I	IDA	I	I		I		I		I
5. Issue clearances & clearance changes		IDA		IDA				I		
6. Monitor aircraft progress		I	I	I				I	I	ID
7. Maintain conformance with flight plan	I	IDA	I	I				I		
8. Assure separation of aircraft		I	IDA	I				I		
9. Control spacing of aircraft	I	I		IDA						
10. Provide airborne, landing and ground navigation capability					IDA					
11. Provide aircraft guidance		IDA	IDA	IDA				I		IDA
12. Issue flight advisory & instructions						IDA		I		I
13. Handoff		IDA	IDA	IDA				I		
14. Maintain system records								IDA		
15. Provide ancillary & special services		I	I	I		I		I	IDA	
16. Provide emergency services	I		I	I		I		I		IDA
17. Maintain system capability & status information	I	I	I	I	I	I	I	I	I	I

I = Information
D = Decision
A = Action

- Function 14, Maintain System Records, which supports Service 8, Record Services.

In most cases several functions contribute to a single service and a single function contributes to several services. In two cases a function has what is really an "overhead" role in that it produces information that is used by a considerable member of the other functions in support of a majority of the services. These two cases are Function 6.0, Monitor Aircraft Progress, and Function 17.0, Maintain System Capability and Status Information.

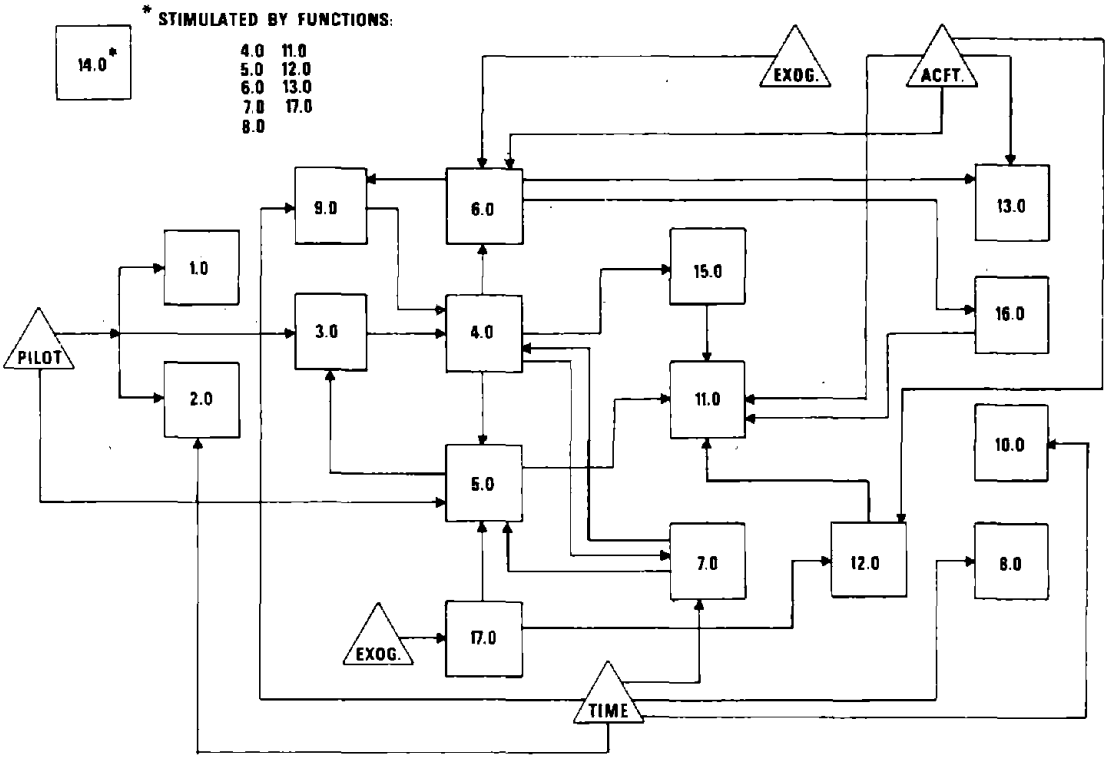
3.2 INTER-FUNCTION RELATIONSHIPS

Inter-function relationships are established by the flow of information among the functions and the sequence of function performance. The flow of information is invariant - that is, a specified input always comes from the same function. On the other hand, the functions that are performed and the sequence of performance is a product of the air traffic scenario - that is, of what the aircraft are doing.

Figure 3.2-1 is a simplified top-level diagram showing the ATM functions in a sequential relationship based on function stimulus. It should be emphasized that this diagram is not a complete representation of how information flows within the ATM system. The lines show where the information that stimulates a function originates. Therefore, there are some functions from which no lines exit. Those functions do not stimulate the performance of other functions, they stimulate activities on-board the aircraft or within an exogenous source. Of course, those activities may, in turn, stimulate other functions. This diagram is intended to provide a simplified overview of the ATM system at the function level and to serve as an introduction to the more detailed diagrams presented in subsequent sections of this report.

Table 3.2-I and Figure 3.3-1 (Page 3.3-43) deal with all input-output information, supplemental data as well as function stimuli. Table 3.2-I summarizes the inter-function flow of information. Figure 3.3-1 identifies the inputs and outputs of each function and shows their sources and destinations. It illustrates the profusion of information that flows within the Air Traffic Management system, and the complex flows patterns, even at the function level. Processes (functions) are shown as rectangles and information inputs and outputs as ovals. The triangles are connector symbols. The source of an input or the destinations of an output are identified by the function numbers within the triangles.

Figure 3.3-1, like all other fold-outs in this report, has been placed following all text directly related to it. This makes it easier to refer to the figure while the related function descriptions in Section 3.3 are being read.



1.0: PROVIDE FLIGHT PLANNING INFORMATION
2.0: CONTROL TRAFFIC FLOW
3.0: PREPARE FLIGHT PLAN
4.0: PROCESS FLIGHT PLAN
5.0: ISSUE CLEARANCES AND CLEARANCE CHANGES
6.0: MONITOR AIRCRAFT PROGRESS
7.0: MAINTAIN CONFORMANCE WITH FLIGHT PLAN
8.0: ASSURE SEPARATION OF AIRCRAFT
9.0: CONTROL SPACING OF AIRCRAFT
10.0: PROVIDE AIRBORNE, LANDING AND GROUND NAVIGATION CAPABILITY
11.0: PROVIDE AIRCRAFT GUIDANCE
12.0: ISSUE FLIGHT ADVISORIES AND INSTRUCTIONS
13.0: HANDOFF
14.0: MAINTAIN SYSTEM RECORDS
15.0: PROVIDE ANCILLARY AND SPECIAL SERVICES
16.0: PROVIDE EMERGENCY SERVICES
17.0: MAINTAIN SYSTEM CAPABILITY AND STATUS INFORMATION

FIGURE 3.2-1. TOP-LEVEL DIAGRAM SHOWING SOURCES OF FUNCTION STIMULI

Table 3.2-I. Inter-Function Information Flow

FROM	TO																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Pilot	Acft	Exog	End
1																		✓			
2				✓	✓				✓			✓	✓					✓			✓
3				✓																	✓
4			✓		✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓			✓
5			✓				✓	✓	✓		✓			✓		✓		✓			
6				✓	✓		✓	✓	✓		✓	✓	✓	✓		✓	✓		✓		
7				✓	✓									✓		✓	✓		✓		✓
8														✓					✓		✓
9				✓	✓																✓
10																			✓		
11														✓		✓			✓		✓
12											✓			✓		✓			✓		✓
13					✓									✓							✓
14																				✓	✓
15				✓				✓			✓	✓					✓		✓		✓
16					✓		✓				✓	✓							✓	✓	✓
17	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			✓	✓	✓
Pilot	✓	✓	✓	✓																	
Acft					✓	✓	✓	✓			✓	✓			✓	✓	✓				
Exog	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				

3.3 FUNCTION DESCRIPTIONS

The 17 generic Air Traffic Management functions are described in this section of the report. These descriptions, together with Figure 3.2-1 represent the first, or top, level of the function analysis.

The descriptions are recorded in a standard format which consists of the following items:

FILE: Each function, subfunction, and task is assigned an hierarchical number. For example, the first function is Function 1.0, its first subfunction is Subfunction 1.1, and its first task is Task 1.1.1.

FUNCTION: The name of the function.

OUTPUTS: Those information products (produced by the function) that go to a destination outside the function. A product produced by a function for its own use, and which is not an input to any other function or to a user outside the system, is not considered an output of that function.

DESCRIPTION: Consists of

Purpose: Reason for performing the function; why it is necessary.

Stimulus: A statement of whether the function is time-stimulated or event-stimulated. If event-stimulated, the stimulating event is identified.

Subfunctions:

Those subprocesses that must be performed to accomplish the function. (These, in turn, are described at the subfunction level of the analysis.)

Critical Performance Parameters:

Those factors, such as accuracy, timeliness, etc., which impose severe or critical requirements on function performance.

INPUTS: The items of data that the function processes to produce its outputs.

FUNCTION DESCRIPTION

FILE: 1.0
FUNCTION: Provide Flight Planning Information

OUTPUTS:

(1) Displayed flight planning information

(2) Transmitted flight planning information

DESCRIPTION:

Purpose: To receive requests for flight planning information, determine the required information, and display or transmit the information to the requester*

Stimulus: Event-stimulated by receipt of a request for flight planning information

Subfunction:

(1) Receive requests for flight planning information

(2) Select information to service the request

(3) Format and display the requested information

Critical Performance Parameters:

(1) Flexibility

(2) Capacity

(3) Availability

(4) Completeness

(5) Utility

(6) Validity

Allocation Sensitivities:

INPUTS:

(1) From pilot:

- Request for flight planning information

* Flight planning information is also provided in Function 3.0 as an integral part of the process of preparing and submitting a flight plan.

(2) From exogneous source:

- Message format (for response)

(3) From Function 17.0, Maintain System Capability and Status:

- Printouts
- Voice tapes
- Electronic displays
- Stored weather sequences
- Stored severe weather phenomena data
- Stored weather forecasts
- Stored route summaries
- Stored weather charts
- Request for PIREP
- Stored data base item (rules and procedures)
- Stored data base item (route information)
- Stored data base item (hazards to flight)
- Stored data base item (COMM-NAV system status)
- Stored data base item (ground facilities status)
- Stored user class data base item
- Stored traffic data

FUNCTION DESCRIPTION

FILE: 2.0
FUNCTION: Control Traffic Flow

OUTPUTS:

(1) Deleted reservation

(2) Reservation disapproval with alternate available times

(3) Confirmed reservations

(4) Terminal/jurisdiction total demand as a function of time

(5) Terminal delays

(6) Terminal release quotas

(7) Enroute jurisdiction release quotas

(8) No capacity overload

DESCRIPTION:

Purpose: To determine the volume of traffic which various segments of the system can accept, and to establish directives to prevent system overload

Stimulus: Time-stimulated and event-stimulated by user request

Subfunctions:

(1) Determine system capacity

(2) Determine system demand

(3) Determine and resolve capacity overload situations

Critical Performance Parameters:

(1) Accuracy

(2) Capacity

(3) Completeness

(4) Flexibility

(5) Validity

Allocation Sensitivities:

INPUTS:

(1) From exogenous source:

- Flow control paradigm
- Time stimulus
- List of terminals/jurisdictions in ATM system
- Commercial schedules

(2) From the pilot:

- User request to establish or cancel reservation

(3) From Function 17.0, Maintain System Capability and Status Information:

- Stored weather sequences
- Stored severe weather phenomena data
- Stored route summaries
- Stored weather forecasts
- Stored data base items

  (rules and procedures)

  (ground equipment)

  (flight hazards)

  (airspace restrictions)

FUNCTION DESCRIPTION

FILE: 3.0
FUNCTION: Prepare Flight Plan

OUTPUTS:
(1) Cancel flight plan

(2) Submitted flight plan

DESCRIPTION:

Purpose: To develop a statement of intent to use the air traffic system and a request for approval to use the airspace

Stimulus: Event-stimulated by a decision to use the airspace or an intention to proceed to the alternate following a missed approach

Subfunctions:

(1) Develop preliminary flight plan

(2) Assess operational, environmental, and regulatory factors

(3) Compile and submit flight plan

Critical Performance Parameters:

(1) Completeness

(2) Flexibility

(3) Validity

(4) Timeliness

(5) Accuracy

Allocation Sensitivities:

INPUTS:
(1) From the pilot:

- Decision to use airspace
- Intentions
- Aircraft capability and status
- Status of onboard equipment

- Pilot qualifications
- Aircraft identification and type

(2) From Function 5.0, Issue Clearance and Clearance Changes:

- Proceeding to alternate

(3) From Function 4.0, Process Flight Plan:

- Changes required to make flight plan acceptable (to ATM)

(4) From Function 17.0, Maintain System Capability and Status Information:

- Stored weather sequences
- Stored weather forecasts
- Stored severe weather phenomena data
- Stored route summaries
- Stored weather charts
- Stored data base item

  (airspace restriction information)

  (route information)

  (ground facility status)

  (rules and procedures)

  (flight hazard information)

  (airspace structure and jurisdictional boundary)

- Stored traffic data

(5) From exogenous source:

- Flight plan format
- Consistency checking paradigm

FUNCTION DESCRIPTION

FILE: 4.0
FUNCTION: Process Flight Plan

OUTPUS:

(1) Intended time-position profile

(2) Priority of proposed flight plan

(3) Information to pilot of flight plan approval

(4) Information to pilot that flight plan is unacceptable and changes to make it acceptable to ATM

(5) Accepted flight plan

(6) Cancellation of the flight plan

(7) Communication links to be used between aircraft and ATM system

(8) Special services required

(9) No special services required

(10) No flight plans that must be modified

DESCRIPTION:

Purpose: The purpose of this function is to review all submitted flight plans (requests for airspace use) and to determine their acceptability in terms of system capacity, level of demand, flight conditions and flight rules. The result of this function is an approved flight plan and distribution of appropriate flight data to ATM jurisdictions (facilities) which will control the flight.

Stimulus: Event-stimulated by receipt of the submitted flight plan or of proposed revisions or modifications

Subfunctions:

(1) Develop intended time-position profile

(2) Review flight plan

(3) Propose modified flight plan

(4) Determine responsibility for control and communication

Critical Performance Parameters:

(1) Accuracy

(2) Capacity

(3) Timeliness

(4) Availability

(5) Completeness

(6) Utility

(7) Flexibility

(8) Validity

Allocation Sensitivities:

INPUTS: (1) From Function 17.0, Maintain System Capability and Status Information:

- Weather sequences
- Weather forecasts
- Route summaries
- Stored data base items

  (rules and procedures)

  (airspace structure and jurisdictional boundary information)

  (route information)

  (airspace restriction information)

  (flight hazards information)

  (COMM-NAV system status)

  (ground facilities status)
- Stored user class data base items
- Stored traffic data

(2) From Function 2.0, Control Traffic Flow:

- Terminal release quotas
- Enroute jurisdiction release quotas

(3) From Function 3.0, Establish Flight Plan:

- Submitted flight plan

(4) From Function 6.0, Monitor Aircraft Progress:

- Correlated position and identification
- Predicted long-range time-position profile

(5) From Function 7.0, Maintain Conformance with Flight Plan:

- Proposed flight plan revision

(6) From Function 9.0, Control Spacing of Aircraft:

- Proposed revised flight plan

(7) From Function 15.0, Provide Ancillary and Special Services:

- Special service no longer required
- New flight plan priority

(8) From exogenous source:

- Approval criteria
- Prioritizing criteria

(9) From pilot:

- Acceptance of flight plan
- Request for cancellation of flight plan

FUNCTION DESCRIPTION

FILE: 5.0
FUNCTION: Issue Clearance and Clearance Changes

OUTPUTS:

(1) Proceeding to alternate

(2) Request approach

(3) Flight plan tolerances

(4) Vectoring requirement

(5) Transmitted clearance

(6) Unable to issue clearance

(7) Issued clearance

DESCRIPTION:

Purpose: To assign an identity code to each aircraft within the ATM, to determine which tolerances are to be applied to a flight plan, to specify the conflict free portion of an intended time-position profile, to determine the instructions needed to amplify or explain the clearance action being taken, and to transmit a clearance message to the aircraft and assure that it is received and accepted

Stimulus: Event-stimulated by an accepted flight plan, execution of a missed approach, sequencing performance changes, present out-of-tolerance deviations, status of nav-aids directly affecting the flight, and pilot request for deviation from clearance

Subfunctions:

(1) Check clearance status

(2) Determine clearance to be ussued

(3) Issue clearance and clearance changes

Critical Performance Parameters:

(1) Timeliness

(2) Completeness

(3) Accuracy

(4) Availability

(5) Validity

Allocation Sensitivities:

(1) To the speed and timeliness with which the outputs of the task are required for further clearance operations

(2) To the work loads of the ATC clearance process and the speed with which the tasks has to be completed

INPUTS:

(1) From exogenous source:

- Identification code usage procedures
- Time stimulus
- Identity code paradigm
- Terminated code assignments
- Clearance format

(2) From Function 2.0, Control Traffic Flow:

- Terminal release quotas
- Enroute jurisdiction release quotas

(3) From Function 4.0, Process Flight Plan:

- Accepted flight plan

(4) From Function 6.0, Monitor Aircraft Progress:

- Long-range predicted time-position profile
- Correlated position and identification
- Readiness of aircraft

(5) From Function 7.0, Maintain Conformance with Flight Plan:

- Present out-of-tolerance deviations
- Pilot preference to return to flight plan
- Pilot preference for a revised flight plan
- Flight plan is conflict free until _____
- Conflicts identified by location, time, and aircraft involved

(6) From Function 13.0, Handoff:

- Handoff not acceptable
- Responsible facility
- Functions transferred
- Communication channel

(7) From Function 16.0, Provide Emergency Services:

- Emergency ended
- Emergency flight plan
- Revised emergency flight plan

(8) From Function 17.0, Maintain System Capability and Status Information:

- Rules and procedures data base item
- COMM-NAV system status data base item
- Stored weather sequences
- Stored weather forecasts
- Route information data base item
- User class data base item

(9) From aircraft:

- Pilot response
- No response
- Request for deviation from clearance
- Intentions

(10) From Function 9.0, Control Spacing of Aircraft:

- Performance necessary to implement sequenced change

FUNCTION DESCRIPTION

FILE: 6.0
FUNCTION: Monitor Aircraft Progress

OUTPUTS:

(1) Identity request

(2) Correlated position and identification

(3) Updated actual time-position profile

(4) Short-range predicted time-position profile

(5) Long-range predicted time-position profile

(6) Readiness of the aircraft

(7) Description of emergency

(8) Emergency ended

(9) Current aircraft status

(10) Current aircraft capability

DESCRIPTION:

Purpose: To produce and maintain aircraft identity, present position, short and long-range predicted positions, readiness, capabilities, and descriptions of emergency situations

Stimulus: Event-stimulated by receipt of identification and/or position data, or by entry of an aircraft into the system

Subfunctions:

(1) Determine present position

(2) Compile aircraft time-position profile

(3) Predict future positions/ETAs of the aircraft

(4) Determine aircraft capability and status

Critical Performance Parameters:

(1) Timeliness

(2) Completeness

(3) Validity

(4) Capacity

(5) Utility

Allocation Sensitivities:

To the nature (electronic or voice) of the incoming position and identification reports

INPUTS:

(1) From the aircraft or exogenous:

- Electronic position and identification reports
- Voice position and identification reports

(2) From exogenous:

- Aircraft position
- Request message format
- Rate of performance change

(3) From Function 4.0, Process Flight Plan:

- Intended time-position profile
- Accepted flight plan

(4) From Function 17.0, Maintain System Capability and Status Information:

- Stored weather sequences
- Stored weather forecasts
- Stored user class data base item

(5) From aircraft:

- No response
- Report of changes in aircraft or equipment status
- Report of emergency situation
- Report of readiness
- Report of aircraft capability change

FUNCTION DESCRIPTION

FILE: 7.0
FUNCTION: Maintain Conformance with Flight Plan

OUTPUS:

(1) Flight plan is conflict free until _____

(2) Conflicts identified by location, time, and aircraft involved

(3) Proposed flight plan revision (to correct long-term conflicts)

(4) Closed flight plan

(5) All deviations are within tolerance

(6) Present deviations (x, y, h and t) which exceed tolerance

(7) Pilot's preference for a revised flight plan

(8) Proposed flight plan revision (to correct out-of-tolerance deviations)

(9) Proposed revisions to emergency flight plan

(10) Short-range predicted deviations (x, y, and h) which exceed tolerances

(11) Long-range predicted deviations (t) which exceed tolerances

(12) Message to pilot (informing of out-of-tolerance deviations)

(13) Request for pilot's preference regarding resolutions of deviations

(14) Pilot's preference to return to flight plan

DESCRIPTION:

