DORMAN Computer Program (Study 2.5) Final Report

Volume I

Executive Summary

Prepared by ADVANCED VEHICLE SYSTEMS DIRECTORATE

Systems Planning Division

15 September 1973

Prepared for OFFICE OF MANNED SPACE FLIGHT

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D. C.

Contract No. NASW-2472

Systems Engineering Operations

THE AEROSPACE CORPORATION

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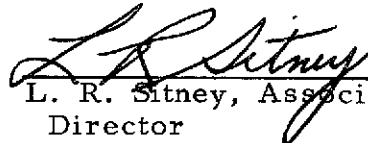
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FOREWORD

Study 2.5 DORCA Applications has been directed at development of a data bank management computer program identified as DORMAN. Because of the size of the DORCA data files and the manipulations required on that data to support analyses with the DORCA program, automated data techniques to replace time-consuming manual input generation are required. The Dynamic Operations Requirements and Cost Analysis (DORCA) program was developed by The Aerospace Corporation for use by NASA in planning future space programs. Both programs are designed for implementation on the UNIVAC 1108 computing system at the NASA Computing Facility, Slidell, Louisiana.

The purpose of this Executive Summary Report is to define for the NASA managment the basic functions of the DORMAN program and its capabilities. In addition to this volume, the following support documentation is provided.

Volume II   User's Guide and Programmer's Guide

Volume III   Original Data Bank Listing

Volume IV   DORMAN program listing, UNIVAC 1108 Version

By agreement with the NASA Task Monitor, V. N. Huff, the DORMAN program will be delivered directly to the NASA Computing Facility.

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FIGURES

TABLES

1. INTRODUCTION

The DORCA computer program was developed as a tool for NASA's use in conjunction with its long range space program planning function. This program is designed to analyze an integrated space program in terms of launch vehicle traffic rates, vehicle inventories, procurement schedules, and fiscal year and total program funding requirements. The computer program basically "captures," with appropriate vehicles, all payloads scheduled for delivery to or retrieval from orbit in a given year. Payloads are combined for transport to minimize the number of vehicle flights required, thereby reducing operations costs. The program then summarizes the individual fiscal year statistics to present the total program picture in terms of payload and logistic vehicle procurements and operations costs.

An extensive amount of input data is required to perform these analyses. The data includes vehicle performance capabilities, mission requirements, payload definitions, and, where necessary, operational constraints. Further, once a basic set of data is developed, some of the fundamental variables must be altered to determine sensitivities. The procedures involved to validate the input data and provide traceability become very time consuming and tend to reduce the effectiveness of the DORCA program. In order to gain some means of control of this data handling and data management problem, a data bank and data retrieval program was developed; it is called DORMAN.

Study 2.5, DORCA Applications, was responsible for developing the DORMAN program and the supporting data bank. The DORMAN program and a reference data bank have been installed at the NASA computing facility, Slidell, Louisiana. The program is operable by remote terminals at numerous NASA centers and at NASA Headquarters. With this capability new input files for the DORCA program can be composed from existing data in a matter of minutes enhancing the utility of the DORCA program to support NASA study efforts.

The DORCA program has been used in support of NASA Study 2.4 Space Shuttle/Payload Interface Analysis, and Study 2.6, Operations Analysis, during the past year. For Study 2.4, DORCA was used to perform a number of capture analyses on the June 1972 excursion to the basic 1971 mission model. Several capture analyses were performed in order to determine the "best mix" payload mission model; a capture analysis was also performed on the model itself after its initial compilation. In addition, DORCA was used to perform the capture analysis on a version of the mission model employing expendable launch vehicles and payloads. The reference data for these efforts is included in the DORMAN data bank.

In Study 2.6 DORCA was used to conduct trade studies involving the operation of different Tugs and phased Tug combinations in conjunction with Space Shuttle operations. Including an expendable upper stage as one type of Tug, a total of six different Tug designs were considered in the analysis. These were considered both individually and in phased combinations for a total of fourteen separate cases. These data have also been incorporated into the DORMAN data bank.

