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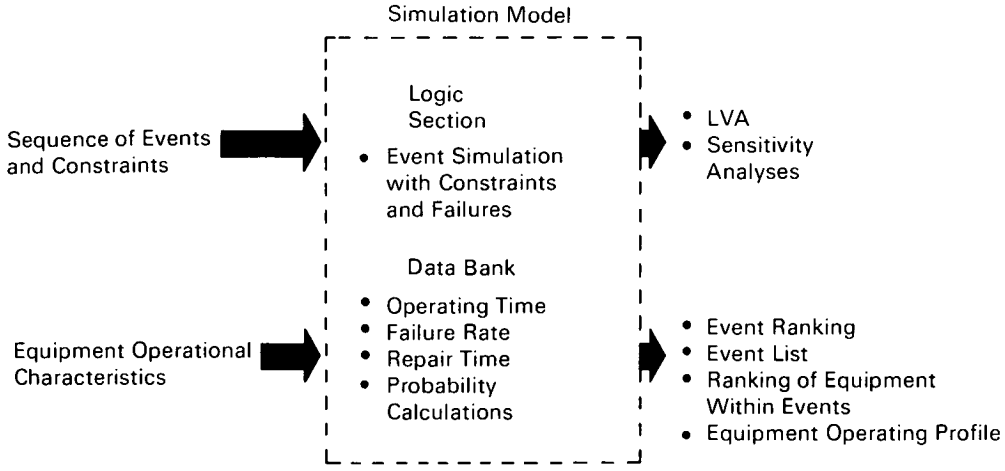
NASA TECH BRIEF

Programmed Schedule Holds for Improving Launch Vehicle Availability



To determine how much time and where holds should be scheduled, three items must be considered: (1) the most advantageous points for a prelaunch countdown hold; (2) necessary time length for each hold; and (3) the impact of hold locations and durations on the performance of the system. The basic inputs used for the analysis of programmed holds are developed through a prelaunch systems analysis. This analysis effort has two elements: baseline definition and system optimization.

Baseline definition includes the identification of design specifications for the ground support equipment from operations and maintenance concepts, and design specifications. These basics are used to describe the functional utilization of the overall flow process. Using these definitions, a Time Line Analysis (TLA) is developed which provides the series/parallel relationship of the utilization of Ground Support Equipment (GSE) in the prelaunch countdown. This analysis provides the basic logic for simulating the assembly, test, and checkout of the launch vehicle system.

A digital computer simulates equipment failures as predicted by the reliability analysis, and repair time as defined by the maintenance analysis. The model consists of a data bank and a logic section. The data bank stores all input data and performs calculations independent of the sequential logic. The logic section contains the sequential logic and the programs for compiling results.

The major output of the model is Launch Vehicle Availability (LVA) which is produced by simulating a series of launch attempts.

The method for determining the length of hold that maximizes LVA at each hold point is a searching technique. LVA predictions and independent time distributions are collected from the prelaunch simulation model. The independent time distributions

(continued overleaf)

provide the probability distributions for processing between successive hold locations. LVA prediction provides a baseline for comparison of different hold locations and amounts of hold time. Hold distributions, identified by the hold evaluator model, provide an assessment of the ability of the launch vehicle system to sustain a hold.

The model does not provide an assessment of the capability to sustain a hold. Hold constraints, dictated by equipment characteristics, are included as limiting factors in the logic's sequence.

The purpose of introducing holds is to optimize LVA by recognizing the cumulative effect of reliability and maintainability. The rationale is that equipment is unavailable for use only when a failure occurs and cannot be fixed within any time constraint which may be allowed. The complement of unavailability is availability. A >50% improvement in predicted LVA was achieved for the Saturn V Launch Vehicle.

Notes:

1. The information contained in this Tech Brief may be adapted to airline schedules, manufacturing scheduling, and construction scheduling.
2. Requests for further information may be directed to:

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   Code A&TS-TU
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   Reference: B69-10602

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