Purpose: To check flight plans against each other to reveal any long-term conflicts, to determine any present or predicted deviations from flight plan, and to determine resolutions of those deviations

Stimulus: Initially event-stimulated by receipt of flight plan; subsequently time-stimulated

Subfunctions:

(1) Detect long-term conflicts among flight plans

(2) Determine current deviations from flight plans

(3) Predict deviations from flight plan

(4) Determine appropriate resolution of deviations

Critical Performance Parameters:

(1) Timeliness

(2) Accuracy

(3) Capacity

(4) Flexibility

(5) Validity

Allocation Sensitivities:

INPUTS:

(1) From Function 4.0, Process Flight Plan:

- Accepted flight plan
- Flight plan priority
- Communication links between ATM and aircraft

(2) From Function 5.0, Issue Clearance and Clearance Changes:

- Flight plan tolerance limits

(3) From Function 6.0, Monitor Aircraft Progress:

- Actual time-position profile
- Short-range predicted time-position profile
- Long-term predicted time-position profile
- Correlated position and identification

(4) From Function 16.0, Provide Emergency Services:

- Emergency flight plan
- Revised emergency flight plan
- Emergency ended

(5) From exogenous source:

- Time stimulus
- System capacity to perform Function 7.0

(6) From aircraft:

- Statement of preference for correction back to flight plan
- Statement of preference for revision of flight plan

(7) From Function 17.0, Maintain System Capability and Status Information:

- Active flight plan count

FUNCTION DESCRIPTION

FILE: 8.0
FUNCTION: Assure Separation of Aircraft

OUTPUTS:

(1) High imminence conflict pairs

(2) No action required

(3) Careful monitoring required

(4) Performance correction required

(5) Transmitted performance change message

(6) Transmission required

(7) Revision required (of performance change message)

(8) Revision not required

(9) Action classification updated

DESCRIPTION:

Purpose: To assure separation of aircraft by predicting and resolving conflicts

Stimulus: Time-stimulated

Subfunctions:

(1) Predict conflicts

(2) Resolve conflicts

Critical Performance Parameters:

(1) Speed

(2) Accuracy

(3) Capacity

(4) Timeliness

(5) Completeness

(6) Utility

(7) Validity

Allocation Sensitivities:

INPUTS:

(1) From exogenous source:

- Time stimulus
- Designation of airspace volumes for conflict detection
- Designation of time intervals for conflict detection
- Path probability paradigm
- Update cycle time

(2) From Function 6.0, Monitor Aircraft Progress:

- Predicted short-range time-position profile for the aircraft
- Predicted long-range time-position profile for the aircraft
- Current aircraft capability (includes performance capability and user class)

(3) From Function 15.0, Provide Ancillary and Special Services:

- Definition of special separation minima
- Special service no longer required

(4) From the aircraft:

- Acknowledgement (of performance change message)

(5) From Function 17.0, Maintain System Capability and Status Information:

- Stored data base item (rules and procedures - minimum separation standards)

(6) From Function 5.0, Issue Clearance and Clearance Changes:

- Clearance issued

FUNCTION DESCRIPTION

FILE: 9.0
FUNCTION: Control Spacing of Aircraft

OUTPUTS:

(1) Acceptable distribution (spacing not required)

(2) No ETA/ETD changes required

(3) Performance necessary to implement sequence change

(4) Revised flight plan

DESCRIPTION:

Purpose: The purpose of this function is to control the traffic handling capability of an airport by scheduling arrivals and departures so that the maximum efficient use is made of terminal airways and runways

Stimulus: Time-stimulated, and event-stimulated by additions to the predicted arrival departure schedule

Subfunctions:

(1) Maintain predicted arrival/departure schedule for each airport

(2) Determine requirement for spacing control

(3) Establish runway configuration schedule

(4) Determine most efficient arrival and departure sequence/schedule for runway

(5) Initiate implementation of sequence/schedule

Critical Performance Parameters:

(1) Timeliness

(2) Accuracy

(3) Validity

Allocation Sensitivities:

INPUTS:

(1) From Function 2.0, Control Traffic Flow:

- Terminal/jurisdictional total demand as a function of time

(2) From Function 4.0, Process Flight Plan:

- Priority of the proposed flight plans
- Accepted flight plan

(3) From Function 5.0, Issue Clearance and Clearance Changes:

- Flight plan tolerances
- Request approach

(4) From Function 6.0, Monitor Aircraft Progress:

- Predicted short-range time-position profile for the aircraft
- Predicted long-range time-position profile for the aircraft
- Current aircraft capability (includes performance capability and user class)

(5) From Function 17.0, Maintain System Capability and Status Information:

- Stored weather sequences
- Stored weather forecasts
- Stored data base items

  (rules and procedures - minimum allowable separation)

  (ground facilities status)
- Stored user class data-base items

(6) From exogenous source:

- Baseline capacity
- Time stimulus
- Criteria of excess demand and slack

FUNCTION DESCRIPTION

FILE: 10.0
FUNCTION: Provide Airborne, Landing and Ground Navigation Capability

OUTPUTS:

(1) Enroute navigation signals

(2) Landing navigation signals

(3) Ground navigation signals

DESCRIPTION:

Purpose: To provide signals which can be sensed on board the aircraft and used to determine aircraft position

Stimulus: Time-stimulated (continuous)

Subfunctions:

(1) Produce and transmit enroute navigation signals

(2) Produce and transmit landing navigation signals

(3) Produce and transmit ground navigation signals

Critical Performance Parameters:

(1) Accuracy

(2) Timeliness

Allocation Sensitivities:

INPUTS: The specific inputs are a function of the implementation chosen for the navigation subsystem but consist of some form of the following from exogenous sources:

- Geographic location of the nav aid
- A time reference
- The navigation system structure

Note: The airborne, landing and ground navigation service provides a position location capability which is available for use by the aircraft. It does not determine an aircraft's position, merely provides signals which may be used onboard the aircraft to make that determination. These signals are produced and transmitted by the function

equipment. Their production places no demands on the "controllers". This results in the "function" which produces that service being considerably different from the other ATM functions.

This function does not utilize inputs produced by the other functions, nor produce outputs used by them. It does not require a series of man-machine interactions to produce the service provided.

There are, of course, monitoring, calibration, and maintenance tasks which must be performed. However, monitoring to determine if the function equipment is operating properly has been included with similar tasks in Function 17.0, Maintain System Capability and Status Information. The nature of calibration and maintenance activities are a function of system implementation. They are not generic air traffic management activities. Therefore, the analysis of Function 10.0 has not been extended to the subfunction level.

FUNCTION DESCRIPTION

FILE: 11.0
FUNCTION: Provide Aircraft Guidance

OUTPUTS:

(1) Vectoring not required

(2) Transmitted vectoring message

(3) Responding as commanded

(4) Not responding as commanded, retransmit

(5) Not responding as commanded, declare emergency

DESCRIPTION:

Purpose: The purpose of this function is to provide aircraft guidance by computing and implementing vectors

Stimulus: Event-stimulated by receipt of:

- A request for vectoring from the pilot as a result of a hazardous weather warning
- A pilot-initiated vectoring request
- Vectoring instructions as a result of a clearance
- Description of guidance assistance required (special services)
- Description of guidance required (emergency)

Subfunctions:

(1) Initiate/terminate guidance

(2) Compute vector requirements

(3) Compute air vectors

(4) Compute guidance commands

(5) Compile and transmit guidance instructions

Critical Performance Parameters:

(1) Accuracy

(2) Timeliness

(3) Speed

(4) Validity

(5) Completeness

Allocation Sensitivities:

INPUTS:

(1) From Function 6.0, Monitor Aircraft Progress:

- Correlated position and identification

(2) From Function 17.0, Maintain System Capability and Status Information:

- Stored weather sequences
- Stored weather forecasts
- Stored severe weather phenomena data
- Stored data base items (flight hazards information)

(3) From Function 16.0, Provide Emergency Services:

- Description of guidance assistance required

(4) From Function 15.0, Provide Ancillary and Special Services:

- Description of guidance assistance required

(5) From Function 5.0, Issue Clearance and Clearance Changes:

- Vectoring requirement

(6) From Function 12.0, Provide Flight Advisories and Instruction:

- Vectoring desired

(7) From aircraft:

- Vectoring request
- Heading
- Airspeed
- Vertical speed

(8) From exogenous source:

- Vectoring message format

FUNCTION DESCRIPTION

FILE: 12.0
FUNCTION: Provide Flight Advisories and Instruction

OUTPUTS:

(1) Acknowledgement of pilot request (for information)

(2) Information requested not available

(3) Transmitted performatted advisory message

(4) Transmitted special response

(5) Transmitted message to pilot

(6) Vectoring desired

(7) No vectoring desired

(8) No applicable aircraft (i.e., no aircraft need the information)

(9) No response

DESCRIPTION:

Purpose: To provide the pilot with the information essential to the safe and orderly conduct of the flight

Stimulus: Event-stimulated by receipt of pilot's request for information, or by receipt of preformatted data modules or severe weather phenomena data from Function 17.0

Subfunctions:

(1) Service requests for information

(2) Issue flight advisories and instructions

(3) Notify pilot of imminent encounter with hazardous weather phenomenon

Critical Performance Parameters:

(1) Availability

(2) Completeness

(3) Flexibility

(4) Accuracy

(5) Validity

(6) Timeliness

(7) Speed

Allocation Sensitivities:

INPUTS:

(1) From Function 17.0, Maintain System Capability and Status Information:

- Stored weather sequences
- Stored weather forecasts
- Stored data base items

  (rules and procedures)

  (route information)

  (airspace restrictions information)

  (hazards to flight information)

  (COMM-NAV system status)

  (ground facilities status)
- Stored user class data base item
- Stored traffic data
- Printouts (NOTAMS)
- Voice tapes
- Electronic displays

(2) From Function 4.0, Process Flight Plan:

- Accepted flight plan

(3) From Function 6.0, Monitor Aircraft Progress:

- Correlated position and identification
- Short-range predicted time-position profile for the aircraft

(4) From exogenous source:

- Response message format
- Acknowldegement message format
- Flight advisory distribution paradigm
- Advisory priority distribution paradigm
- Alert message format
- Time stimulus

(5) From the aircraft:

- Pilot information request message
- Pilot's response
- No response

(6) From Function 2.0, Control Traffic Flow:

- Terminal delays

(7) From Function 15.0, Provide Ancillary and Special Service:

- Description of required advisories

(8) From Function 16.0, Provide Emergency Service:

- Description of required technical instructions

FUNCTION DESCRIPTION

FILE: 13.0
FUNCTION: Handoff

OUTPUTS:

(1) Ground to ground handoff not required

(2) No air to ground/ground to air handoff required

(3) Handoff not acceptable

(4) Functions transferred

(5) Responsible facility

(6) Communication channel

DESCRIPTION:

Purpose: To detect the requirement for, and to effect the transfer of responsibility for control of an aircraft between two ground jurisdictions or between the aircraft and a ground jurisdiction

Stimulus: Event-stimulated by pilot's request, or aircraft(s) position in relationship to airspace structure or jurisdictional boundary

Subfunctions:

(1) Determine handoff responsibility requirements

(2) Determine communication channel assignment

(3) Effect transfer of responsibility

Critical Performance Parameters:

(1) Timeliness

(2) Utility

(3) Validity

(4) Flexibility

(5) Availability

(6) Capacity

(7) Accuracy

Allocation Sensitivities:

INPUTS:

(1) From Function 4.0, Process Flight Plan:

- Accepted flight plan

(2) From Function 6.0, Monitor Aircraft Progress:

- Correlated position and identification

(3) From Function 17.0, Maintain System Capability and Status Information:

- Stored weather sequences
- Stored weather forecasts
- Stored data base items

  (rules and procedures)

  (airspace structure and jurisdictional boundary information)

  (route information)

  (airspace restriction information)

  (hazards to flight information)

  (COMM-NAV system status)

(4) From exogenous source:

- Pilot's request (for ground/air handoff)
- Assignment paradigm
- Time stimulus

(5) From Function 2.0, Control Traffic Flow:

- Terminal release quotas
- Enroute jurisdiction release quotas

FUNCTION DESCRIPTION

FILE: 14.0
FUNCTION: Maintain System Records

OUTPUTS:

(1) Operational report not required

(2) Completed statistical or special reports

DESCRIPTION:

Purpose: To maintain flight history information, and to make up operational, statistical and special reports as required

Stimulus: Event-stimulated by any of the listed inputs except "responsible facility", "stored data base item", "classification paradigm", "data base form and format criteria", "data base storage paradigm", "additional required information", or "list of stored formats available"

Subfunctions:

(1) Prepare operational reports

(2) Compile and store system records

(3) Prepare and maintain statistical and special reports

Critical Performance Parameters:

(1) Validity

(2) Utility

(3) Capacity

(4) Completeness

(5) Accuracy

Allocation Sensitivities:

INPUTS:

(1) From Function 4.0, Process Flight Plan:

- Accepted flight plan
- Cancellation of the flight plan
- Communication links to be used between aircraft and ATM system

(2) From Function 5.0, Issue Clearance and Clearance Changes:

- Transmitted clearance

(3) From Function 6.0, Monitor Aircraft Progress:

- Actual time-position profile
- Current aircraft status
- Current aircraft capability

(4) From Function 7.0, Maintain Conformance with Flight Plan:

- Conflicts identified by location, time and aircraft involved
- Closed flight plan
- Present out-of-tolerance deviations from flight plan (x, y, h and t)
- Short-range predicted out-of-tolerance deviations from flight plan (x, y, and h)
- Long-range predicted out-of-tolerance deviations from flight plan (t)
- Statement from pilot that he prefers correction of performance in order to return to existing flight plan
- Statement from pilot that he prefers a revised flight plan

(5) From Function 8.0, Assure Separation of Aircraft:

- High imminence conflict pairs
- Performance correction required
- Careful monitoring required
- Transmitted performance change message
- Transmission required
- Performance change revision required

(6) From Function 11.0, Provide Aircraft Guidance:

- Transmitted vectoring message

- Responding as commanded
- Not responding as commanded, retransmit
- Not responding as commanded, declare emergency

(7) From Function 12.0, Provide Flight Advisories and Instruction:

- Transmitted preformatted message to pilot
- Transmitted specially formatted message to pilot
- Transmitted message (severe weather warning) to pilot
- No response (to severe weather warning)
- Vectoring desired
- No vectoring desired

(8) From Function 13.0, Handoff:

- Responsible facility
- Functions transferred
- Communication channel

(9) From Function 17.0, Maintain System Capability and Status Information:

- Stored data base items (rules and procedures)

(10) From exogenous source:

- Classification paradigm
- Data base form and format criteria
- Data base storage paradigm
- Operational report information
- Additional required information (not in data base)
- Request for special report
- List of stored formats available
- Recurring reports schedule

FUNCTION DESCRIPTION

FILE: 15.0
FUNCTION: Provide Ancillary and Special Services

OUTPUTS:

(1) Special service no longer required

(2) Cease action because of safety

(3) New flight plan priority

(4) Definition of area of restriction

(5) Description of guidance required

(6) Definition of special separation minima

(7) Description of required advisories

(8) Description of NOTAM requirement

(9) No new flight plan priority required

(10) No area of restriction required

(11) No guidance required

(12) Special separation minima not required

(13) Advisories not required

(14) NOTAM not required

DESCRIPTION:

Purpose: To determine the special or ancillary service required and to provide that service

Stimulus: Event-stimulated by request for special services or by a determination that special service is required (Function 4.0) or by information regarding progress of the service

Subfunctions:

(1) Determine nature of service required

(2) Initiate action to provide service

Critical Performance Parameters:

Flexibility

Allocation Sensitivities:

INPUTS:

(1) From Function 4.0, Process Flight Plan:

- Special services required
- Priority of the proposed flight plan

(2) From Function 17.0, Maintain System Capability and Status:

- Stored data base items (rules and procedures)

(3) From the aircraft:

- Request for special service
- Information regarding progress of service

(4) From exogenous source:

- Request for special service
- Information regarding progress of service

FUNCTION DESCRIPTION

FILE: 16.0
FUNCTION: Provide Emergency Services

OUTPUTS:

(1) Information request (for additional information about the emergency)

(2) Description of required technical instructions

(3) Description of guidance assistance required

(4) Assistance instructions (to assisting aircraft)

(5) Emergency ended, assisting aircraft cease assistance

(6) Instructions to provide ground support assistance

(7) Instructions to cancel ground support assistance

(8) None required (ground support assistance, assistance from other aircraft, technical instructions, guidance)

(9) Emergency communications link not required

(10) Instructions to change to emergency communications link

(11) Emergency flight plan

(12) Revised emergency flight plan

(13) Emergency ended

DESCRIPTION:

Purpose: To determine the action necessary to resolve an emergency situation and to implement that action

Stimulus: Event-stimulated by receipt of a description of an emergency situation (Function 6.0)

Subfunctions:

(1) Describe emergency situation

(2) Determine required response to emergency

Critical Performance Parameters:

(1) Timeliness

(2) Flexibility

Allocation Sensitivities:

INPUTS:

(1) From the pilot or an exogenous source:

- Additional required information
- Information regarding the progress or status of the emergency

(2) From Function 6.0, Monitor Aircraft Progress:

- Description of emergency situation
- Emergency ended
- Current aircraft capabilities
- Correlated position and identification

(3) From Function 5.0, Issue Clearance and Clearance Changes:

- Unable to issue clearance

(4) From Function 12.0, Provide Flight Advisories and Instruction:

- Information not available

(5) From Function 4.0, Process Flight Plan:

- Accepted flight plan
- Communication links to be used between aircraft and ATM system

(6) From Function 7.0, Maintain Conformance with Flight Plan:

- Proposed revisions to emergency flight plan

(7) From Function 11.0, Provide Aircraft Guidance:

- Not responding as commanded, retransmit

(8) From Function 17.0, Maintain System Capability and Status Information:

- Stored weather sequences
- Stored weather forecasts
- Ground facilities status data base item

FUNCTION DESCRIPTION

FILE: 17.0
FUNCTION: Maintain System Capability and Status Information

OUTPUTS:

(1) Weather observation report not required

(2) Request for PIREP

(3) Transmitted weather observation report

(4) Purged data

(5) Stored data base items

(rules and procedures)

(airspace structure and jurisdictional boundary information)

(route information)

(airspace restriction information)

(flight hazard information)

(COMM-NAV system status)

(ground facilities status)

(6) No change in status

(7) Stored user class data base items

(8) Active flight plan count

(9) ETA's and ETD's by destination and origin

(10) ETOV's by jurisdictional boundry

(11) Stored traffic data

(12) Preformatted data module not required

(13) Printouts (NOTAMS)

(14) Voice tapes

(15) Electronic displays

(16) Stored weather sequences

(17) Stored severe weather phenomena data

(18) Stored weather forecasts

(19) Stored route summaries

(20) Stored weather charts

DESCRIPTION:

Purpose: To update system capability and status information and to provide this information to the other functions as required

Stimulus: Event-stimulated by the receipt of system data, or time-stimulated by schedules for the production of certain outputs

Subfunctions:

(1) Determine current and forecast weather

(2) Update rules and procedures information

(3) Update airspace structure and jurisdictional boundary information

(4) Update route information

(5) Update airspace restriction information

(6) Update hazards to flight information

(7) Determine capability and status of COMM-NAV system

(8) Determine capability and status of ground facilities

(9) Maintain user class information

(10) Compile traffic data

(11) Prepare preformatted data modules

Critical Performance Parameters:

(1) Speed

(2) Accuracy

(3) Capacity

(4) Timeliness

(5) Availability

(6) Renewal rate

(7) Completeness

(8) Utility

(9) Flexibility

(10) Validity

Allocation Sensitivities:

INPUTS: (1) From exogenous sources:

- Time stimulus
- Weather sensors data
- Weather observation report schedule
- Weather observation report criteria
- Weather transmission schedule
- Position and movement of severe weather phenomena
- Weather sequences
- Weather forecasts
- Weather charts
- Weather route summaries
- Rules and procedures change information
- Airspace structure and jurisdictional boundary change information
- Route change information
- Airspace restriction change information
- Hazards to flight change information
- NAV equipment status
- COMM equipment status
- Ground facilities status

- Pilot qualification changes
- Aircraft capability changes
- Avionics changes
- Event counting criteria
- Preformatted data module criteria

(2) From the aircraft:

- PIREPs
- NAV equipment status
- COMM equipment status
- Ground facilities status

(3) From Function 6.0, Monitor Aircraft Progress:

- Correlated position and identification

(4) From Function 4.0, Process Flight Plan:

- Accepted flight plan

(5) From Function 7.0, Maintain Conformance with Flight Plan:

- Closed flight plan

(6) From Function 15.0, Provide Ancillary and Special Services:

- Description of NOTAM requirements
- Definition of area of restriction
- Description of required advisories
- Special service no longer required

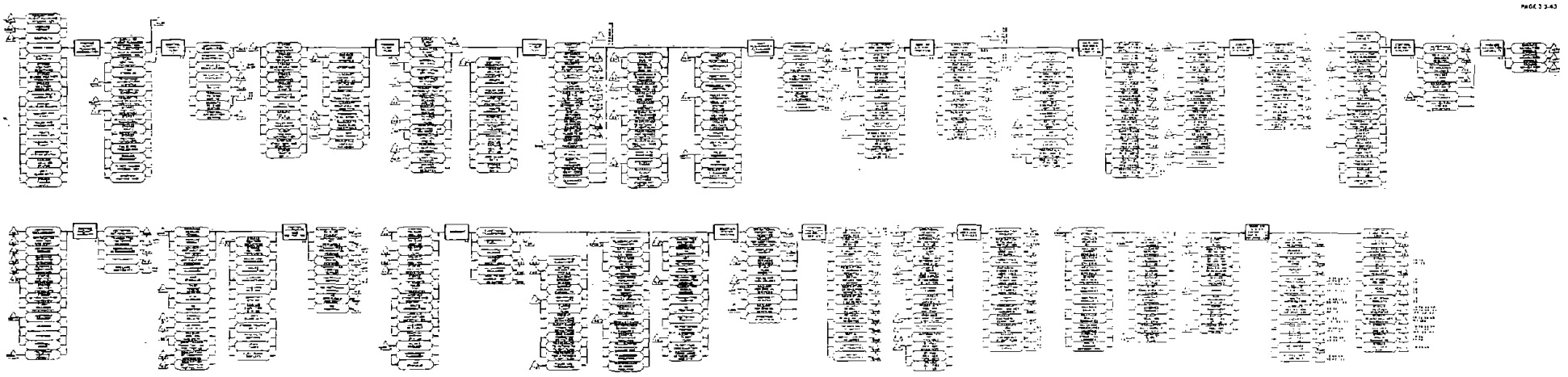


FIGURE 3.3-1 TOP LEVEL ATM FUNCTION DIAGRAM SHOWING INFORMATION FLOW

4.0 SUBFUNCTIONS AND TASKS

The second and third levels of the function analysis are presented in this section of the report. The information presented consists of:

- Subfunction Descriptions - A description of each subfunction listed in the function description sheets in Section 3.3 (These subfunction descriptions are printed on blue paper)
- Task Descriptions - A description of each task listed in the subfunction description sheets
- Detailed Diagrams - A flow chart of each function showing subfunctions, tasks, and the flow of information among the tasks
- Input-Output Tables - A summary of the flow of information to, from, and through each function, identifying each information product and its source and destination

The above information is organized by function. In each case there is a cover sheet that identifies the function; a list of the subfunctions and tasks that make up the function; the subfunction and task descriptions arranged by subfunction; the input-output matrix, and the detailed function diagram.