Since each of the individual case analyses referred to above requires from 1500 to 2000 cards, the data bank quickly became physically unwieldy. An early data bank transmitted to NASA, consisting solely of basic data decks, totaled 45,612 card images. Therefore, a data management program capable of altering, compressing, storing, and transmitting data items or data decks by remote means became highly desirable. In addition, maintaining trace-ability from case to case became increasingly difficult. After DORMAN was created, a later data bank that was transmitted contained the same data as the earlier bank, but totalled only 15,000 cards.

DORMAN is a user-oriented interactive program designed to run on the UNIVAC 1108 computer. Its vocabulary consists of eleven simple com-mands. Each command has its own series of prompting requests for additional information that leads the user along the required trail to complete a desired

process. By coupling together a sequence of commands, the user can build a data file, add or delete decks from the data file, set up input decks for DORCA analyses, and modify existing DORCA data decks to assess the effects of varying mission model parameters. Likewise, new data decks can be created for data bank storage or for input to the DORCA program. A schematic of this process is shown in Figure 1.

Relatively minor changes to be made in order to investigate the results of small variations in mission model parameters (e.g., vehicle performance or payload weight) can be accomplished by editing existing data decks. Other cases involving major changes, such as changing the model to incorporate expendable payloads and vehicles rather than reusable ones, can best be handled by generating a new data deck instead of trying to modify an existing deck.

New data decks representing perhaps the latest mission model data and/or vehicle performance data can be created and added to the data bank. Old decks containing obsolete data may in a similar fashion be deleted from the data bank.

Decks containing a lot of common data can be differenced to obtain relatively small modified or "mod" decks. This process is one of automatically comparing two reference decks, card by card, and recording all cards that are not common, between the two decks. These mod decks can then replace all of the basic decks except for the one deck to which the mod decks are referenced. In this manner, the size of the data bank and its storage requirements can be significantly reduced.
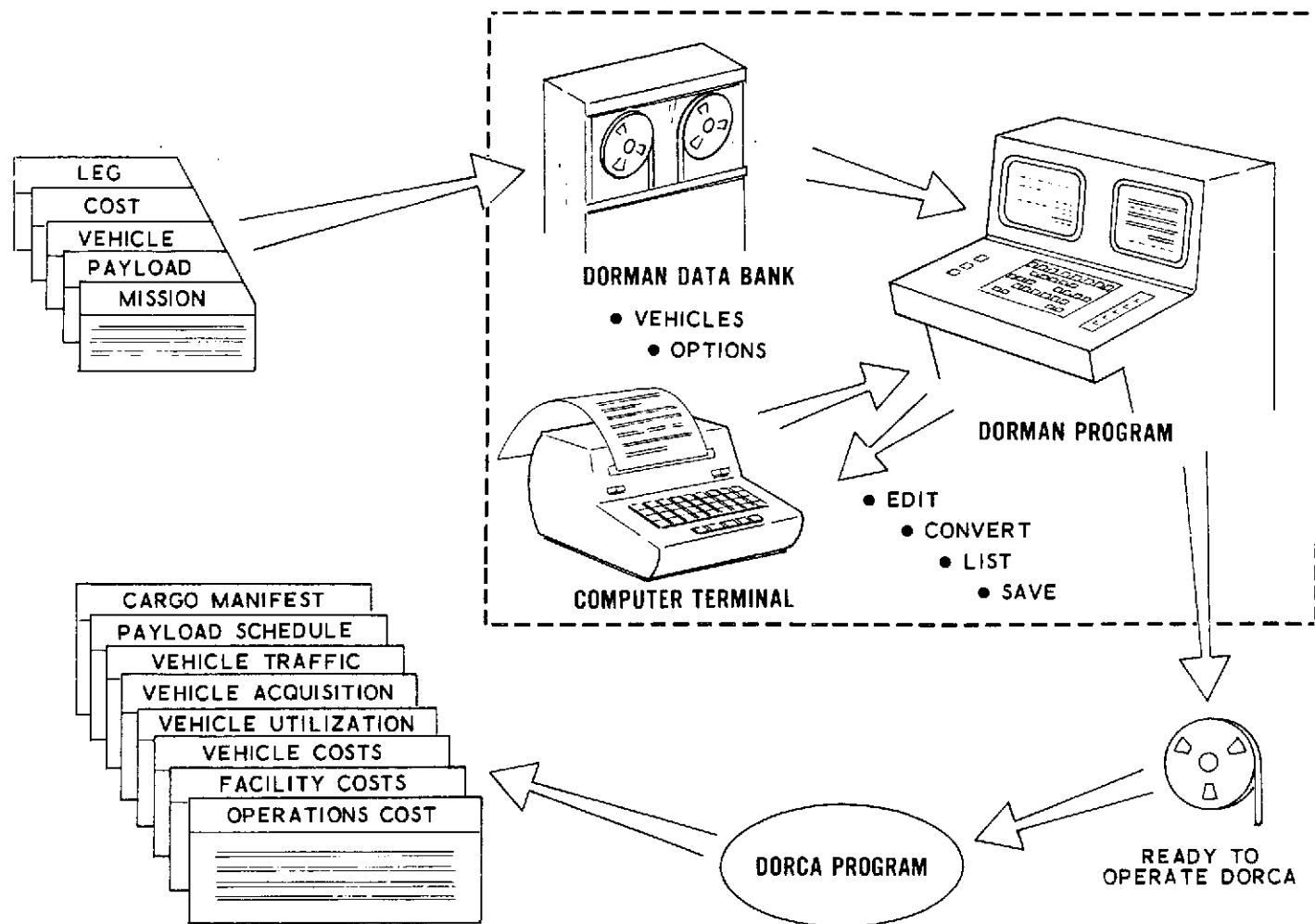
Figure 1. DORCA Applications

