March 1973
B73-10104

NASA TECH BRIEF

Marshall Space Flight Center

A Summary Report on System Effectiveness and Optimization Study

A report has been published which discusses solutions to system optimization and system effectiveness. The report treats optimization and effectiveness separately.

System optimization involves a selection of subsystems which, combined, yield the best performance for a specified cost. The selection is based on the optimum choice of parameters, such as reliability, cost, weight, etc., that are considered critical to the system operation. Such selection is not an easy task particularly when several subsystems must be selected from numerous alternatives. Consider, for example, a system which calls for eight subsystems. If each subsystem has three possible design approaches, and if each approach involves a choice among ten different detailed designs, the total number of possible system configurations will exceed 600 billion. Obviously, an examination of each design is not feasible.

The proposed solution to system optimization lies in dynamic programming which provides several advantages as discussed below:

1. It is not necessary to curve fit a relationship among the various system level parameters. The elimination of this process reduces computational error and allows the subsystem parameter data to be used in its natural context.
2. The method not only provides the analyst with the optimum set of system level parameters for this requirement, but also indicates the subsystem configurations which result in this optimum system.
3. A large amount of peripheral data is generated in the solution of the original problem which, when given proper interpretation, can be used in performing trade-off studies.

The report illustrates an example of the dynamic programming solution to the system optimization.

System effectiveness, although closely related to system optimization, is an evaluation of a particular system design that measures its effectiveness. This measure must reflect the value of specific "characteristics" parameters considered to be representative of that which makes a system effective. To develop a solution to the effectiveness problem, the procedure must use the following phases:

1. Establishing parameters which are important to the functional requirements of a system and which characterize the qualities of effectiveness for the system.
2. Numerically evaluating the parameters at the level (system, subsystem, etc.) desired.
3. Relating the parameter values to the system level and quantifying them.
4. Weighting the qualified parameter values according to their relative importance.
5. Combining the weighted values to produce an overall system effectiveness measure (effectiveness index).

A computer algorithm has been developed for this technique and is included within the report. Effectiveness of this technique is demonstrated by a sample problem.

Notes:

1. The report may be useful to systems engineers and systems analysts.
2. Requests for further information may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Code A&PS-TU
   Marshall Space Flight Center, Alabama 35812
   Reference: B73-10104

Source: O. L. Williamson, A. J. Rydberg, and G. Dorris of
Federal Electric Corp.
under contract to
Marshall Space Flight Center
(MFS-22126)

Category 09, 02, 06