The subfunction and task descriptions follow a format similar to that used in Section 3.3 for the function descriptions. The subfunction format contains two items not found in the function format: (1) Subfunction, the subfunction title; and (2) Allocation Sensitivities - those system characteristics, concepts, or other potential system decisions that would influence the allocation of the subfunction activities to man or machine. The item which lists the subprocess that must be performed to accomplish the subfunction is entitled Tasks, whereas in the function format it is entitled Subfunction. (A subfunction is composed of tasks in the same way that a function is composed of subfunctions).

The task description format contains four additional items not found in the subfunction format. It is described below in its entirety:

TASK DESCRIPTION

FILE: The three-digit hierarchical number assigned to each task. This consists of the function number, the subfunction number, and the task number (e.g., File 9.4.3 would identify Task 3 of Subfunction 4 of Function 9)

TASK: The task title

SUBFUNCTION: The subfunction title

FUNCTION: The function title

OUTPUTS: The information products produced by the task and which go to other tasks or to destinations outside the system

DESCRIPTION: Consists of -

Purpose: The reason for performing the task

Stimulus: A statement of whether the task is time-stimulated or event-stimulated. If event-stimulated, the stimulating event is identified

Decisions and Actions:

The activities that must be accomplished to perform the task

Phase of Flight:

The phases of flight during which the task must be performed. During Phase B of the study TSC developed a standard list of phases of flight and distributed it to all AATMS contractors. It consists of:

(1) Preflight

(2) Departure taxi

(3) Takeoff

(4) Departure

(5) Departure transition

(6) Enroute CONUS

(7) Enroute oceanic

(8) Arrival transition

(9) Arrival

(10) Approach

TASK DESCRIPTION FORMAT CONTINUED

(11) Landing

(12) Arrival taxi

(13) Postflight

This list with the addition of "Missed Approach" was then used instead of the one described in Section 1.0 that was developed by TRW during Phase A.

Critical Performance Parameters:

Those parameters critical to satisfactory performance of the task, including:

(1) Speed - the rate of accomplishment or the time required to accomplish an activity

(2) Accuracy - the degree of precision inherent in a process plus the error produced in carrying out a process

(3) Capacity - the ability to receive, hold, or accommodate inputs or the ability to carry out transactions

(4) Timeliness - the relation between the time an activity is completed and the preferred or required time of completion

(5) Availability - the existence of a product or capability at the time and place needed

(6) Renewal Rate - the repetition rate of a process

(7) Completeness - the degree to which all elements of a product or process are present

(8) Utility - the degree to which a process or product is useful in meeting needs or objectives

(9) Flexibility - the ability to improvise or respond to diverse or changing motives or constraints

(10) Validity - the correctness or appropriateness of a decision, product, or course of action

TASK DESCRIPTION FORMAT CONTINUED

Performance Capabilities:

The categories of man-machine performance capability required to perform the task. The major categories, the subcategories of each, and some typical examples are listed below:

(1) Monitoring - To maintain a state of readiness or preparation for receipt of input signals pertaining to an operation or condition. Monitoring includes:

- Search
- Surveillance
- Vigilance
- Watch-keeping

Some examples are:

- Listening for messages
- Vigilance for warning signals
- Observation of displays
- Surveillance of traffic patterns

(2) Sensing - To preceive external stimuli, to recognize a change of external state, to acquire data from the environment. Sensing includes:

- Perception
- Signal detection
- Discrimination
- Recognition of discrete change
- Recognition of dynamic change

Some examples are:

- Sensing aircraft position
- Signal/noise discrimination
- Recognition of movement
- Detection of alarm signal

TASK DESCRIPTION FORMAT CONTINUED

(3) Information Processing - To transform, organize, break down, combine, or operate on input data or signals. Information processing includes:

- Encoding/decoding
- Sorting
- Filtering
- Ordering
- Merging
- Analysis
- Calculation

Some examples are:

- Encoding flight data
- Solving navigation equations
- Calculating flight path
- Listing arriving aircraft by ETA

(4) Interpreting - To construe, to derive, to translate, to assign meaning to information, data, or signals. Interpreting includes:

- Pattern recognition
- Interpolation
- Extrapolation
- Prediction
- Association
- Classification

Some examples are:

- Reading flight plans
- Estimating ETA

TASK DESCRIPTION FORMAT CONTINUED

- Conflict prediction
- Weather forecasting

(5) Decision making - To select among alternatives, to determine a course of action, or to assess the validity of a proposition. Decision making includes:

- Hypothesis formulation
- Induction/deduction/inference
- Probability/contingency estimation
- Identification of alternatives
- Comparison of alternatives
- Comparison of temporally different states
- Comparison with standard (criterion reference)
- Selection/choice

Some examples are:

- Flight plan approval
- Path selection
- Compare deviations with tolerances
- Propose change to flight plan

(6) Storing and retrieving information - To retain or to remain aware of information and conversely, to recall or to bring forth previously acquired information. Storing and retrieving information includes:

- Short-term memory
- Long-term memory
- Total retrieval/recall
- Selective retrieval/recall
- Purging

TASK DESCRIPTION FORMAT CONTINUED

Some examples are:

- Retention of instructions
- Accumulation of flight history
- Remembering call sign
- Recall of procedures/rules

(7) Responding - To take or to effect action, to transfer information. Responding includes:

- Operation of controls
- Regulation of processes
- Communication
- Display
- Data transmission

Some examples are:

- Enter data by keyboard
- Give oral instructions
- Manipulate aircraft controls
- Generate visual display

Allocation Sensitivities:

Those system characteristics, concept, or other potential system decisions that would influence the man-machine allocation of the task. It is possible that a task would be automated under one implementation concept but manual under another (e.g., use of data link vs voice reports). In some case, a task might not exist under certain concepts. The objective is to flag those tasks which may need to be reallocated depending on the concept implemented.

External Constraints:

Any unusual external factor, condition, or contingency that acts as a limiting factor on, or influences the adequacy of, task performance. (As it was used during the analysis, this item produced very little useful information).

INPUTS: The items of data that the task processes to produce its outputs.

The detailed function diagrams show the subfunctions, tasks, information products, and flow of information among the tasks. Tasks are shown as rectangles and are identified by title (within the rectangle) and file number (below the rectangle). Information products (inputs and outputs) are shown as ovals and the flow of information is indicated by solid lines with arrows and small circular routing symbols.

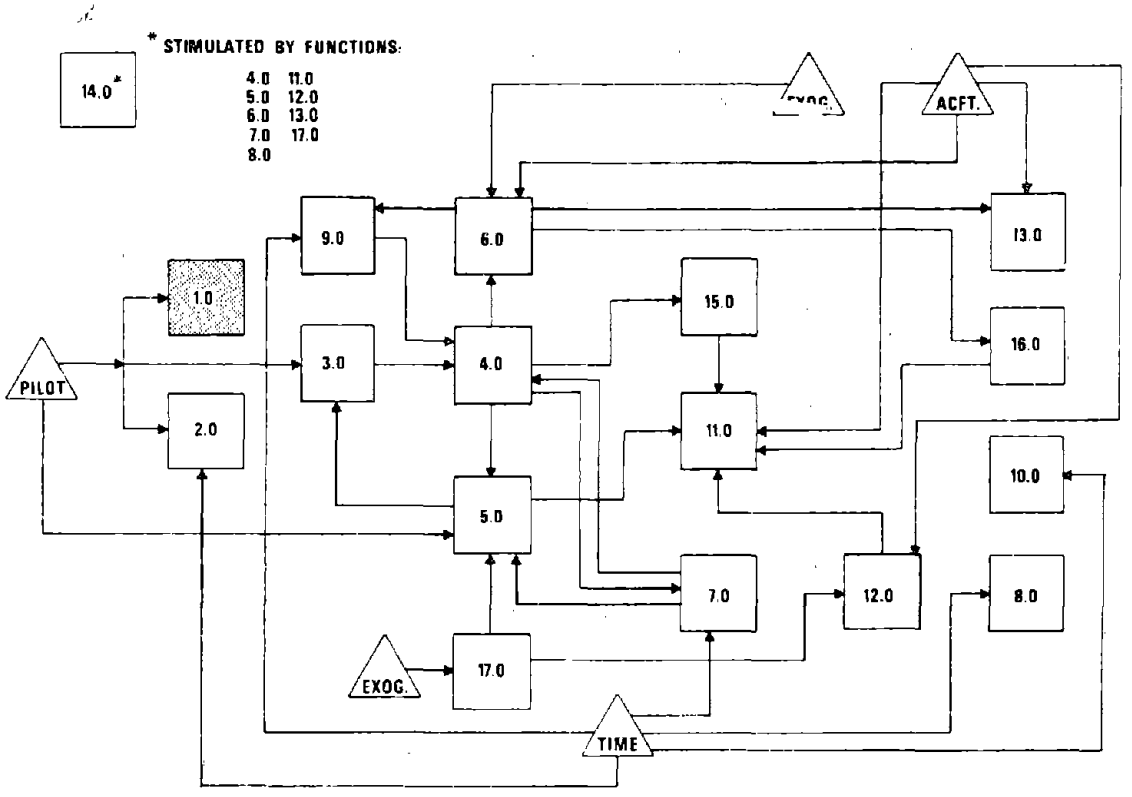
Three routing symbols are used. The "And" symbol is a dot within a circle. It indicates that each time a preceding function is performed it produces all of the outputs to which the lines exiting from the circle lead; or that each time the next succeeding function is performed it requires all of the inputs which flow into the circle. The "Or" symbol is a hyphen within a circle. It indicates that each time a preceding function is performed it produces only one of the outputs to which the lines exiting from the circle lead; or that each time the next succeeding function is performed it requires only one of the inputs which flow into the circle. The "Any" symbol is a plus within a circle. It indicates that each time a preceding function is performed it may produce any number (from one to all) of the outputs to which the lines exiting from the circle lead; or that each time the next succeeding function is performed it may use any number of the inputs which flow into the circle.

Two kinds of connector symbols are used. The triangles containing task numbers identify the tasks which are the source or destination of an information product. It is used when that task is located in some remote section of the diagram. The circles containing letters of the alphabet indicate page-to-page connections.

The tasks and information products which compose each subfunction are enclosed within large boxes constructed of dashed lines. The subfunction title and file number are placed in the upper left-hand corner of the box.

The input-output tables are summaries of the flow of information to, from, and within each function. The information flow is summarized by task. The identity and source of each input required by the task, and the identity and destinations of each output produced by the task are listed.

FUNCTION 1.0: PROVIDE FLIGHT PLANNING INFORMATION



1.0: PROVIDE FLIGHT PLANNING INFORMATION
2.0: CONTROL TRAFFIC FLOW
3.0: PREPARE FLIGHT PLAN
4.0: PROCESS FLIGHT PLAN
5.0: ISSUE CLEARANCES AND CLEARANCE CHANGES
6.0: MONITOR AIRCRAFT PROGRESS
7.0: MAINTAIN CONFORMANCE WITH FLIGHT PLAN
8.0: ASSURE SEPARATION OF AIRCRAFT
9.0: CONTROL SPACING OF AIRCRAFT
10.0: PROVIDE AIRBORNE, LANDING AND GROUND NAVIGATION CAPABILITY
11.0: PROVIDE AIRCRAFT GUIDANCE
12.0: ISSUE FLIGHT ADVISORIES AND INSTRUCTIONS
13.0: HANDOFF
14.0: MAINTAIN SYSTEM RECORDS
15.0: PROVIDE ANCILLARY AND SPECIAL SERVICES
16.0: PROVIDE EMERGENCY SERVICES
17.0: MAINTAIN SYSTEM CAPABILITY AND STATUS INFORMATION

1.0 PROVIDE FLIGHT PLANNING INFORMATION

- 1.1 Receive Requests for Flight Planning Information
  - 1.1.1 Accept data link request
  - 1.1.2 Accept telephone request
  - 1.1.3 Enter request into system
- 1.2 Select Information to Service the Request
  - 1.2.1 Select preformatted reply
  - 1.2.2 Retrieve information requested
- 1.3 Format and Display the Requested Information
  - 1.3.1 Compile non-preformatted response
  - 1.3.2 Display information requested
  - 1.3.3 Transmit requested information via telephone

SUBFUNCTION DESCRIPTION

FILE: 1.1
SUBFUNCTION: Receive Requests for Flight Planning Information
FUNCTION: Provide Flight Planning Information

OUTPUTS:

(1) Category of information requested

(2) Location or geographic area

DESCRIPTION:

Purpose: To receive and enter into the system pilot's request for flight planning information

Stimulus: Event-stimulated by receipt of a request for flight planning information

Tasks:

(1) Accept data link request

(2) Accept telephone request

(3) Enter request into system

Critical Performance Parameters:

(1) Flexibility

(2) Capacity

(3) Availability

Allocation Sensitivities:

INPUTS: From Pilot:

- Request for information

TASK DESCRIPTION

FILE: 1.1.1
TASK: Accept "Data Link" Request*
SUBFUNCTION: Receive Requests for Flight Planning Information
FUNCTION: Provide Flight Planning Information

OUTPUTS:

(1) Category of information requested

(2) Location or geographic area involved

DESCRIPTION:

Purpose: To receive and enter into the system a request from the pilot for flight planning information

Stimulus: Event-stimulated by receipt via data link of a request for flight planning information

Decisions and Actions:

(1) Monitor for incoming request

(2) Detect incoming request

(3) Enter request into System

(4) Categorize information request into information category and location category

Phase of Flight:

Preflight planning

Critical Performance Parameters:

(1) Capacity

(2) Availability

(3) Flexibility

Performance Capabilities Required:

(1) Monitoring:

- Watch keeping

*Requests which, because of the equipment available at the pilot's location can be entered into the system by the pilot, and, therefore, serviced without operator intervention.

(2) Sensing:

- Signal detection
- Discrimination

Allocation Sensitivities:

External Constraints:

INPUTS: (1) From pilot:

- Request for information

TASK DESCRIPTION

FILE: 1.1.2
TASK: Accept "Telephone" Request*
SUBFUNCTION: Receive Requests for Flight Planning Information
FUNCTION: Provide Flight Planning Information

OUTPUTS: Message content of telephone request

DESCRIPTION:

Purpose: To receive pilot's telephone request for flight planning information

Stimulus: Event-stimulated by receipt via telephone of a request for flight planning information

Decisions and Actions:

(1) Monitor for incoming request

(2) Detect incoming request

(3) Interpret incoming request

Phase of Flight:

Preflight planning

Critical Performance Parameters:

(1) Availability

(2) Flexibility

(3) Capacity

Performance Capabilities Required:

(1) Monitoring:

- Watch keeping

(2) Sensing:

- Discrimination

Allocation Sensitivities:

*Requests which must be received and entered into the system by an operator (other than the pilot)

External Constraints:

INPUTS: (1) From pilot:

- Request for information

TASK DESCRIPTION

FILE: 1.1.3
TASK: Enter Request into System
SUBFUNCTION: Receive Requests for Flight Planning Information
FUNCTION: Provide Flight Planning Information

OUTPUTS:

(1) Category of information requested

(2) Location or geographic area involved

DESCRIPTION:

Purpose: To enter a telephone request for flight planning information into the system

Stimulus: Event-stimulated by acceptance via telephone of pilot request for flight planning information

Decisions and Actions:

(1) Evaluate request content for information category and location or geographic area information

(2) Enter request into System

Phase of Flight:

Preflight planning

Critical Performance Parameters:

(1) Validity

(2) Flexibility

(3) Completeness

Performance Capabilities Required:

(1) Information processing:

- Encoding
- Merging

(2) Interpreting:

- Classification

(3) Responding:

- Data transmission

Allocation Sensitivities:

External Constraints:

INPUTS: (1) From Task 1.1.2, Accept Telephone Request:

- Message content of telephone request

SUBFUNCTION DESCRIPTION

FILE: 1.2
SUBFUNCTION: Select Information to Service Request
FUNCTION: Provide Flight Planning Information

OUTPUTS:
(1) Information elements to service and request
(2) Preformatted reply

DESCRIPTION:

Purpose: To obtain either a preformatted reply or information elements to satisfy the information request of the pilot

Stimulus: Event-stimulated by request being entered into the system

Tasks:
(1) Select preformatted reply
(2) Retrieve information requested

Critical Performance Parameters:
(1) Availability
(2) Completeness
(3) Utility

Sensitivities:

INPUTS:
(1) From Subfunction 1.1, Receive Requests for Flight Planning Information:
- Category of information requested
- Location or geographic area involved

(2) From Subfunction 17.11, Prepare Preformatted Data Modules:
- Printouts (NOTAMS)
- Voice tapes
- Electronic displays

(3) From Subfunction 17.1, Determine Current and Forecasted Weather:
- Stored weather sequences

- Stored severe weather phenomena data
- Stored weather forecasts
- Stored route summaries
- Stored weather charts

(4) From Subfunction 17.10, Compile Traffic Data:

- Stored traffic data

(5) From Subfunction 17.2, Update Rules and Procedures Information:

- Stored data base items (rules and procedures)

(6) From Subfunction 17.4, Update Route Information:

- Stored data base items (route information)

(7) From Subfunction 17.7, Determine Capability and Status of COMM-NAV System:

- Stored data base items (COMM-NAV system status)

(8) From Subfunction 17.8, Determine Capability and Status of Ground Facilities:

- Stored data base items (ground facilities status)

(9) From Subfunction 17.9, Maintain User Class Information:

- Stored user class data base items

(10) From Subfunction 17.6, Update Hazards to Flight Information:

- Stored data base items (flight hazards information)

TASK DESCRIPTION

FILE: 1.2.1
TASK: Select Preformatted Reply
SUBFUNCTION: Select Information to Service Request
FUNCTION: Provide Flight Planning Information

OUTPUTS:

(1) Preformatted reply

(2) No preformatted reply available

DESCRIPTION:

Purpose: To determine if a pilot's request for flight planning information can be served by available preformatted messages, and if so, select the appropriate one