2. PROGRAM FEATURES

The DORMAN computer program is written in FORTRAN and is coded to be compatible with both the CDC 6000/7000 series machines and the UNIVAC 1108 with EXEC 8 control. With this arrangement future analyses can be performed independently or cooperatively by NASA and The Aerospace Corporation utilizing the DORMAN and DORCA programs. The DORMAN program code consists of 3384 80-column cards.

The DORMAN program provides the means to manage the voluminous DORCA program data files from a remote terminal console. It can create new data, add to or delete existing data, edit existing data, and compress considerably the existing data files. The data compression is accomplished by differencing two basic (reference) decks to obtain a relatively short mod deck, which is to be stored in place of one basic deck. The replaced basic deck can be regenerated when needed by applying the mod deck to the basic deck that was retained. To accommodate the numerous manipulations required for these functions, the program utilizes eighteen storage files (tapes or slots in mass storage). Seven of the eighteen are basically "scratch" files, for temporary storage of information used in the process of implementing the basic program features. The other eleven files are assigned as follows:

Tape No.	Function
1	Source of permanent data base. This tape cannot be altered via DORMAN; however, it can be copied and changes made to the copied version.
4	Current (temporary) version of data base.
5	Console input.
6	Console output.
11	Mod decks input by user.
12	Data decks to be used in DORCA analysis.
13	Current mod deck generated by basic deck differencing process.
14	Current basic deck being utilized by program.

Tape No.	Function
20	Print file for data deck listings.
21	Basic deck storage unit.
24	Mod deck storage unit.

The DORMAN program consists of one main routine (DORMAN) and 44 subroutines. The subroutines serve to implement the eleven basic options (commands) available in the program. A list of the options and the subroutines called by DORMAN when the options are invoked is given below:

Table 1. DORMAN Data Base Options

Input Command	Description	Subroutine
CREATE*	Create a new data base	INCRT
USE	Use existing data base	USER
OPTION	List options available	OPT
SAVE	Save a card file	SAVER
ADD*	Add deck to data base	ADDER
DELETE*	Delete deck from data base	DELET
EDIT*	Build mod deck via input	EDITER
CONVERT*	Build mod deck by differencing two basic decks	CONV
REPLACE	Replace deck in data base	REPL
LIST	Request listings	LISTER
DONE	Terminate run	TERM

*Of the eleven options, these perform the five basic functions required to manage the data bank. The other six options are used in support of, or as alternates to, the basic five options.

Most of the eleven basic options themselves have subordinate options that permit the user, through an orderly stepwise process, to communicate with all levels of the program.

