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SILVER SPRING, MARYLAND

AVIATION SYSTEM MODELING STUDY  
AND ALTERNATIVES FINAL REPORT

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DIRECTED BY THE  
OFFICE OF STUDY ANALYSIS AND PLANNING, OAST  
NASA HEADQUARTERS  
WASHINGTON, D. C.

PREPARED UNDER CONTRACT No. NAS 5-24033, MOD 22  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
GODDARD SPACE FLIGHT CENTER  
GREENBELT, MARYLAND

## AVIATION SYSTEM MODELING STUDY SUMMARY FINAL REPORT

### INTRODUCTION

1. This is a Summary Final Report documenting the nature and scope of efforts under Contract No. NAS 5-24033, Mod 22. Individual efforts and interim results have likewise been prepared and delivered to NASA in the form of draft memoranda and reports, which are not contained herewith. This report is limited to the presentation of an overview of all work performed and the main thrust of these activities.

### Goals

2. The Aviation System Modeling Study has been directed toward two primary goals:

- An improved understanding of the U.S. aviation system, and
- An improved analysis capability for aeronautical research and technology (R&T).

The first goal is thought of as largely supportive of the second, which itself deals with questions related to roles, processes, trends, issues and programs.

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## Scope

3. The scope of the Aviation System Modeling Study has been rather broad and, at this time, is considered an on-going effort with continuing spin-off value in terms of the direction and shape of the aeronautical R&T program within NASA. There are three major categories into which the individual study efforts may be subdivided. These categories are listed below, together with their individual components and the potential uses seen at this time for each of them.

<u>Category</u>	<u>Use</u>
SPECIAL ISSUE STUDIES	
● NASA Role in Aeronautical R&T	● Review, Establishment and Support of Policy and Program Direction
● Productivity and R&T	
● Recoupment	
TASK STUDIES	
● Domestic Aviation	● Understanding of Decision Processes, Government Contributions, Future Trends, Competition, Constraints to Innovation, Etc.
● Foreign Aviation	
● Comparisons/Other Modes	● Specific Comparative Analysis Between and Within Transportation Modes
DATA BASE DEVELOPMENT	
● Content and Organization	● Quick Reaction Response to Future Questions
● Data Entry and Access	
● Data for Special Issue and Task Studies	● Support for Special Issue and Task Studies

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In addition to the above, selected analytical efforts have been identified under a category called "Dynamic Modeling." These efforts, which up to this time have been minimal and largely exploratory, involve examinations of further options for modeling, the aircraft manufacturing decision process and the potential impact of accounting changes.

## SPECIAL ISSUE STUDIES

### NASA Role in Aeronautical R&T

4. Notwithstanding the many substantive R&T contributions made by NASA (and its predecessor, NACA), the future role of NASA in aeronautical R&T depends strongly upon issues surrounding the question of how best to satisfy "public good" objectives within the context of available resources. In examining this question, a sequence of areas for analysis was prepared, dealing with the following:

- Reasons for lack of private sector incentive to achieve objectives
- Advantages of public role in achieving objectives
- Conclusions—public vs. private role
- Alternatives for execution of public role
- Comparison between alternatives for execution of public role
- Selected historical viewpoints
- Direction of major socioeconomic trends
- Broad conclusions
- Conclusions—thrusts for NASA in aeronautical R&T.

5. As indicated above, more detailed data gathering and analysis may be warranted in all or some of the above areas. The assessment of the need for such activities is under evaluation by NASA.

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## Productivity and R&T

6. The ORI effort focused on the overall productivity measurement of aeronautical research and development. The following specific areas were addressed:

- What is productivity measurement?
- Why is productivity measurement important?
- Approaches to measurement of R&D
  - Productivity indicators for R&D support activities
  - Quantitative assessment of the impact of R&D on productivity
  - Cost/productivity relationship
  - Publications/citations/peer evaluation
  - Effects of R&D on productivity of the aviation industry.
- Conclusions.

## Recoupment

7. Background data and historical developments in the area of recoupment were also examined by ORI. An outline of the subjects investigated follows:

- Background
- Pros and cons of recoupment
- Present practices
  - U.S. government
  - Foreign governments

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- Approaches to recoupment
  - Alternatives to recovery
  - Pricing policies
- Potential recoupment alternatives
  - Policy considerations
  - Resulting potentials for recoupment/cost sharing.

## TASK STUDIES

### Domestic Aviation

8. The effort in the area of domestic aviation was carried out by the Ames Research Center. ORI provided some support, principally by collecting data and making it available to ARC. ARC defined the following aspects of domestic aviation and showed how they tend to interact:

- Community and national benefits
- Demand projections
- Airline costs and reserves
- New aircraft technology
- Manufacturer production programs
- Fleet requirements.

In doing this, Program BET (Benefit Evaluation of Technology) was initiated. A detailed examination was performed of the manufacturer decision process for production as well as aircraft costs (program ACCOST) and a cash flow model.

### Foreign Aviation

9. Work in this area was performed by the Langley Research Center. Here again ORI provided a variety of source data available in and around the Washington Metropolitan area. The scope of analysis by LaRC, for this phase, focused on the U.S.S.R. with regard to:

- The characteristics of Aeroflot
- The types and numbers of aircraft being produced

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- The emphasis in aeronautical technology
  - Planning activities.
10. A summary of their findings may be stated as:
- The U.S.S.R. plans strong competition in world air passenger/freight markets
  - Technology has some unique characteristics
  - R&D framework can provide aerospace market competition
  - Education strongly supports technology enhancement.
11. A draft memorandum was prepared by ORI dealing with selected statistics concerning the potential foreign aerospace industry impact. Areas that were broadly considered include:
- Why is foreign trade essential
  - Foreign subsidization to aerospace industry
  - Impact of foreign competition
  - Balance of trade.

### Comparisons/Other Modes

12. A moderate effort by ORI was devoted to collecting information that could be used to compare key parameters within the aviation field and between aviation and other modes. For example, the average cost of fuel per ton-mile and operating costs per ton-mile for air, highways and rail were among the several comparisons shown. The data collected was documented in a series of documents separately devoted to air, highways and rail.

### DATA BASE DEVELOPMENT

#### Content and Organization

13. Work on setting up a data base for use by NASA emphasized two areas, the use of the GE MAP system and an aviation specific data base, both in a

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compatible format for access and retrieval. The data of interest in these two areas are cited below:

- GE MAP
  - NBER time series
  - SIC data
  - U.S. regional data
  - NEMA industry data
  - MAPCAST data
  - U.S.S. engineers and consultants regional industrial production index data
- Aviation specific data
  - Organizations and roles
  - Physical and operational
  - Economics
  - Sociopolitical
  - Regulatory
  - Variable directory file.

## Data Entry and Access

14. Data entry can be viewed as consisting of two processes: initialization and maintenance. These two processes have the following subareas that have been examined in some detail and reported on:

- Initialization
  - Data selection
  - Physical data entry
  - Directory entry (keywords and description)
  - Verification

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- Maintenance
  - Data update
  - Directory update
  - Verification.

15. Access, for the most part, involves being able to enter the system and search for data relevant to a specific problem. A search capability is provided, utilizing the following system features:

- Indices
- Bibliographies
- Cross-mode tabulations
- LOCATE using coded fields
- LOCATE using data descriptions.

### DOCUMENTATION

16. A variety of draft memoranda, papers and viewgraphs were provided in each of the categories listed below:

- Recoupment
- Productivity
- Aviation System Data Base
- Roles and Bibliography in Aeronautical R&T
- Economic/Financial Outlook and Impact
- Foreign Impact
- Aviation Indicators.

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