Stimulus: Event-stimulated by a request for information being entered into the system

Decisions and Actions:

(1) Determine if preformatted reply is available

(2) Select preformatted reply

Phase of Flight:

Preflight planning

Critical Performance Parameters:

(1) Availability

(2) Validity

Performance Capabilities Required:

(1) Information processing:

- Sorting

(2) Decision making:

- Selection/choice

(3) Storing and retrieving information:

- Selective retrieval

Allocation Sensitivities:

External Constraints:

INPUTS:

(1) From Task 1.1.1, Accept Data Link Request or from Task 1.1.3, Enter Request into System:

- Category of information requested
- Location or geographic area involved

(2) From Task 17.11.2:

- Printouts (NOTAMS)
- Voice tapes
- Electronic displays

TASK DESCRIPTION

FILE: 1.2.2
TASK: Retrieve Information Requested
SUBFUNCTION: Select Information to Service Request
FUNCTION: Provide Flight Planning Information

OUTPUTS: Information elements to service request

DESCRIPTION:

Purpose: To collect the information to service pilot's request for preflight planning information

Stimulus: Event-stimulated by determination that no appropriate preformatted reply is available

Decisions and Actions:

(1) Note category of information and geographic area involved in the request

(2) Retrieve the indicated information

Phase of Flight:

Preflight planning

Critical Performance Parameters:

(1) Utility

(2) Completeness

Performance Capability Required:

(1) Information processing:

- Sorting

(2) Storing and retrieving information:

- Selective retrieval/recall

Allocation Sensitivities:

External Constraints:

INPUTS: (1) From Task 1.2.1, Select Preformatted Reply:

- No preformatted reply available

(2) From Task 17.1.8, Store Weather Information:

- Stored weather sequences
- Stored severe weather phenomena data
- Stored weather forecasts
- Stored route summaries
- Stored weather charts

(3) From Task 17.10.3, Store Traffic Data:

- Stored traffic data

(4) From Task 17.2.6, Store Data Base Items:

- Stored data base items (rules and procedures)

(5) From Task 17.4.6, Store Data Base Items:

- Stored data base items (route information)

(6) From Task 17.6.6, Store Data Base Items:

- Stored data base items (flight hazards information)

(7) From Task 17.7.5, Store Data Base Items:

- Stored data base items (COMM-NAV system status)

(8) From Task 17.8.5, Store Data Base Items:

- Stored data base items (ground facilities status)

(9) From Task 17.9.6, Store User Class Data Base Items:

- Stored user class data base items

SUBFUNCTION DESCRIPTION

FILE: 1.3
SUBFUNCTION: Format and Display the Requested Information
FUNCTION: Provide Flight Planning Information

OUTPUTS:

(1) Displayed information

(2) Transmitted telephone message

DESCRIPTION:

Purpose: To compile, format, display and transmit to the pilot flight planning information

Stimulus: Event-stimulated by receipt of information retrieved in response to pilot's request

Tasks:

(1) Compile non-preformatted response

(2) Display information requested

(3) Transmit requested information via telephone

Critical Performance Parameters:

(1) Validity

(2) Availability

(3) Completeness

Sensitivities:

INPUTS:

(1) From Subfunction 1.2, Select Information To Service Request:

- Information elements to service request
- Preformatted reply

(2) From exogenous source:

- Message format

TASK DESCRIPTION

FILE: 1.3.1
TASK: Compile Non-preformatted Response
SUBFUNCTION: Format and Display the Requested Information
FUNCTION: Provide Flight Planning Information

OUTPUTS: Compiled and formatted response

DESCRIPTION:

Purpose: To compile and format information required to service pilot's request for preflight planning information

Stimulus: Event-stimulated retrieval of information in response to pilot's request

Decisions and Actions:

Compile the information into proper format and prepare it for transmission

Phase of Flight:

Preflight planning

Critical Performance Parameters:

(1) Validity

(2) Completeness

Performance Capabilities Required:

(1) Information processing:

- Merging
- Encoding

Allocation Sensitivities:

External Constraints:

INPUTS: (1) From Task 1.2.2, Retrieve Information Requested:

- Information elements to answer request

(2) From exogenous source:

- Message format

TASK DESCRIPTION

FILE: 1.3.2
TASK: Display Information Requested
SUBFUNCTION: Format and Display the Requested Information
FUNCTION: Provide Flight Planning Information

OUTPUTS: Displayed information

DESCRIPTION:

Purpose: To display the compiled information or preformatted response to the pilot, or to an operator who will relay it to him *

Stimulus: Event-stimulated by:

(1) Receipt of preformatted response or

(2) Receipt of compiled response

Decisions and Actions:

(1) Display response to request for flight planning information

Phase of Flight:

Preflight planning

Critical Performance Parameters:

(1) Availability

(2) Utility

(3) Validity

Performance Capabilities Required:

(1) Responding:

- Display
- Data transmission/communication

Allocation Sensitivities:

* See Task 1.3.3

External Constraints:

INPUTS:

(1) From Task 1.3.1, Compile Non-preformatted Response:

- Compiled response

(2) From Task 1.2.1, Select Preformatted Reply:

- Preformatted reply

TASK DESCRIPTION

FILE: 1.3.3
TASK: Transmit Requested Information Via Telephone
SUBFUNCTION: Format and Display the Requested Information
FUNCTION: Provide Flight Planning Information

OUTPUTS: Transmitted telephone message

DESCRIPTION:

Purpose: To transmit the compiled information or preformatted response to the pilot request via telephone

Stimulus: Event-stimulated by:

(1) Receipt of compiled response

(2) Receipt of preformatted message

(3) Display of response

Decisions and Actions:

(1) Transmit message via telephone

Phase of Flight:

Preflight planning

Critical Performance Parameters:

(1) Completeness

(2) Validity

Performance Capabilities Required:

(1) Responding:

- Data transmission/communications

Allocation Sensitivities:

External Constraints:

INPUTS: (1) From Task 1.3.1, Compile Non-preformatted Response:

- Compiled response

(2) From Task 1.2.1, Select Preformatted Reply:

- Preformatted reply

(3) From Task 1.3.2, Display Information Requested:

- Displayed information

Table 4.1-I. Flow of Information

Function 1.0: Provide Flight Planning Information

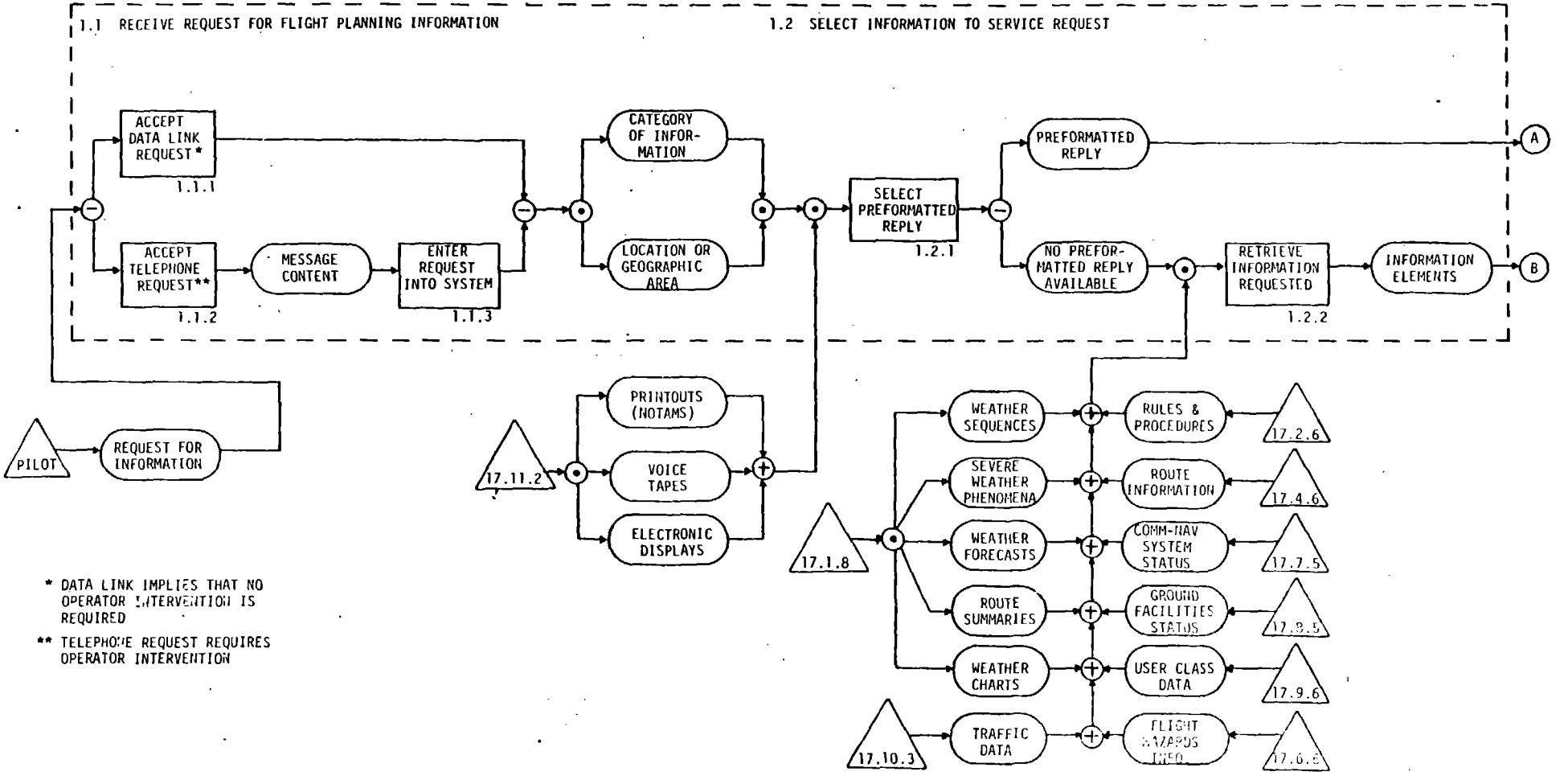
TASK	INPUTS		OUTPUTS	
	IDENTIFICATION	SOURCE	IDENTIFICATION	DESTIN.
1.1.1	*Request for information	Pilot	Category of info.	1.2.1
			Location or geographic area	1.2.1
1.1.2	*Request for information	Pilot (tel.)	Message content of telephone request	1.1.3
1.1.3	*Message content (of telephone request)	1.1.2	Category of info.	1.2.1
			Location or geographic area	1.2.1
1.2.1	*Category of information	1.1.1 1.1.3	Preformatted reply	1.3.2
	Location or geographic area	1.1.1 1.1.3	No preformatted reply available	1.2.2
	Printouts (NOTAMS)	17.11.2		
	Electronic displays	17.11.2		
	Voice tapes	17.11.2		
1.2.2	*No preformatted reply available	1.2.1	Information elements (to answer pilot's request)	1.3.1
	Stored weather sequences	17.1.8		
	Stored severe weather phenomena	17.1.8		
	Stored weather forecasts	17.1.8		
	Stored weather charts	17.1.8		
	Stored traffic data	17.10.3		
	Rules and procedures	17.2.6		
	COMM-NAV systems status	17.7.5		
	Ground facilities status	17.8.5		
	Stored user class data base items	17.9.6		
	Flight hazards information	17.6.6		
	Route information	17.4.6		
	Stored route summaries	17.1.8		

*Task stimulus

Table 4.1-I. Flow of Information

Function 1.0: Provide Flight Planning Information (Cont'd.)

TASK	INPUTS		OUTPUTS	
	IDENTIFICATION	SOURCE	IDENTIFICATION	DESTIN.
1.3.1	*Information elements (to answer request)	1.2.2	Compiled response	1.3.3 1.3.2
	Message format	Exog.		
1.3.2	*Compiled response	1.3.1	Displayed information	1.3.3 Pilot
	*Preformatted reply	1.2.1		
1.3.3	*Compiled response	1.3.1	Transmitted telephone message	Pilot
	*Preformatted reply	1.2.1		
	*Displayed information	1.3.2		



* DATA LINK IMPLIES THAT NO OPERATOR INTERVENTION IS REQUIRED

** TELEPHONE REQUEST REQUIRES OPERATOR INTERVENTION

FIGURE 4.1-1. FUNCTION 1.0: PROVIDE FLIGHT PLANNING INFORMATION (SHEET 1 OF 2)

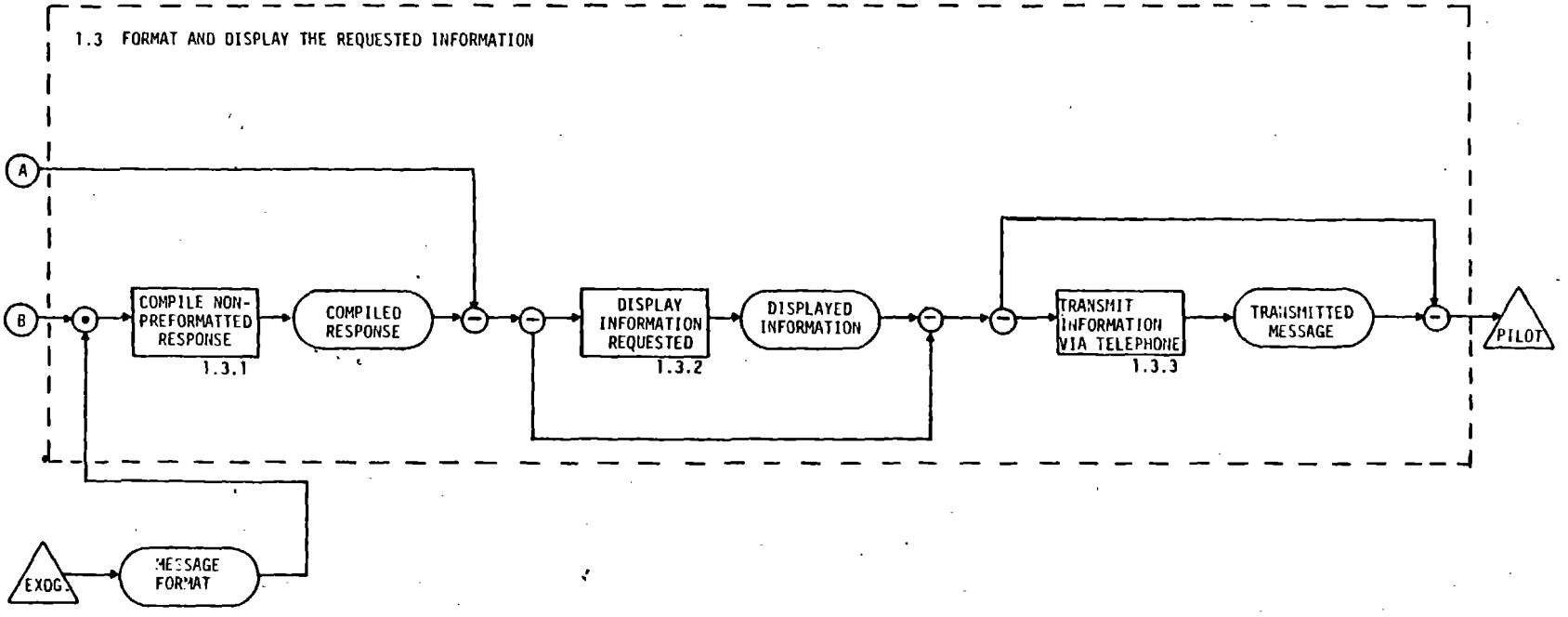
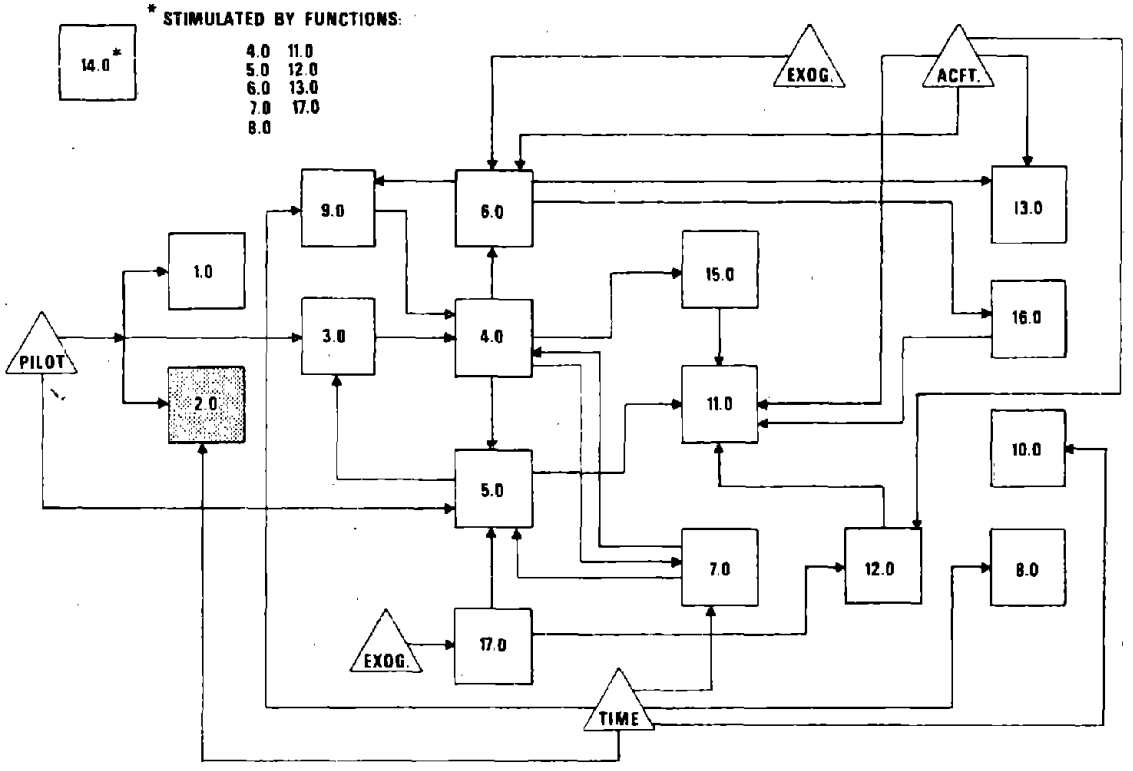


FIGURE 4.1-1. FUNCTION 1.0: PROVIDE FLIGHT PLANNING INFORMATION (SHEET 2 OF 2)

FUNCTION 2.0: CONTROL TRAFFIC FLOW



1.0: PROVIDE FLIGHT PLANNING INFORMATION
2.0: CONTROL TRAFFIC FLOW
3.0: PREPARE FLIGHT PLAN
4.0: PROCESS FLIGHT PLAN
5.0: ISSUE CLEARANCES AND CLEARANCE CHANGES
6.0: MONITOR AIRCRAFT PROGRESS
7.0: MAINTAIN CONFORMANCE WITH FLIGHT PLAN
8.0: ASSURE SEPARATION OF AIRCRAFT
9.0: CONTROL SPACING OF AIRCRAFT
10.0: PROVIDE AIRBORNE, LANDING AND GROUND NAVIGATION CAPABILITY
11.0: PROVIDE AIRCRAFT GUIDANCE
12.0: ISSUE FLIGHT ADVISORIES AND INSTRUCTIONS
13.0: HANDOFF
14.0: MAINTAIN SYSTEM RECORDS
15.0: PROVIDE ANCILLARY AND SPECIAL SERVICES
16.0: PROVIDE EMERGENCY SERVICES
17.0: MAINTAIN SYSTEM CAPABILITY AND STATUS INFORMATION

2.0 CONTROL TRAFFIC FLOW

2.1 Determine System Capacity

2.1.1 Select terminal or jurisdiction and time period to be considered

2.1.2 Determine effects of weather on capacity

2.1.3 Determine effects of airspace restrictions on capacity

2.1.4 Determine effects of ground equipment capability and status on capacity

2.1.5 Determine effects of flight hazards on capacity

2.1.6 Determine total effect on capacity

2.2 Determine System Demand

2.2.1 Determine jurisdiction/terminal demand due to commercial schedules

2.2.2 Process and store reservations

2.2.3 Determine jurisdiction/terminal demand due to reservations

2.2.4 Determine total jurisdiction/terminal demand

2.3 Determine and Resolve Capacity Overload Situations

2.3.1 Compare capacity with demand

2.3.2 Determine origins of demand in capacity overload situations

2.3.3 Determine what number of aircraft are to be delayed for what period of time

2.3.4 Determine where delays are to be absorbed

2.3.5 Formulate flow control directives

SUBFUNCTION DESCRIPTION

FILE: 2.1
SUBFUNCTION: Determine Sytem Capacity
FUNCTION: Control Traffic Flow

OUTPUTS:

(1) Actual capacity of terminal or jurisdistion in terms of number of aircraft as a function of time