During previous analyses utilizing the DORCA program it was often necessary to modify existing data decks in order to evaluate the effects of changing vehicle performances and/or changes in mission model composition. To accomplish this task the data deck first had to be physically removed from storage and a listing of the deck created. If a separate deck representing the modified conditions was also desired, the card deck had to be duplicated. The changes to be made then had to be identified, key punch sheets had to be filled out, and the change cards had to be key punched. These cards were then physically inserted into the deck and the deck submitted to the computation center to be input to the DORCA program. In addition to being very time consuming, this type of operation was fraught with chances for human error.

Operating via the DORMAN program reduces considerably the time involved and eliminates a number of manual operations, thereby reducing the risk of error. Via a remote terminal, the DORMAN program is called and readied for operation. Following are the steps to be accomplished:

a. Locate and access the data deck that is to be modified. This requires that the data deck be extracted from the data bank and placed on a file accessible to the remote terminal console. This basic operation is accomplished via the USER option in the program.

b. Verify that the deck extracted from the data bank is the desired deck. This verification is needed to assure that the impending modifications are made to the proper data deck. Verification is done by listing, via the LIST option, on the terminal console the card or cards containing the data deck identifiers.

c. Insert the new and updated data into the deck and remove the obsolete data from the deck. This procedure involves deleting some of the existing cards in the deck, changing discrete entries on others, and inserting cards containing new data to be added. DORMAN performs this editing function on card images via the remote console thereby

eliminating the necessity for manual manipulation of the actual cards. The editing function is accomplished via the EDIT option in the program and results in a mod deck representing a new basic deck.

d.   Verify that what has been done is correct. This verification requires a visual check of the modifications that have been made to the original data deck. This is accomplished by listing on the terminal console the contents of the mod deck created by the editing job.

e.   Save the new mod deck so that it can be subsequently analyzed by the DORCA program. The user may want to save the deck on a temporary basis or on a permanent basis depending on the magnitude and/or implication of the changes that were made. The program will add the data deck to the data bank for permanent retention via the ADD option or temporarily retain the deck on a storage file by invoking the SAVE option.

f.   Input the new data deck to the DORCA program for analysis. DORCA itself cannot operate on a mod deck so the DORMAN program applies the mod deck to the basic deck that was edited to synthesize the new basic deck for input to DORCA. DORCA then performs an analysis of the new input and documents the results in terms of information such as traffic rates, fleet sizes, and program costs. The conversion of the mod deck and its availability to the DORCA program input is accomplished via the SAVE option in the DORMAN program.

The procedures described in the foregoing paragraphs are illustrated in Figure 2.

The alternative to modifying an existing data deck for DORCA analysis is to input an entirely new basic deck containing virtually all new data. Once in the DORMAN program, the procedure to input the data to the DORCA program is the same as previously described. However, in this case it is not necessary to locate and edit an existing data deck, verify the mod deck created by the edit, or synthesize a new basic deck as in the previous example.