(2) Terminal/jurisdiction to be considered

(3) Time period to be considered

DESCRIPTION:

Purpose: To select the terminal or jurisdiction for which demand and capacity are to be examined, to select the time period over which the demand and capacity are to be examined, and to determine the total remaining capacity of terminal/jurisdiction

Stimulus: Time-stimulated

Tasks:

(1) Select terminal or jurisdiction and time period to be considered

(2) Determine effect of weather on capacity

(3) Determine effects of airspace restrictions on capacity

(4) Determine effects of ground equipment capability and status on capacity

(5) Determine effects of flight hazards on capacity

(6) Determine total effect on capacity

Critical Performance Parameters:

(1) Accuracy

(2) Capacity

(3) Completeness

Allocation Sensitivities:

INPUTS:

(1) From Exogenous:

- List of Terminals/Jurisdiction in ATM System
- Time stimulus

(2) From Subfunction 17.1, Determine Current and Forecast Weather:

- Stored weather sequence
- Stored severe weather phenomena data
- Stored weather forecast
- Stored rate summaries

(3) From Subfunction 17.2, Update Rules and Procedures Information:

- Stored data bank items (rules and procedures)

(4) From Subfunction 17.8, Determine Capability and Status of Ground Facilities:

- Stored data base item (ground equipment capability and status)

(5) From Subfunction 17.6, Update Hazards to Flight Information:

- Stored data base items (flight hazards information)

(6) From Subfunction 17.5, Update Airspace Restrictions Information:

- Stored data base item (airspace restrictions)

(7) From exogenous source:

- Flow control paradigm

TASK DESCRIPTION

FILE: 2.1.1
TASK: Select Terminal or Jurisdiction
SUBFUNCTION: Determine System Capacity
FUNCTION: Control Traffic Flow

OUTPUTS:

(1) Terminal/jurisdiction to be considered

(2) Time period to be considered

DESCRIPTION:

Purpose: To select the terminal or jurisdiction for which to examine capacity and demand and to determine the time period over which capacity and demand are to be examined. (All of Subfunction 2.1 is performed for every terminal/jurisdiction)

Stimulus: Time-stimulated

Decisions and Actions:

(1) Select terminal or jurisdiction (along with its nominal capacity) to be considered from list of terminals/jurisdictions

(2) Apply flow control paradigm to determine the time period to be considered

Phase of Flight:

Not applicable

Critical Performance Parameters:

Capacity

Performance Capability Required:

(1) Storing and retrieving information:

- Selective retrieval

(2) Decision making:

- Selection/choice

Allocation Sensitivities:

External Constraints:

INPUTS: From exogenous source:

- List of terminals/jurisdictions in ATM system
- Flow control paradigm
- Time stimulus

FILE: 2.1.2
TASK: Determine Effects of Weather on Capacity
SUBFUNCTION: Determine System Capacity
FUNCTION: Control Traffic Flow

OUTPUTS: Capacity reduction in terms of number of aircraft as a function of time

DESCRIPTION:

Purpose: The purpose of this task is to determine the amount by which nominal capacity is reduced by weather conditions

Stimulus: Event-stimulated by the receipt of the terminal/jurisdiction to be considered and the time period to be considered from Task 2.1.1

Decisions and Actions:

(1) Retrieve weather information applicable to the terminal or jurisdiction

(2) Apply rules and procedures applicable to weather

(3) Determine capacity reduction due to weather in terms of number of aircraft as a function of time

Phase of Flight:

Not applicable

Critical Performance Parameters:

Accuracy

Performance Capability Required:

(1) Decision making:

- Induction/inference

(2) Information processing:

- Sorting

(3) Interpreting:

- Prediction

(4) Storing and retrieving information:

- Selective retrieval/recall

Allocation Sensitivities:

External Constraints:

(1) Accuracy of weather information

(2) Applicability of rules and procedures

INPUTS: (1) From Task 17.1.8, Store Weather Information:

- Stored weather sequences
- Stored severe weather phenomena data
- Stored route summaries
- Stored weather forecasts

(2) From Task 17.2.6, Update Rules and Procedures Information:

- Stored data base items (applicable rules and procedures)

(3) From Task 2.1.1, Select Terminal or Jurisdiction and Time Period to be Considered:

- Terminal/jurisdiction to be considered
- Time period to be considered

TASK DESCRIPTION

FILE: 2.1.3
TASK: Determine Effects of Airspace Restrictions on Capacity
SUBFUNCTION: Determine System Capacity
FUNCTION: Control Traffic Flow

OUTPUTS: Capacity reduction in terms of number of aircraft as a function of time

DESCRIPTIONS:

Purpose: The purpose of this task is to determine the amount by which nominal capacity is reduced by airspace restrictions

Stimulus: Event-stimulated by the receipt of the jurisdiction/terminal to be considered and the time period to be considered from Task 2.1.1

Decisions and Actions:

(1) Retrieve airspace restrictions information applicable to the terminal or jurisdiction

(2) Apply rules and procedures applicable to airspace restrictions

(3) Determine capacity reduction due to airspace restrictions in terms of number of aircraft as a function of time

Phase of Flight:

Not applicable

Critical Performance Parameters:

Completeness

Performance Capability Required:

(1) Decision making:

- Induction/inference

(2) Information processing:

- Sorting

(3) Interpreting:

- Prediction

(4) Storing and retrieving information:

- Selective retrieval/recall

Allocation Sensitivities:

External Constraints:

Applicability of rules and procedures

INPUTS:

(1) From Task 2.1.1, Select Terminal or Jurisdiction and Time Period to be Considered:

- Terminal/jurisdiction to be considered
- Time period to be considered

(2) From Task 17.5.6, Store Data Base Items:

- Stored data base items (airspace restrictions)

(3) From Task 17.2.6, Store Data Base Items:

- Stored data base items (applicable rules and procedures)

TASK DESCRIPTION

FILE: 2.1.4
TASK: Determine Effects of Ground Equipment Capability and Status on Capacity
SUBFUNCTION: Determine System Capacity
FUNCTION: Control Traffic Flow

OUTPUTS: Capacity reduction in terms of number of aircraft as a function of time

DESCRIPTION:

Purpose: The purpose of this task is to determine the amount by which nominal capacity is reduced by ground equipment capability and status

Stimulus: Event-stimulated by the receipt of the jurisdiction/terminal to be considered and the time period to be considered from Task 2.1.1

Decisions and Actions:

(1) Retrieve ground equipment capabilities and status information applicable to the terminal or jurisdiction

(2) Apply rules and procedures applicable to ground equipment capabilities and status

(3) Determine capacity reduction due to ground equipment capabilities and status in terms of number of aircraft as a function of time

Phase of Flight:

Not applicable

Critical Performance Parameters:

(1) Decision making:

- Induction/inference

(2) Information processing:

- Sorting

(3) Interpreting:

- Prediction

(4) Storing and retrieving information:

- Selective retrieval/recall

Allocation Sensitivities:

External Constraints:

Applicability of rules and procedures

INPUTS:

(1) From Task 2.1.1, Select Terminal or Jurisdiction and Time Period to be Considered:

- Terminal/jurisdiction to be considered
- Time period to be considered

(2) From Task 17.8.5, Store Data Base Items:

- Stored data base items (ground facilities status)

(3) From Task 17.2.6, Store Data Base Items:

- Stored data base items (applicable rules and procedures)

TASK DESCRIPTION

FILE: 2.1.5
TASK: Determine Effects of Flight Hazards on Capacity
SUBFUNCTION: Determine System Capacity
FUNCTION: Control Traffic Flow

OUTPUTS: Capacity reduction in terms and number of aircraft as a function of time

DESCRIPTION:

Purpose: The purpose of this task is to determine the amount by which nominal capacity is reduced by flight hazards

Stimulus: Event-stimulated, by the receipt of the terminal/ jurisdiction to be considerd and the time period to be considered from Task 2.1.1

Decisions and Actions:

(1) Retrieve flight hazards information applicable to the terminal or jurisdiction

(2) Apply rules and procedures applicable to flight hazards

(3) Determine capacity reduction due to flight hazards in terms of number of aircraft as a function of time

Phase of Flight:

Not applicable

Critical Performance Parameters:

Completeness

Performance Capability Required:

(1) Decision making:

- Induction/inference

(2) Information processing:

- Sorting

(3) Interpreting:

- Prediction

(4) Storing and retrieving information:

- Selective retrieval/recall

Allocation Sensitivities:

External Constraints:

Applicability of rules and procedures

INPUTS:

(1) From Task 2.1.1, Select Terminal or Jurisdiction and Time Period to be Considered:

- Terminal/jurisdiction to be considered
- Time period to be considered

(2) From Task 17.6.6, Store Data Base Items:

- Stored data base items (flight hazards information)

(3) From Task 17.2.6, Store Data Base Items:

- Stored data base items (applicable rules and procedures)

TASK DESCRIPTION

FILE: 2.1.6
TASK: Determine Total Effect on Capacity
SUBFUNCTION: Determine System Capacity
FUNCTION: Control Traffic Flow

OUTPUTS: Actual capacity of terminal or jurisdiction in terms of number of aircraft as a function of time

DESCRIPTION:

Purpose: The purpose of this task is to determine the cumulative or total effect on capacity of a terminal or jurisdiction as caused by the various capacity reduction determined in Task 2.1.1 through 2.1.5.

Stimulus: Event-stimulated by the completion of Tasks 2.1.1, 2.1.2, 2.1.3, 2.1.4 and 2.1.5

Decisions and Actions:

(1) Determine if combinations of two or more capacity reductions has more or less than a additive effect

(2) Compute total reduced capacity in terms of number of aircraft

Phase of Flight:

Not applicable

Critical Performance Parameters:

(1) Accuracy

(2) Completeness

Performance Capability Required:

(1) Information processing:

- Calculation

(2) Decision making:

- Induction/inference

(3) Interpreting:

- Prediction

(4) Storing/retrieving:

- Short term memory

Allocation Sensitivities:

External Constraints:

Applicability of rules and procedures

INPUTS:

(1) From Task 2.1.2, Determine Effects of Weather on Capacity:

- Capacity reduction in terms of number of aircraft as a function of time

(2) From Task 2.1.1, Select Terminal or Jurisdiction and Time Period to be Considered:

- Terminal/jurisdiction to be considered
- Time period to be considered

(3) From Task 2.1.3, Determine Effects of Airspace Restrictions on Capacity:

- Capacity reduction in terms of number of aircraft as a function of time

(4) From Task 2.1.4, Determine Effects of Ground Equipment Capability and Status on Capacity:

- Capacity reduction in terms of number of aircraft as a function of time

(5) From Task 2.1.5, Determine Effects of Flight Hazards on Capacity:

- Capacity reduction in terms of number of aircraft as a function of time

(6) From Task 17.2.6, Store Data Base Items:

- Stored data base items (rules and procedures)

SUBFUNCTION DESCRIPTION

FILE: 2.2
SUBFUNCTION: Determine System Demand
FUNCTION: Control Traffic Flow

OUTPUTS:

(1) Terminal/jurisdiction total demands as a function of time

(2) Compilation of total terminal/jurisdiction demand

(3) Deleted reservations

(4) Reservation disapproval with alternate available times

(5) Confirmed reservation(s)

DESCRIPTION:

Purpose: To process and store reservations for high activity terminals and to determine the terminal/jurisdiction total air traffic demand

Stimulus: Event-stimulated by receipt of user requests for reservations, or of the time period and the terminal/jurisdiction to be considered from Subfunction 2.1

Tasks:

(1) Determine jurisdiction/terminal demand based on commercial schedules

(2) Process and store reservations

(3) Determine jurisdiction/terminal demand based on reservations

(4) Determine total jurisdiction/terminal demand

Critical Performance Parameter:

(1) Completeness
(2) Flexibility

Allocation Sensitivities:

INPUTS:

(1) From exogenous source:

- Commercial schedules

(2) From the pilot:

- User request to establish or cancel reservation

(3) From Subfunction 2.1, Determine System Capacity:

- Time period to be considered
- Terminal/jurisdictions to be considered

(4) From Subfunction 17.10, Compile Traffic Data:

- ETA's/ETD's by origins and destinations
- ETOV's by jurisdictions

TASK DESCRIPTION

FILE: 2.2.1
TASK: Determine Jurisdiction/Terminal Demand Due to Commercial Schedules
SUBFUNCTION: Determine System Demand
FUNCTION: Control Traffic Flow

OUTPUTS: Compilation of aircraft operations

DESCRIPTIONS:

Purpose: To determine the jurisdiction/terminal traffic demand caused by commercial traffic as per published commercial schedules

Stimulus: Event-stimulated by the receipt of the time period to be considered and the jurisdiction of terminal to be considered from Task 2.1.1

Decisions and Actions:

(1) Select from commercial schedules aircraft operation (takeoffs, landings, entries and exits) applicable to the jurisdiction/terminal and time period

(2) Compile list identifying individual flights and their associated times (ETA and ETD) and origins

Phase of Flight:

Not applicable

Critical Performance Parameters:

(1) Information processing:

- Sorting
- Merging

(2) Storing/retrieving:

- Selective retrieval/recall

Allocation Sensitivities:

External Constraints:

INPUTS:

(1) From exogenous source:

- Commercial schedules

(2) From task 2.1.1, Select Terminal or Jurisdiction and Time Period to be Considered:

- Terminal jurisdiction to be considered
- Time period to be considered

TASK DESCRIPTION

FILE: 2.2.2
TASK: Process and Store Reservations
SUBFUNCTION: Determine System Demand
FUNCTION: Control Traffic Flow

OUTPUTS:

(1) Confirmed reservations

(2) Disapproved reservation request with suggested alternate available reservation times

(3) Deleted reservation

DESCRIPTION:

Purpose: To process and store reservations for use of high traffic density terminals

Stimulus: Event-stimulated by a request for a reservation from the user (exogenous), or by receipt of commercial schedules (exogenous)

Decisions and Actions:

(1) Determine if time requested is available

(2) Determine alternate available time, if requested time is not available

(3) Record reservation, if requested time is available

(4) Issue reservation confirmation (to include informing user) or

(5) Inform user of reservation disapproval with alternate times, or

(6) Delete existing reservation and inform user of deletion

Phase of Flight:

Preflight phase only

Critical Performance Parameters:

Flexibility

Performance Capability Required:

(1) Decision making:

- Comparison of alternatives
- Selection/choice

(2) Information processing:

- Filtering

(3) Storing/retrieving:

- Short-term memory

External Constraints:

Allocation Sensitivities:

INPUTS: (1) From the pilot:

- Request to establish or cancel reservations

(2) From exogenous source:

- Commercial schedules

TASK DESCRIPTION

FILE: 2.2.3
TASK: Determine Jurisdiction/Terminal Demand Due to Reservations
SUBFUNCTION: Determine System Demand
FUNCTION: Control Traffic Flow

OUTPUTS: Compilation of aircraft operations

DESCRIPTION:

Purpose: To determine the jurisdiction/terminal traffic demand caused by air traffic for which reservations have been made

Stimulus: Event-stimulated by the receipt of the time period to be considered and the jurisdiction or terminal to be considered from Task 2.1.1 (see External Constraints below)

Decisions and Actions:

(1) Select from reservations, aircraft operations (takeoffs, landings, entries and exits) applicable to the jurisdiction/terminal and time period

(2) Compile list identifying individual flights and their associated times (ETA and ETD) and origins

Phase of Flight:

Not applicable

Critical Performance Parameters:

Completeness

Performance Capabilities Required:

(1) Information processing

- Sorting
- Calculation

(2) Storing/retrieving:

- Selective retrieval/recall

Allocation Sensitivities:

External Constraints:

Present reservation system is concerned with terminals only; future reservation systems may or may not include enroute jurisdictions. Therefore, the determination of jurisdiction (vice terminal) demand may not be possible. In addition, there are at present only five terminals which use the reservation system; the future ATM system will make more use of reservations but probably not for all jurisdictions and terminals. The impact of the above is that whether this task is performed is dependent upon the nature of the reservation system where it is used.

INPUTS:

(1) From Task 2.1.1, Select Terminal or Jurisdiction and Time Period to be Considered:

- Terminal/jurisdiction to be considered
- Time period to be considered

(2) From Task 2.2.2, Process and Store Reservations:

- Confirmed reservations

TASK DESCRIPTION

FILE: 2.2.4
TASK: Determine Total Jurisdiction/Terminal Demand
SUBFUNCTION: Determine System Demand
FUNCTION: Control Traffic Flow

OUTPUTS:

(1) Terminal/jurisdiction total demand as a function of time

(2) Compilation of total terminal/jurisdiction demand consisting of individual flights and their associated times (ETA and ETD) and origins

DESCRIPTION:

Purpose: To determine the total air traffic demand for a terminal/jurisdiction

Stimulus: Event-stimulated by the receipt of compilations of aircraft operations from Tasks 2.2.1 and from Task 2.2.3 if it is performed

Decisions and Actions:

(1) Determine traffic data duplication (overlap) between compilations from Tasks 2.2.1, 2.2.3 and 2.2.4

(2) Compile refined list of all aircraft operations for the terminal/jurisdiction

(3) Compute aircraft operations rate as a function of time

Phase of Flight:

Not applicable

Critical Performance Parameters:

Completeness

Performance Capabilities Required:

(1) Information processing:

- Sorting
- Calculation

(2) Interpreting:

- Prediction

External Constraints:

Allocation Sensitivities:

INPUTS:

(1) From Task 2.2.1, Determine Jurisdiction/Terminal Demand Due To Commercial Schedules:

- Compilation of aircraft operations

(2) From Task 2.2.3, Determine Jurisdiciton/Terminal Demand Due To Reservations:

- Compilation of aircraft operations

(3) From Task 17.10.2, Compile ETA's, ETOV's and ETD's:

- ETA's and ETD's by origins and destinations
- ETOV's by jurisdictions

(4) From Task 2.1.1, Select Terminal or Jurisdiction and Time Period To Be Considered:

- Time period to be considered
- Terminal/jurisdiction to be considered

SUBFUNCTION DESCRIPTION

FILE: 2.3
SUBFUNCTION: Determine and Resolve Capacity Overload Situations
FUNCTION: Control Traffic Flow

OUTPUTS:

(1) Required delay at terminal

(2) Terminal release quotas

(3) Enroute jurisdictional release

(4) No capacity overload

DESCRIPTION:

Purpose: To determine where and identify when demand exceeds capacity, and to derive and promulgate directives and aircraft holds to insure flow control

Stimulus: Event-stimulated by receipt of capacity overloads (demand)

Tasks:

(1) Compare capacity with demand

(2) Determine origins of demand in capacity overload situations

(3) Determine what number of aircraft are to be delayed for what period of time

(4) Determine where delays are to be absorbed

(5) Formulate flow control directives

Critical Performance Parameters:

(1) Completeness

(2) Accuracy

(3) Capacity

(4) Flexibility

(5) Validity

Allocation Sensitivities:

INPUTS:

(1) From Subfunction 2.2, Determine System Demand:

- Terminal/jurisdiction total demand as a function of time
- Compilation of total terminal/jurisdiction demand

(2) From exogenous source:

- Flow control solution paradigm

(3) From Subfunction 2.1, Determine System Capacity:

- Actual terminal/jurisdiction capacity

TASK DESCRIPTION

FILE: 2.3.1
TASK: Compare Capacity With Demand
SUBFUNCTION: Determine and Resolve Capacity Overload Situations
FUNCTION: Control Traffic Flow

OUTPUTS:

(1) Capacity overloads identified by jruisdiction/terminal and time durations of capacity overloads

(2) Difference between demand and capacity as a function of time by jurisdiction/terminal

(3) No capacity overload

DESCRIPTION:

Purpose: To determine where and during which periods of time demand exceeds capacity

Stimulus: Event-stimulated by the receipt of the total demand as a function of time

Decisions and Actions:

(1) Compare terminal/jurisdiction capacity with corresponding terminal/jurisdiction demand

(2) Determine jurisdictions/terminals where demand exceeds capacity

(3) Calculate amount of overload as a function of time

Phase of Flight:

Not applicable

Critical Performance Parameters:

(1) Completeness

(2) Accuracy

Performance Capability Required:

(1) Information processing:

- Calculation

(2) Decision making:

- Comparison with standard

(3) Interpreting:

- Classification

External Constraints:

Allocation Sensitivities:

INPUTS:

(1) From Task 2.1.6, Determine Total Effect on Capacity:

- Actual capacity of terminal or jurisdiction in terms of number of aircraft as a function of time (for every terminal/jurisdiction)

(2) From Task 2.2.4, Determine Total Terminal/Jurisdiction Demand:

- Terminal/jurisdiction total demand as a function of time (for every terminal/jurisdiction)

TASK DESCRIPTION

FILE: 2.3.2
TASK: Determine Origins of Demand in Capacity Overload Situations
SUBFUNCTION: Determine and Resolve Capacity Overload Situations
FUNCTION: Control Traffic Flow

OUTPUTS: Compilations of demand origins by time and locations

DESCRIPTION:

Purpose: To determine where demand originates in capacity overload situations

Stimulus: Event-stimulated by the receipt of capacity overloads from Task 2.3.1

Decisions and Actions:

(1) Compare compilation of total jurisdiction/terminal demand from Task 2.2.4 with capacity overloads from Task 2.3.1 with regard to time periods of overloads

(2) Compile new list, eliminating those flights whose ETA's at the jurisdiction/terminal do not occur during the periods of capacity overload

Phase of Flight:

Not applicable

Critical Performance Parameters:

Completeness

Performance Capability Required:

(1) Information processing:

- Sorting
- Merging

(2) Interpreting:

- Classification

(3) Decision making:

- Comparison with standard

(4) Storing/retrieval:

- Selective retrieval/recall

External Constraints:

Allocation Sensitivities:

INPUTS:

(1) From Task 2.2.4, Determine Total Jurisdiction/Terminal Demand:

- Compilation of total terminal/jurisdiction demand consisting of individual flights and their associated times (ETA and ETD) and origins

(2) From Task 2.3.1, Compare Capacity With Demand:

- Capacity overloads identified by jurisdiction/terminal and time durations of capacity overloads

TASK DESCRIPTION

FILE: 2.3.3
TASK: Determine What Number of Aircraft are to be Delayed for What Period Of Time
SUBFUNCTION: Determine and Resolve Capacity Overload Situations
FUNCTION: Control Traffic Flow

OUTPUTS: List of numbers of aircraft by origin with corresponding required delays

DESCRIPTION:

Purpose: To determine how many aircraft are to be delayed for what period of time in order to reduce demand to the level of capacity

Stimulus: Event-stimulated by the receipt of description of excessive demand as a function of time from Task 2.3.1

Decisions and Actions:

(1) Revise time function of demand from 2.3.1 by shifting demand from overloaded time periods to underloaded time periods so that capacity does not exceed demand

(2) Perform the above so that total delay is minimum and individual delays are most nearly equal

(3) Compile list of changes in the time function of demand made in (1) and (2)

Phase of Flight:

Not applicable

Critical Performance Parameters:

(1) Capacity

(2) Completeness

Performance Capability Required:

(1) Information processing:

- Analysis
- Calculation

(2) Interpreting:

- Classification

(3) Decision making:

- Selection/choice

External Constraints:

Allocation Sensitivities:

INPUTS:

(1) From Task 2.2.4, Determine Total Jurisdiction/Terminal Demand:

- Compilation of total jurisdiction/terminal demand consisting of individual flights and their associated times (ETA and ETD) and origins

(2) From Task 2.3.1, Compare Capacity With Demand:

- Difference between demand and capacity as a function of time by jurisdiction/terminal

TASK DESCRIPTION

FILE: 2.3.4
TASK: Determine Where Delays are to be Absorbed
SUBFUNCTION: Determine and Resolve Capacity Overload Situations
FUNCTION: Control Traffic Flow

OUTPUTS:

(1) Required delay at demand origin

(2) Required delay enroute

(3) Required delay at terminal

DESCRIPTION:

Purpose: To determine distribution of required delay among origin (departure delays), enroute (rerouting, and enroute holding) and terminal (stacks)

Stimulus: Event-stimulated by the receipt of list of numbers of aircraft with corresponding delays from Task 2.3.3

Decisions and Actions:

(1) Determine from flow control paradigm if delays are large enough to institute origin or enroute delays

(2) If no, relay expected terminal delay times to Task 12.1.4, Retrieve Information Requested

(3) If yes, apply flow control paradigm to determine distribution of delay between origin and enroute

Phase of Flight:

Not applicable

Critical Performance Parameters:

(1) Flexibility

(2) Completeness

(3) Validity

(4) Capacity

Performance Capability Required:

(1) Decision making:

- Comparison with standard
- Selection/choice

(2) Information processing:

- Analysis
- Calculation

(3) Interpreting:

- Classification

External Constraints:

System dependency of flow control paradigm

Allocation Sensitivities:

INPUTS:

(1) From Task 2.3.2, Determine Origins of Demand in Capacity Overload Situations:

- Compilations of demand origins by time and locations

(2) From Task 2.3.3, Determine What Number of Aircraft are to be Delayed for What Period of Time:

- List of numbers of aircraft by origin with corresponding required delays

(3) From exogenous source:

- Flow control paradigm

TASK DESCRIPTION

FILE: 2.3.5
TASK: Formulate Flow Control Directives
SUBFUNCTION: Determine and Resolve Capacity Overload Situations
FUNCTION: Control Traffic Flow

OUTPUTS:

(1) Terminal release quotas

(2) Enroute jurisdiction release quotas

DESCRIPTION:

Purpose: To derive and promulgate directives required to implement flow control

Stimulus: Event-stimulated by the receipt of enroute and origin delays from Task 2.3.4

Decisions and Actions:

(1) Compare number of aircraft from a terminal/jurisdiction to be delayed (from Task 2.3.4) with total demand for that terminal/jurisdiction (from Task 2.2.4)

(2) Calculate difference between number to be delayed and total demand

(3) Promulgate the difference as the flow control directive (release quota) for that terminal/jurisdiction

Phase of Flight:

Not applicable

Critical Performance Parameters:

Accuracy

Performance Capability Required:

(1) Information processing:

- Calculation

(2) Decision making:

- Selection/choice

External Constraints:

Allocation Sensitivities:

INPUTS:

(1) From Task 2.2.4, Determine Total Jurisdiction/Terminal Demand:

- Compilation of total jurisdiction/terminal demand

(2) From Task 2.3.4, Determine Where Delays are to be Absorbed:

- Required delay enroute
- Required delay at demand origin

Table 4.2-I: Flow of Information

Function 2.0: Control Traffic Flow

TASK	INPUTS		OUTPUTS	
	IDENTIFICATION	SOURCE	IDENTIFICATION	DESTIN.
2.1.1	*Time	Exog.	Terminal/jurisdiction	2.1.2 2.1.3 2.1.4 2.1.5 2.1.6 2.2.1 2.2.3 2.2.4
	List of terminals/juris. at ATM system	Exog.		
	Flow control paradigm	Exog.		
			Time period to be considered	2.1.2 2.1.3 2.1.4 2.1.5 2.1.6 2.2.1 2.2.3 2.2.4
2.1.2	Stored weather sequences	17.1.8	Capacity reduction in number of aircraft as a function of time	2.1.6
	Stored severe weather phenomena	17.1.8		
	Stored weather forecasts	17.1.8		
	Stored route summaries	17.1.8		
	Rules and procedures	17.2.6		
	*Terminal or jurisdiction	2.1.1		
	*Time period to be considered	2.1.1		
2.1.3	*Time period to be considered	2.1.1	Capacity reduction in number of aircraft as a function of time	2.1.6
	*Jurisdiction or terminal	2.1.1		
	Airspace restrictions	17.5.6		
	Rules and procedures	17.2.6		
2.1.4	*Jurisdiction or terminal	2.1.1	Capacity reduction in number of aircraft as a function of time	2.1.6
	*Time period	2.1.1		
	Ground facilities status	17.8.5		
	Rules and procedures	17.2.6		

*Task stimulus

Table 4.2-I: Flow of Information
Function 2.0: Control Traffic Flow (Cont'd.)

TASK	INPUTS		OUTPUTS	
	IDENTIFICATION	SOURCE	IDENTIFICATION	DESTIN.
2.1.5	*Jurisdiction or terminal	2.1.1	Capacity reduction in number of aircraft as a function of time	2.1.6
	*Time period	2.1.1		
	Flight hazards information	17.6.6		
	Rules and procedures	17.2.6		
2.1.6	*Capacity reduction in number of aircraft as a function of time	2.1.2 2.1.3 2.1.4 2.1.5	Actual capacity of terminal or jurisdiction in number of aircraft as a function of time	2.3.1
	*Terminal or jurisdiction	2.1.1		
	*Time period	2.1.1		
	Rules and procedures	17.2.6		
2.2.1	Commercial schedules	Exog.	Compilations of aircraft operations	2.2.4
	*Jurisdiction or terminal	2.1.1		
	*Time period	2.1.1		
2.2.2	*Request to establish or cancel reservation	Pilot	Confirmed reservations	2.2.3 Pilot
	*Commercial schedules	Exog.	Disapproved reservations (with suggested alternate)	Pilot
			Deleted reservation	End Pilot
2.2.3	*Jurisdiction or terminal	2.1.1	Compilations of aircraft operations	2.2.4
	*Time period	2.1.1		
	Confirmed reservation	2.2.2		
2.2.4	*Compilation of aircraft operations	2.2.3 2.2.1	Terminal/jurisdiction total demand as a function of time	2.3.1 9.5.4
	Time period	2.1.1		
	Jurisdiction/terminal	2.1.1	Compilation of total terminal/juris. demand	2.3.3 2.3.2
	ETA's and ETD's by origin and destinations	17.10.2		
	ETOV's by jurisdictions	17.10.2		

Table 4.2-I: Flow of Information
Function 2.0: Control Traffic Flow (Cont'd.)

TASK	INPUTS		OUTPUTS	
	IDENTIFICATION	SOURCE	IDENTIFICATION	DESTIN.
2.3.1	Actual capacity of each terminal/jurisdiction in number of aircraft as a function of time	2.1.6	Capacity overloads by jurisdiction/terminal and time duration	2.3.2
			No capacity overloads	End
	*Terminal/jurisdiction total demand as a function of time (each terminal/ jurisdiction)	2.2.4	Demands as a function of time by jurisdiction terminal	2.3.3
2.3.2	Compilations of total terminal/jurisdictional demand	2.2.4	Compilations of demand origins by time and location	2.3.4
	*Capacity overloads by jurisdiction/terminal and time duration	2.3.1		
2.3.3	Compilations of total jurisdiction/terminal demand	2.2.4	List of numbers of aircraft with corresponding required delays	2.3.4
	*Demand as a function of time by jurisdiction/ terminal	2.3.1		
2.3.4	Demand origins by time and location	2.3.2	Required delay at demand origin	2.3.5
	*List of numbers of acft with corresponding delays	2.3.3	Required delay enroute	2.3.5
	Flow control solution paradigm	Exog.	Required delay at terminal	12.1.4
2.3.5	Compilation of total jurisdiction/terminal demand	2.2.4	Terminal release quotas	4.2.4 5.2.3 13.1.5
	*Required delay enroute	2.3.4	Enroute jurisdiction release quotas	4.2.4 5.2.3 13.1.5
	*Required delay at origin	2.3.4		

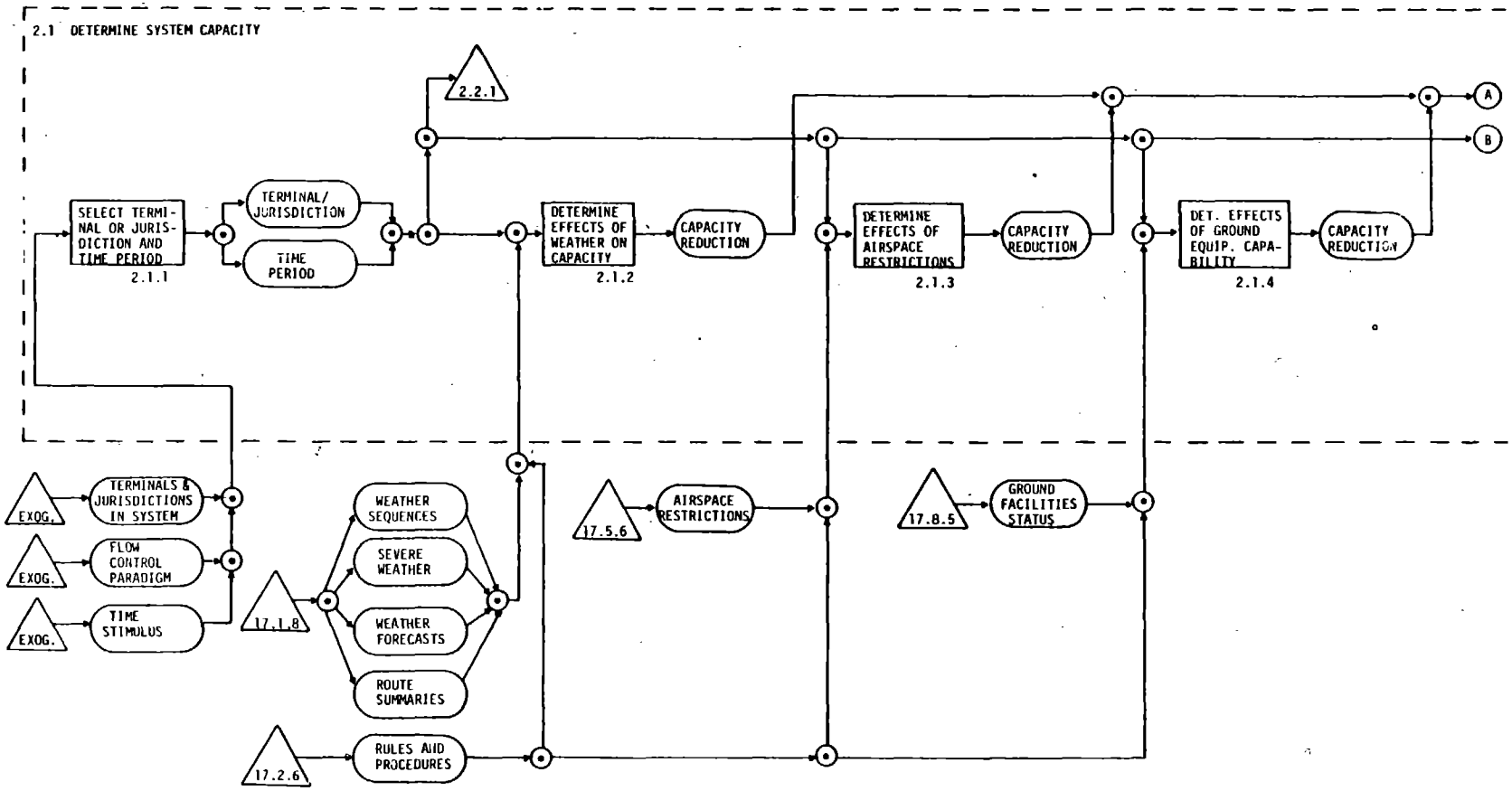


FIGURE 4.2-1. FUNCTION 2.0: CONTROL TRAFFIC FLOW
(SHEET 1 OF 4)

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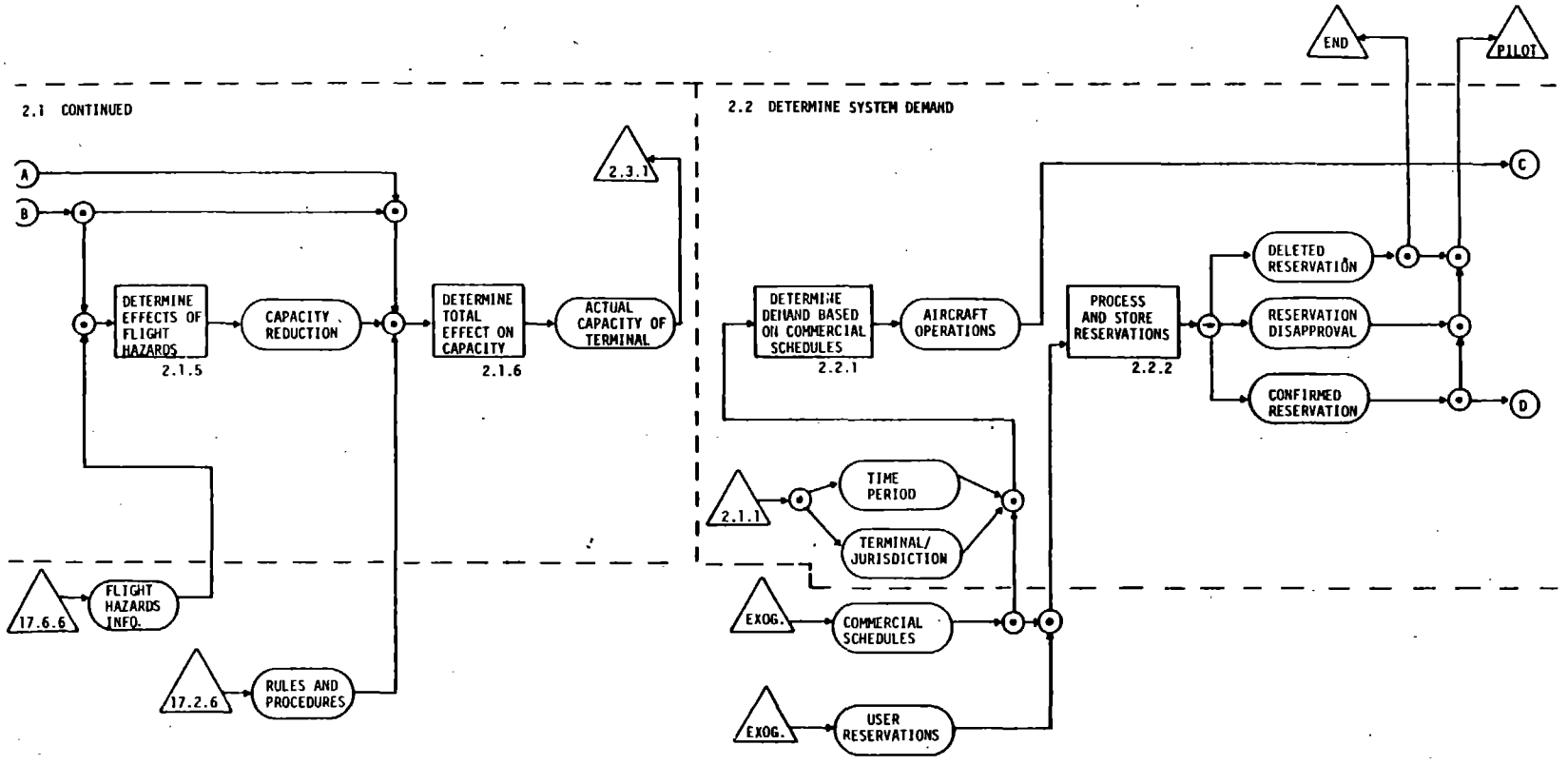


FIGURE 4.2-1. FUNCTION 2.0: CONTROL TRAFFIC FLOW
(SHEET 2 OF 4)

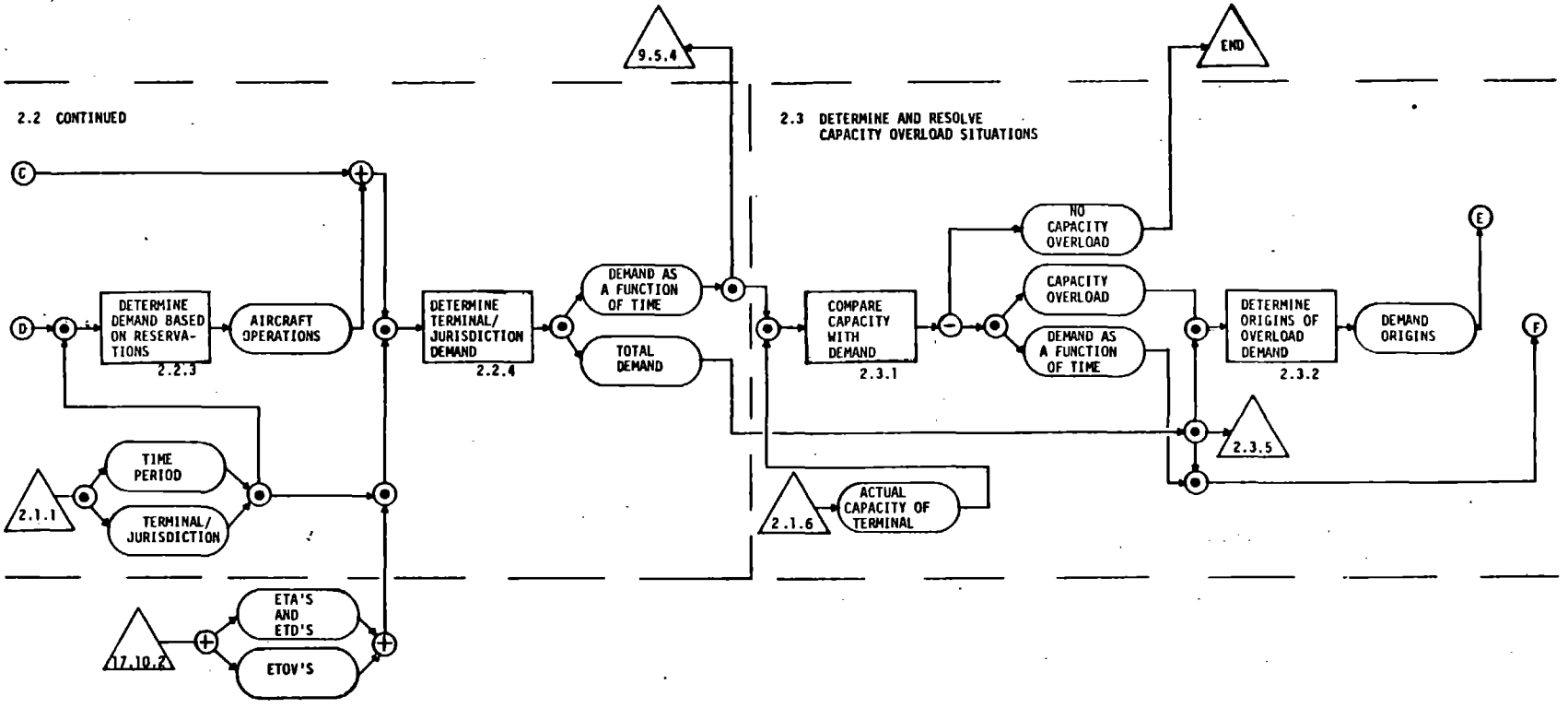


FIGURE 4.2.1. FUNCTION 2.0: CONTROL TRAFFIC FLO.
(SHEET 3 OF 4)