The CREATE option is unique in the sense that it does not involve the modification or deletion of existing data, but the creation of new data.
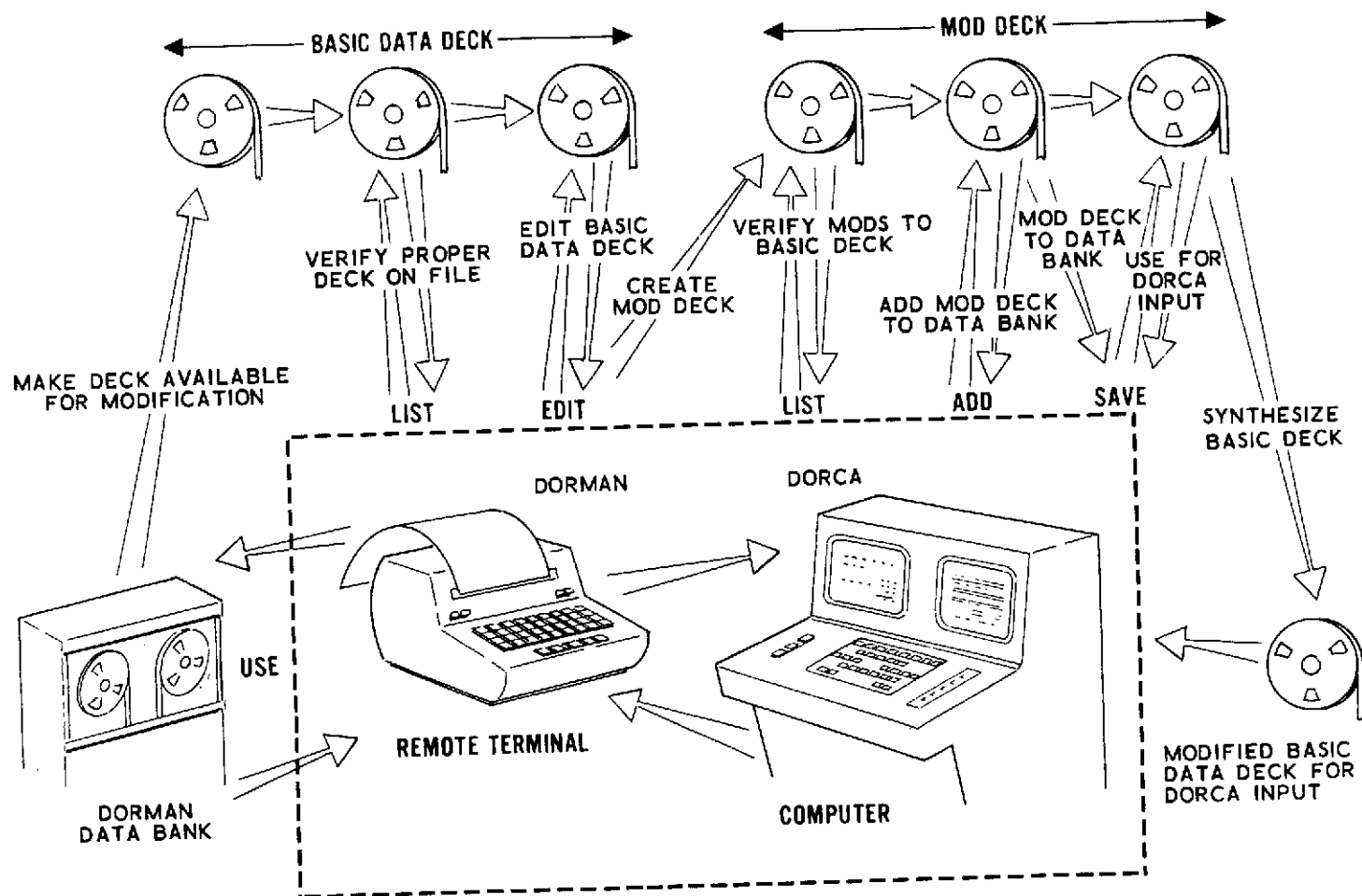
Figure 2. DORMAN Applications

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It is used primarily to introduce totally new data into the DORMAN program. It can be used in the interactive sense where data is entered onto a file via the remote terminal keyboard. Usually, however, it is utilized to introduce new data previously recorded on a file or tape from an existing card deck.

The balance of the options (i.e., OPTION, DELETE, CONVERT, REPLACE, and DONE) are utilized in the maintenance of the data bank or in aiding the user to operate the program. However, one option deserves a further explanation. It is the CONVERT option. It is the use of this option that permits the reduction in size of the data bank. It reduces two similar basic decks to a basic deck and a much smaller mod deck by determining and listing the differences between the two decks. The data bank can therefore be reduced to a few large reference basic decks and a multitude of smaller mod decks.

3. PROGRAM APPLICATIONS

The DORMAN program was developed to assist in the management of the voluminous input data decks generated in conjunction with analyses performed using the DORCA computer program. The analyses to date have required the development of five or six basic decks for investigating various mixes of payload designs and launch schedules along with launch and upper stage vehicles for deployment and retrieval operations. In addition, a large number of perturbations to these basic sets have been developed for various payload and vehicle alternatives. This has required many modifications to the basic decks in the form of additions, deletions, and changes to various data items.

The DORMAN program was designed to supplant the manual manipulation and storage of card files developed up to the present time. It has features which permit most of the previous manual manipulations to be handled in a remote sense and eliminates many of the human errors previously encountered with the card files. Practically any operation that might be required to maintain or modify data can be handled by the features (individually or in combination) incorporated in the program. While its primary application will be in the operation of the DORCA analysis, it is equally applicable to any program requiring the management of large quantities of data.