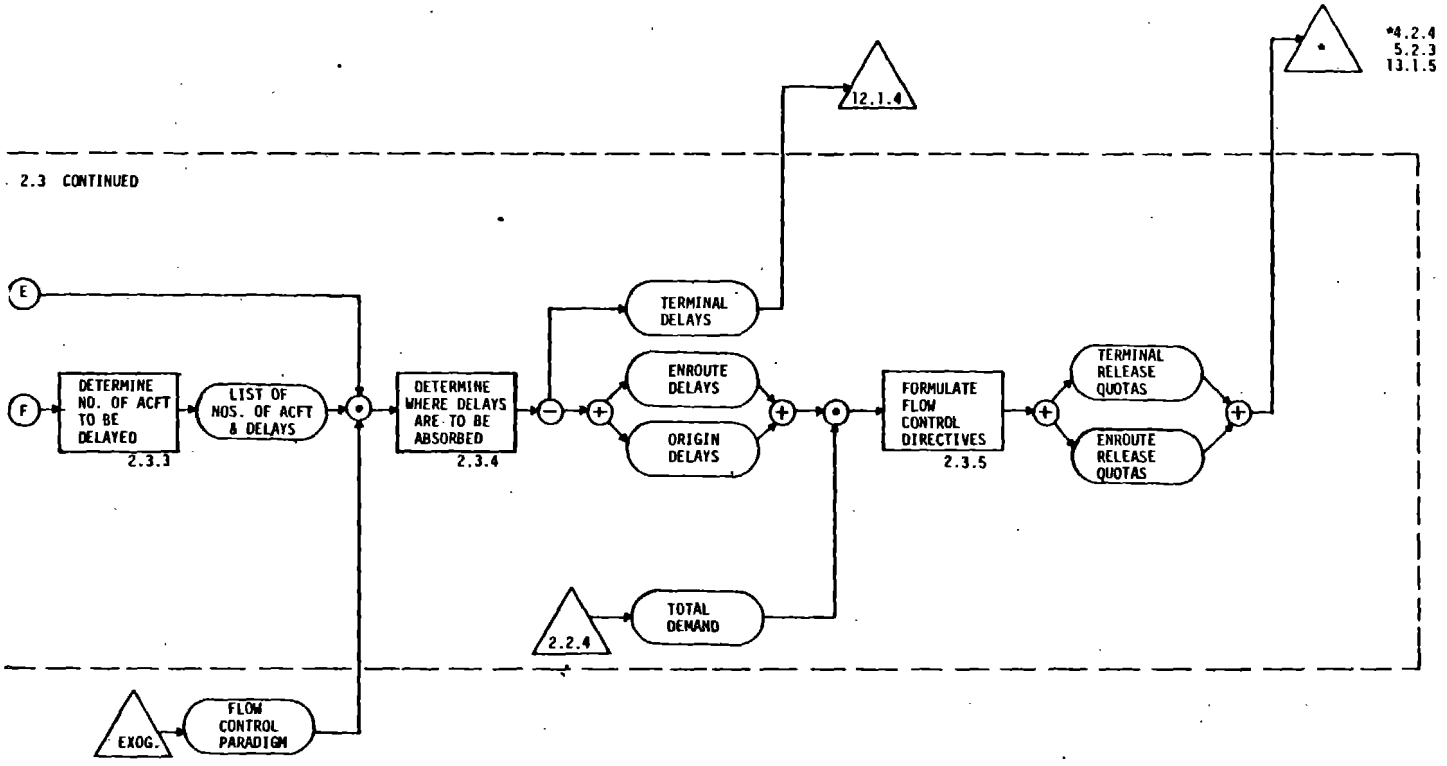
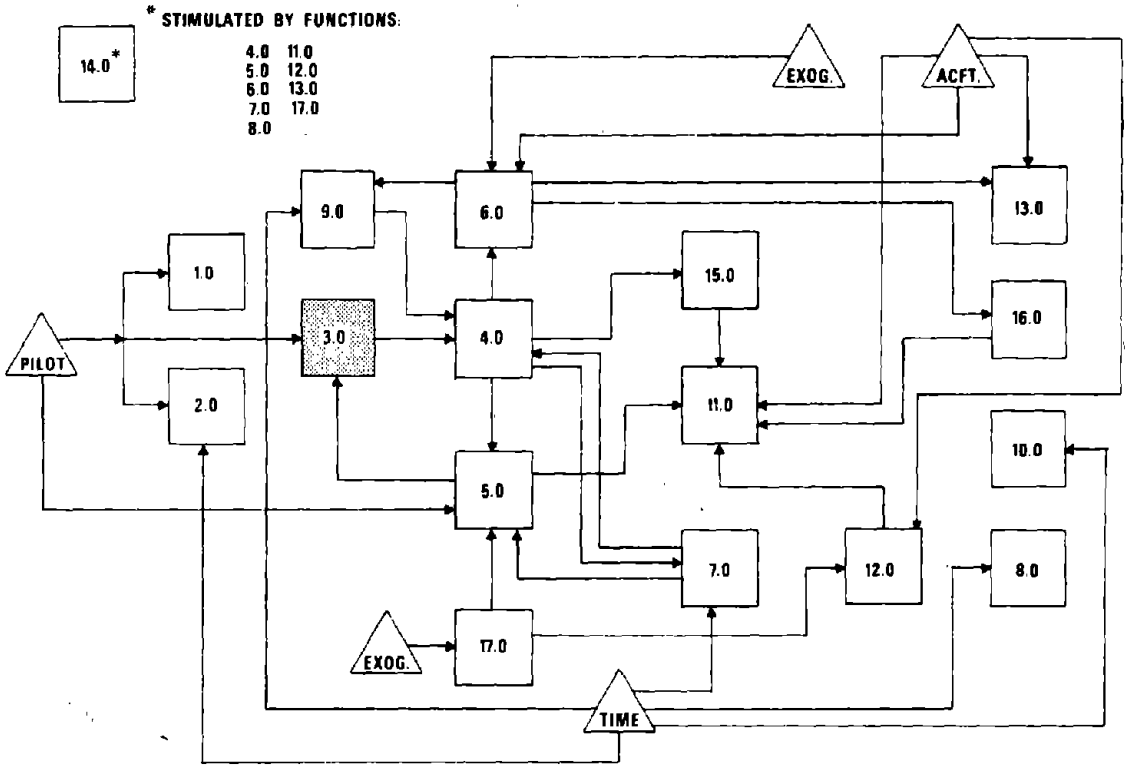


FIGURE 4.2-1. FUNCTION 2.0: CONTROL TRAFFIC FLOW
(SHEET 4 OF 4)

FUNCTION 3.0: PREPARE FLIGHT PLAN



1.0: PROVIDE FLIGHT PLANNING INFORMATION
2.0: CONTROL TRAFFIC FLOW
3.0: PREPARE FLIGHT PLAN
4.0: PROCESS FLIGHT PLAN
5.0: ISSUE CLEARANCES AND CLEARANCE CHANGES
6.0: MONITOR AIRCRAFT PROGRESS
7.0: MAINTAIN CONFORMANCE WITH FLIGHT PLAN
8.0: ASSURE SEPARATION OF AIRCRAFT
9.0: CONTROL SPACING OF AIRCRAFT
10.0: PROVIDE AIRBORNE, LANDING AND GROUND NAVIGATION CAPABILITY
11.0: PROVIDE AIRCRAFT GUIDANCE
12.0: ISSUE FLIGHT ADVISORIES AND INSTRUCTIONS
13.0: HANDOFF
14.0: MAINTAIN SYSTEM RECORDS
15.0: PROVIDE ANCILLARY AND SPECIAL SERVICES
16.0: PROVIDE EMERGENCY SERVICES
17.0: MAINTAIN SYSTEM CAPABILITY AND STATUS INFORMATION

3.0 PREPARE FLIGHT PLAN

3.1 Develop Preliminary Flight Plan

3.1.1 Specify desired destination and route information

3.1.2 Specify aircraft and pilot information

3.1.3 Specify type flight plan and special services desired

3.2 Assess Effects of Operational, Environmental, and Regulatory Factors

3.2.1 Obtain operational, environmental, and regulatory information for desired route and destination

3.2.2 Determine modifications required to make preliminary flight plan consistent with operational, environmental and regulatory information

3.2.3 Determine effects of required modifications on flight intentions

3.3 Compile and Submit Flight Plan

3.3.1 Compile flight plan

3.3.2 Check flight plan for internal consistency

3.3.3 Submit flight plan

SUBFUNCTION DESCRIPTION

FILE: 3.1
SUBFUNCTION: Develop Preliminary Flight Plan
FUNCTION: Prepare Flight Plan

OUTPUTS:

(1) Departure point/ETD

(2) Intended route profile:

- Intended route
- Times over specified intermediate points
- Altitude along route
- True airspeed

(3) Destination/ETA and alternate destination/ETA if applicable

(4) User class

(5) Aircraft identification and type

(6) Type flight plan desired

(7) Special services desired

DESCRIPTION:

Purpose: To specify the destination and intended flight plan of the aircraft

Stimulus: Event-stimulated by the user's decision to make a flight, or by the requirement from Subfunction 3.2, to modify his preliminary flight plan, or by a decision to proceed to alternate

Tasks:

(1) Specify desired destination and route information

(2) Specify aircraft and pilot information

(3) Specify type flight plan and special services desired

Critical Performance Parameters:

(1) Completeness

(2) Flexibility

Allocation Sensitivities:

INPUTS:

(1) From pilot:

- Decision to use airspace
- Intentions
- Aircraft identification and type
- Aircraft capability and status
- Status of onboard equipment
- Pilot qualifications

(2) From Subfunction 3.2, Assess Effects of Operational, Environmental and Regulatory Factors:

- Accepted modifications to flight plan

(3) From Subfunction 5.1, Check Clearance Status:

- Proceeding to alternate

TASK DESCRIPTION

FILE: 3.1.1
TASK: Specify Desired Destination and Route Information
SUBFUNCTION: Develop Preliminary Flight Plan
FUNCTION: Prepare Flight Plan

OUTPUTS:

(1) Departure point and ETD

(2) Desired route profile:

- Desired route
- Times over specified intermediate points (x, y, h and t)
- Desired altitude along route
- True airspeed

(3) Destination and ETA, including alternate destination and ETA

DESCRIPTION:

Purpose: To specify the desired four-dimensional route and departure point to destination

Stimulus: Event-stimulated, by user's decision to make a flight; or by the requirements, from Task 3.2.3, to modify his preliminary flight plan; or by decision to proceed to alternate, from Task 5.1.3

Decisions and Actions:

(1) Specify departure point and ETD

(2) Specify intended route

(3) Specify times over intermediate points

(4) Specify altitude along route

(5) Specify true airspeed

(6) Specify destination and ETA

(7) Specify alternate destination and ETA

Phase of Flight:

All phases except postflight; primarily preflight, but also in any other phase where flight plan changes or inflight filing is required

Critical Performance Parameters:

(1) Completeness

(2) Flexibility

Performance Capabilities Required:

(1) Decision making:

- Identification of alternatives
- Comparison of alternatives
- Selection/choice

(2) Information processing:

- Calculation
- Encoding

(3) Interpreting:

- Interpolation

(4) Storing and retrieving information:

- Selective retrieval/recall

External Constraints:

Allocation Sensitivities:

INPUTS:

(1) From pilot:

- Intentions

(2) From Task 3.2.3, Determine Effect of Required Modifications:

- Accepted modifications to flight plan

(3) From Task 5.1.3, Determine Pilot's Intentions Following Missed Approach:

- Proceeding to alternate

TASK DESCRIPTION

FILE: 3.1.2
TASK: Specify Aircraft and Pilot Information
SUBFUNCTION: Develop Preliminary Flight Plan
FUNCTION: Prepare Flight Plan

OUTPUTS:

(1) User Class

(2) Aircraft identification and type

DESCRIPTION:

Purpose: To specify the identification and required information for the pilot and aircraft

Stimulus: Event-stimulated by user's decision to make flight

Decisions and Actions:

(1) Specify user class

(2) Specify aircraft identity and type

Phase of Flight:

All phases except postflight; primarily preflight, but also in any other phase where flight plan change or inflight filing is required

Critical Performance Parameters:

(1) Completeness

Performance Capabilities Required:

(1) Information processing:

- Calculation
- Encoding

(2) Interpreting:

- Association

(3) Storing and retrieving information:

- Selective retrieval/recall

External Constraints:

Allocation Sensitivities:

INPUTS: (1) From pilot:

- Decision to use airspace
- Aircraft identification and type
- Aircraft capability and status
- Status of onboard equipment
- Pilot qualifications

TASK DESCRIPTION

FILE: 3.1.3
TASK: Specify Type Flight Plan and Special Services Desired
SUBFUNCTION: Develop Preliminary Flight Plan
FUNCTION: Prepare Flight Plan

OUTPUTS:

(1) Type flight plan

(2) Special services desired

DESCRIPTION:

Purpose: To specify the type flight plan and any special services desired

Stimulus: Event-stimulated by user's decision to make flight or by the requirements, from Task 3.2.3, to modify his preliminary flight plan

Decisions and Actions:

(1) Specify type flight plan

(2) Specify special services desired

Phase of Flight:

All phases except postflight; primarily preflight, but also in any other phase where flight plan changes or inflight filing is required

Critical Performance Parameters:

(1) Completeness

Performance Capabilities Required:

(1) Decision making:

- Identification of alternatives
- Comparison of alternatives
- Selection/choice

(2) Information processing:

- Encoding

External Constraints:

Allocation Sensitivities:

INPUTS:

(1) From pilot:

- Intentions

(2) From Task 3.2.3, Determine Effect of Required Modifications:

- Accepted modifications to flight plan

(3) From Task 5.1.3, Determine Pilot's Intentions Following Missed Approach:

- Proceeding to alternate

SUBFUNCTION DESCRIPTION

FILE: 3.2
SUBFUNCTION: Assess Affects of Operational, Environmental, and Regulatory Factors
FUNCTION: Establish Flight Plan

OUTPUTS:

(1) Preliminary flight plan that requires no modification

(2) Acceptable (to pilot) modifications to preliminary flight plan

(3) Decision to cancel preliminary flight plan

DESCRIPTION:

Purpose: To determine necessary and acceptable (to the pilot) modifications required to make the proposed flight plan consistent with operational, environmental, and regulatory factors

Stimulus: Event-stimulated by the preliminary flight plan formulated in Subfunction 3.1

Tasks:

(1) Obtain operational, environmental, and regulatory information for the desired route and destination

(2) Determine modifications required to make preliminary flight plan consistent with operational, environmental, and regulatory information

(3) Determine effects of required modifications on flight intentions

Critical Performance Parameters:

(1) Completeness

(2) Flexibility

(3) Validity

(4) Timeliness

Allocation Sensitivities:

To the form in which the operational, environmental and regulatory information is transmitted (e.g., voice or electronic signals). This is particularly applicable for the inflight filing situation.

INPUTS:

(1) From Subfunction 3.1, Develop Preliminary Flight Plan:

- Departure point/ETD
- Intended route
- Time over intermediate points
- Altitude along route
- True airspeed
- Destination/ETA (including alternate destination ETA if applicable)
- User class
- Aircraft identity and type
- Type flight plan
- Special services

(2) From Subfunction 3.3, Compile and Submit Flight Plan:

- Modifications required for consistency with operational, environmental, and regulatory factors

(3) From Subfunction 4.3, Propose Modified Flight Plan:

- Changes required to make flight plan acceptable (to ATM)

(4) From Subfunction 17.1, Determine Current and Forecast Weather:

- Stored weather sequence
- Stored severe weather phenomena data
- Stored weather charts
- Stored weather forecasts
- Stored route summaries

(5) From Subfunction 17.5, Update Airspace Restriction information:

- Stored data base item (airspace restrictions)

(6) From Subfunction 17.4, Update Route Information:

- Stored data base item (route information)

(7) From Subfunction 17.10, Compile Traffic Data:

- Stored traffic data

(8) From Subfunction 17.8, Determine Capability and Status of Ground Facilities:

- Stored data base item (ground facility status)

(9) From Subfunction 17.2, Update Rules and Procedures Information:

- Stored data base item (rules and procedures)

(10) From Subfunction 17.6, Update Hazards to Flight Information:

- Stored data base item (flight hazard information)

(11) From Subfunction 17.3, Update Airspace Structure and Jurisdictional Boundary Information:

- Stored data base item (airspace structure and jurisdictional boundary)

TASK DESCRIPTION

FILE: 3.2.1
TASK: Obtain Operational, Environmental, and Regulatory Information for Desired Route and Destination
SUBFUNCTION: Assess Effects of Operational, Environmental and Regulatory Factors
FUNCTION: Prepare Flight Plan

OUTPUTS: Information, for the desired route and destination, relating to:

- Weather
- Airspace restrictions
- Route information
- Traffic constraints
- Ground equipment capability and status
- Rules and procedures
- Flight hazards information

DESCRIPTION:

Purpose: To obtain current information describing the operational, environmental, and regulatory factors that affect the preliminary flight plan

Stimulus: Event-stimulated by the completion of the three tasks of Subfunction 3.1, Develop Preliminary Flight Plan

Decisions and Actions:

(1) Request the information applicable to the preliminary flight plan

(2) Select the applicable information

(3) Receive the applicable information

Phase of Flight:

All phases of flight except postflight; primarily preflight, but also in any other phase where flight plan changes or in-flight filing is required

Critical Performance Parameters:

(1) Timeliness

(2) Flexibility

(3) Completeness

(4) Validity

Performance Capability Required:

(1) Information processing:

- Decoding
- Filtering

(2) Interpreting:

- Classification

(3) Storing and retrieving information:

- Selective retrieval recall

Allocation Sensitivities:

To the form in which the information is transmitted (e.g., voice or electronic signals)

External Constraints:

The timeliness and completeness of the data collection, processing, and distribution supporting each of the data areas

INPUTS: (1) From Task 3.1.1, Specify Desired Destination and Route Information:

- Destination and ETA
- Departure point and ETD
- Desired route
- Time over intermediate points (x, y, h and t)
- Desired altitude along route
- True airspeed

(2) From Task 3.1.2, Specify Aircraft and Pilot Information:

- User class
- Aircraft identity and type

(3) From Task 3.1.3, Specify Type Flight Plan and Special Services Desired:

- Type flight plan
- Special services desired

(4) From Task 17.1.8, Store Weather Information:

- Stored weather sequences
- Stored severe weather phenomena data
- Stored weather forecasts
- Stored route summaries
- Stored weather charts

(5) From Task 17.2.6, Store Data Base Items:

- Stored data base items (rules and procedures)

(6) From Task 17.3.6, Store Data Base Items:

- Stored data base items (airspace structure and jurisdictional boundaries)

(7) From Task 17.4.6, Store Data Base Items:

- Stored data base items (route information)

(8) From Task 17.5.6, Store Data Base Items:

- Stored data base items (airspace restrictions)

(9) From Task 17.6.6, Store Data Base Items:

- Stored data base items (flight hazards information)

(10) From Task 17.8.5, Store Data Base Items:

- Stored data base items (ground facilities)

(11) From Task 17.10.3, Store Traffic Data:

- Stored traffic data

TASK DESCRIPTION

FILE: 3.2.2
TASK: Determine Modifications Required To Make Preliminary Flight Plan Consistent With Operational, Environmental, and Regulatory Information
SUBFUNCTION: Assess Effects of Operational, Environmental, and Regulatory Factors
FUNCTION: Prepare Flight Plan

OUTPUTS:

(1) Preliminary flight plan that requires no modification

(2) Identified modification(s) that need to be made to the preliminary flight plan:

- Type flight plan
- Departure point and ETD
- Desired route
- Time over intermediate points (x, y, h and t)
- Desired altitude along route
- Destination and ETA
- Special services desired

DESCRIPTION:

Purpose: To compare the preliminary flight plan with the applicable current operational, environmental, and regulatory information to determine if the preliminary flight plan needs modification to make it consistent with these factors

Stimulus: Event-stimulated by the retrieval of the applicable operational, environmental, and regulatory information in Task 3.2.1

Decisions and Actions:

Determine modifications required to make preliminary flight plan consistent with:

(1) Weather

(2) Airspace restrictions

(3) Route information

(4) Traffic constraints

(5) Ground equipment capability and status

(6) Rules and procedures

(7) Flight hazard information

Phase of Flight:

All phases of flight except postflight; primarily preflight, but also in any other phase where flight plan changes or in-flight filing is required

Critical Performance Parameters:

(1) Completeness

(2) Flexibility

(3) Validity

Performance Capability Required:

(1) Interpreting:

- Association

(2) Information processing:

- Analysis

(3) Decision making:

- Hypothesis formulation
- Comparison of alternatives
- Selection/choice

Allocation Sensitivities:

External Constraints:

The timeliness and completeness of the data collection, processing, and distribution supporting each of the ATM data areas

INPUTS: (1) From Task 3.1.1, Specify Desired Destination and Route Information:

- Desired route
- Times over specified intermediate points (x, y, h and t)

- Departure point and ETD
- True airspeed
- Desired altitude along route
- Destination/ETA

(2) From Task 3.1.3, Specify Type Flight Plan and Special Services Required:

- Type flight plan
- Special services desired

(3) From Task 3.2.1, Obtain Operational, Environment, and Regulatory Information for Desired Route and Destination data relating to:

- Weather
- Airspace restrictions
- Route information
- Traffic constraints
- Ground equipment capability and status
- Rules and procedures
- Flight hazards information

(4) From Task 3.1.2, Specify Aircraft and Pilot Information:

- User class
- Aircraft identification and type

TASK DESCRIPTION

FILE: 3.2.3
TASK: Determine Effect of Required Modifications on Flight Intentions
SUBFUNCTION: Assess Effects of Operational, Environmental, and Regulatory Factors
FUNCTION: Prepare Flight Plan

OUTPUTS:

(1) Cancel flight plan

(2) Accepted modifications to flight plan

DESCRIPTION:

Purpose: To compare the required modification(s) with the initial intent for making a flight and to determine if they are acceptable

Stimulus: Event-stimulated by modifications required by operational, environmental, or regulatory factors, from Task 3.2.2; or by modifications required to make a flight plan acceptable from Task 4.3.3; or modifications required for consistency from Task 3.3.2

Decisions and Actions:

(1) Determine if modifications violate the flight intentions

(2) Determine if the flight intentions can be changed to fit the modifications

Phase of Flight:

All phases of flight except postflight; primarily preflight, but also in any other phase where flight plan changes or in-flight filing is required

Critical Performance Parameters:

(1) Flexibility

(2) Validity

Performance Capability Required:

(1) Decision making:

- Comparison of alternatives
- Selection/choice

(2) Inperpreting:

- Classification

(3) Information processing:

- Filtering
- Analysis

Allocation Sensitivities:

External Constraints:

INPUTS:

(1) From Task 3.2.2, Determine Modifications Required to Make Preliminary Flight Plan Consistent with Operational, Environmental, and Regulatory Information:

- Identified modification(s) that need to be made to the preliminary flight plan:
  - (a) Desired route
  - (b) Time over intermediate points
  - (c) Altitude along route
  - (d) Destination and ETA
  - (e) Type flight plan
  - (f) Special services desired
  - (g) True airspeed

(2) From the pilot:

- Flight intentions

(3) From Task 4.3.3, Inform Pilot of Change Required to Make Flight Plan Acceptable:

- Changes required to make flight plan acceptable

(4) From Task 3.3.2, Check Flight Plan for Internal Consistency:

- Modifications required for consistency

SUBFUNCTION DESCRIPTION

FILE: 3.3
SUBFUNCTION: Compile and Submit Flight Plan
FUNCTION: Establish Flight Plan

OUTPUTS:

(1) Submitted flight plan

(2) Modification required for internal consistency

DESCRIPTION:

Purpose: To prepare the flight plan in final form and submit it to ATM for approval

Stimulus: Event-stimulated by a preliminary flight plan requiring no (further) modification to make it consistent with operational, environmental, and regulatory factors

Tasks:

(1) Compile flight plan

(2) Check flight plan for internal consistency

(3) Submit flight plan

Critical Performance Parameters:

(1) Accuracy

(2) Completeness

(3) Validity

Allocation Sensitivities:

INPUTS:

(1) From Subfunction 3.2, Assess Effects of Operational, Environmental, and Regulatory Factors:

- Preliminary flight plan that requires no modification

(2) From exogenous source:

- Flight plan format
- Consistency checking paradigm

TASK DESCRIPTION

FILE: 3.3.1
TASK: Compile Flight Plan
SUBFUNCTION: Compile and Submit Flight Plan
FUNCTION: Prepare Flight Plan

OUTPUTS: Compiled flight plan

DESCRIPTION:

Purpose: To compile the preliminary flight plan data into a flight plan

Stimulus: Event-stimulated by the completion of the preliminary flight plan (no further modifications required) in Task 3.2.2

Decisions and Actions:

(1) Collect preliminary flight plan data (as modified)

(2) Record data in required flight plan form

Phase of Flight:

All phases of flight except postflight; primarily preflight, but also in any other phase where flight plan change or inflight filing is required

Critical Performance Parameters:

(1) Accuracy

(2) Completeness

(3) Validity

Performance Capability Required:

(1) Information processing:

- Encoding
- Merging

(2) Storing and retrieving information:

- Short-term memory

Allocation Sensitivities:

External Constraints:

INPUTS:

(1) From Task 3.2.2, Determine Modifications Required to Make Preliminary Flight Plan Consistent with Operational, Environmental, and Regulatory Information:

- Preliminary flight plan that requires no modification

(2) From exogenous source:

- Flight plan format

TASK DESCRIPTION

FILE: 3.3.2
TASK: Check Flight Plan for Internal Consistency
SUBFUNCTION: Compile and Submit Flight Plan
FUNCTION: Prepare Flight Plan

OUTPUTS:

(1) Internally consistent flight plan

(2) Modifications required to make flight plan internally consistent

DESCRIPTION:

Purpose: To check the compiled flight plan to assure that the information contained is internally consistent

Stimulus: Event-stimulated by the compilation of a flight plan in Task 3.3.1

Decisions and Actions:

(1) Determine if flight plan is internally consistent

(2) Determine what modifications are necessary to make the flight plan internally consistent

Phase of Flight:

All phases of flight except postflight; primarily preflight, but also in any other phase where flight plan change or inflight filing is required

Critical Performance Parameters:

(1) Completeness

(2) Validity

Performance Capability Required:

(1) Interpreting:

- Pattern recognition
- Classification

(2) Decision making:

- Comparison with standard
- Selection/choice

(3) Information processing:

- Filtering
- Analysis

Allocation Sensitivities:

External Constraints:

INPUTS:

(1) From Task 3.3.1, Compile Flight Plan:

- Compiled flight plan

(2) From exogenous source:

- Consistency paradigm

TASK DESCRIPTION

FILE: 3.3.3
TASK: Submit Flight Plan
SUBFUNCTION: Compile and Submit Flight Plan
FUNCTION: Prepare Flight Plan

OUTPUTS: Submitted flight plan (request for approval is implied)

DESCRIPTION:

Purpose: To submit the completed flight plan to ATM for approval

Stimulus: Event-stimulated by development of an internally consistent flight plan -- the successful completion (no further modifications) of Task 3.3.2

Decisions and Actions:

(1) Enter flight plan into the system for approval

Phase of Flight:

All phases of flight except postflight, primarily preflight, but also in any other phase where flight plan changes, or in-flight filing is required

Critical Performance Parameters:

(1) Accuracy

Performance Capability Required:

(1) Responding:

- Data transmission

(2) Information processing:

- Encoding/decoding

Allocation Sensitivities:

External Constraints:

INPUTS: (1) From Task 3.3.2, Check Flight Plan for Internal Consistency:

- Internally consistent flight plan

Table 4.3-I. Flow of Information
Function 3.0: Prepare Flight Plan

TASK	INPUTS		OUTPUTS	
	IDENTIFICATION	SOURCE	IDENTIFICATION	DESTIN.
3.1.1	*Pilot's intentions	Pilot	Departure point/ETD	3.2.1 3.2.2
	*Accepted modifications to flight plan	3.2.3	Desired route	3.2.1 3.2.2
	*Proceding to alternate	5.1.3	Intermediate points ETOV's	3.2.1 3.2.2
			Desired altitude	3.2.1 3.2.2
			True airspeed	3.2.1 3.2.2
			Destination/ETA	3.2.1 3.2.2
3.1.2	Aircraft capability and status	Pilot	User class	3.2.1 3.2.2
	Status of onboard equip.	Pilot	Aircraft ident. and type	3.2.1 3.2.2
	Pilot qualifications	Pilot		
	Aircraft identity & type	Pilot		
	*Decision to use airspace	Pilot		
3.1.3	*Pilot intentions	Pilot	Type flight plan	3.2.1 3.2.2
	*Accepted modifications to flight plan	3.2.3	Special services desired	3.2.1 3.2.2
	*Proceding to alternate	5.1.3		
3.2.1	Stored weather sequences	17.1.8	Rule and procedures	3.2.2
	Stored severe weather phenomena	17.1.8	Flight hazards	3.2.2
			Flight route info.	3.2.2
	Stored weather forecasts	17.1.8	Weather	3.2.2
	Stored route summaries	17.1.8	Airspace restrictions	3.2.2
	Stored weather charts	17.1.8	Traffic constraints	3.2.2
	Rules and procedures	17.2.6	Capability and status of ground equipment	3.2.2
	Route information	17.4.6	(All above factors as related to info. from 3.1.1,3.1.2,3.1.3)	
	Airspace restrictions	17.5.6		

*Task stimulus

Table 4.3-I. Flow of Information

Function 3.0: Prepare Flight Plan (Cont'd.)

TASK	INPUTS		OUTPUTS	
	IDENTIFICATION	SOURCE	IDENTIFICATION	DESTIN.
3.2.1 Cont'd.	Flight hazards information	17.6.6		
	Ground facilities status	17.8.5		
	Airspace structure and jurisdictional boundary info.	17.3.6		
	Stored traffic data	17.10.3		
	*Departure point/ETD	3.1.1		
	*Desired route	3.1.1		
	*Intermediate points/ETOV's	3.1.1		
	*Desired altitute	3.1.1		
	*True airspeed	3.1.1		
	*Destination/ETA	3.1.1		
	*User class	3.1.2		
	*Aircraft identification and type	3.1.2		
	*Type flight plan	3.1.3		
	*Special services required	3.1.3		
3.2.2	*Departure point/ETD	3.1.1	No modification reqd.	3.3.1
	*Desired route *Intermediate points/ETOV's	3.1.1	Modification to preliminary flt.plan	3.2.3
	*Desired altitude	3.1.1		
	*True airspeed	3.1.1		
	*Destination/ETA	3.1.1		
	*User class	3.1.2		
	*Aircraft identification and type	3.1.2		
	*Type flight plan	3.1.5		
	*Special services desired From 3.2.1 as related to 3.1.1, 3.1.2 & 3.1.3:	3.1.3		
	Weather	3.2.1		
	Rules and procedures	3.2.1		

Table 4.3-I. Flow of Information
Function 3.0: Prepare Flight Plan (Cont'd.)

TASK	INPUTS		OUTPUTS	
	IDENTIFICATION	SOURCE	IDENTIFICATION	DESTIN.
3.2.2 Cont'd.	Flight hazards information	3.2.1		
	Flight route information	3.2.1		
	Airspace restrictions	3.2.1		
	Traffic constraints	3.2.1		
	Capability and status ground equipment	3.2.1		
3.2.3	*Modifications to prelim. flight plan	3.2.2	Cancel flight plan	End
			Accepted modifications	3.1.1
	*Modifications to compiled flight plan for consistency	3.3.2	to flight plan	3.1.3
	*Changes to make flight plan acceptable	4.3.3		
	*Pilot's intentions	Pilot		
3.3.1	*No modifications required (portion of preliminary flight plan)	3.2.2	Compiled flight plan	3.3.2
	Flight plan format	Exog.		
3.3.2	*Compiled flight plan	3.3.1	Flt plan consistent	3.3.3
	Consistency paradigm	Exog.	Modifications reqd. for consistency	3.2.3
3.3.3	*Flight plan (internally consistent)	3.3.2	Submitted flight plan	4.1.1 4.1.2 4.2.1 4.2.2 4.2.3 4.2.4 4.2.5 4.2.7 4.2.9 4.2.10

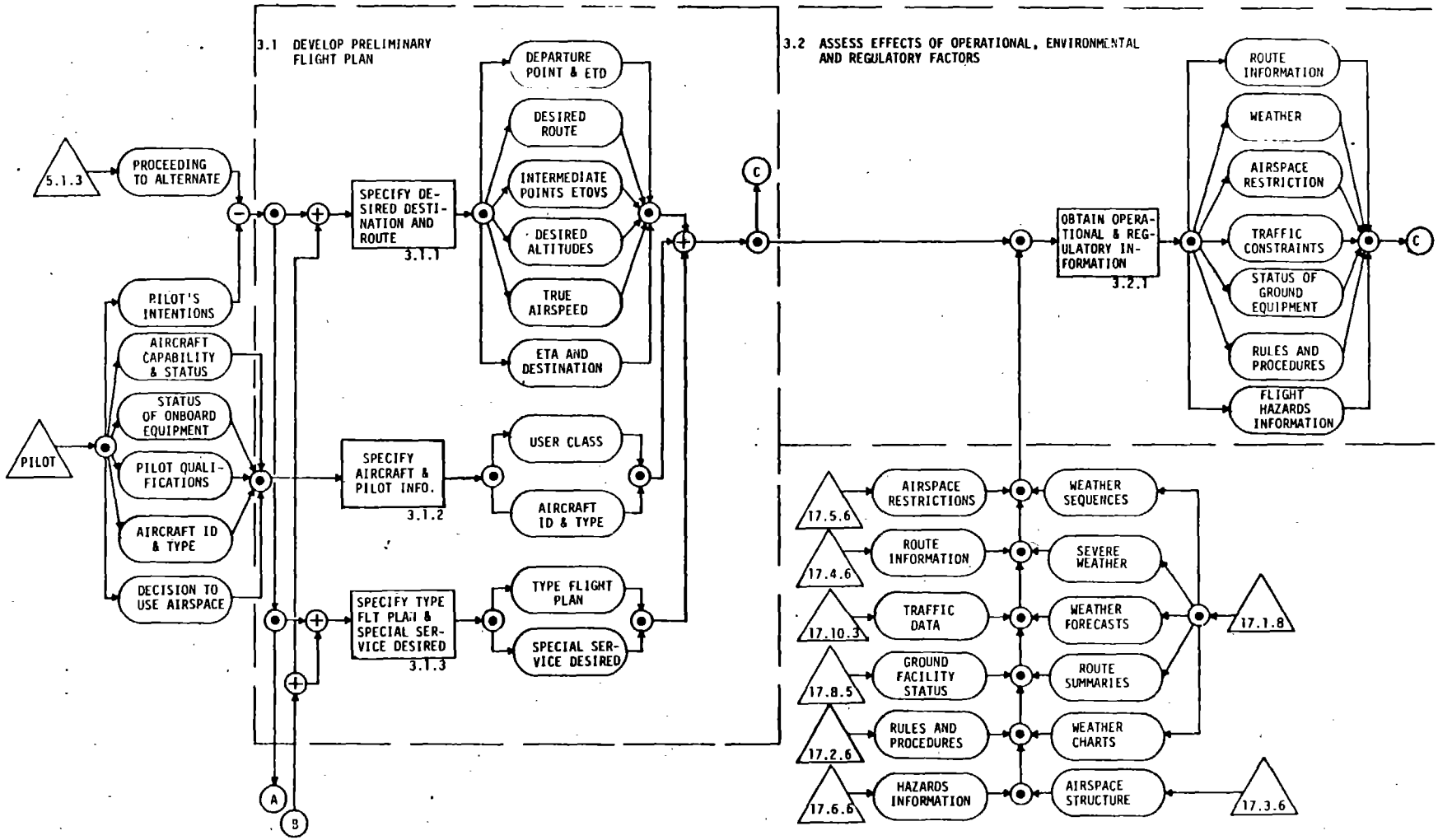


FIGURE 4.3-1. FUNCTION 3.0: PREPARE FLIGHT PLAN
(SHEET 1 OF 2)

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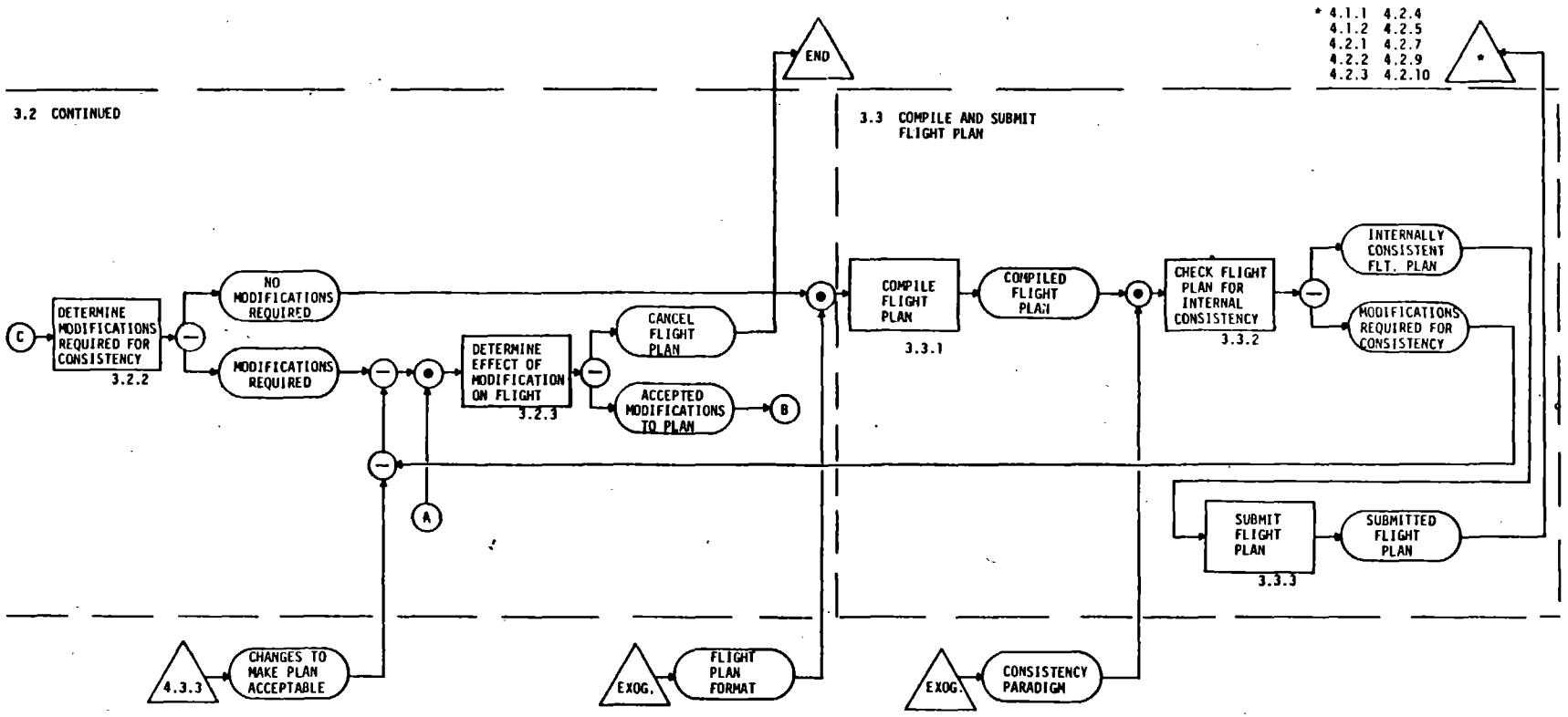

FIGURE 4.3-1. FUNCTION 3.0: PREPARE FLIGHT PLAN
(SHEET 2 OF 2)

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