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STOCHASTIC DECISION ANALYSIS

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Small space flight project design at NASA Langley Research Center goes through a multi-phase process from preliminary analysis to flight operations. The process insures that each system achieves its technical objectives with demonstrated quality and within planned budgets and schedules. A key technical component of early phases is decision analysis, which is a structure procedure for determining the best of a number of feasible concepts based upon project objectives. Feasible system concepts are generated by the designers and analyzed for schedule, cost, risk, and technical measures. Each performance measure value is normalized between the best and worst values and a weighted average score of all measures is calculated for each concept. The concept(s) with the highest scores are retained, while others are eliminated from further analysis. This project automated and enhanced the decision analysis process.

Automation of the decision analysis process was done by creating a user-friendly, menu-driven, spreadsheet macro based decision analysis software program. The program contains data entry dialog boxes, automated data and output report generation, and automated output chart generation.

The enhancements to the decision analysis process permit stochastic data entry and analysis. Rather than enter single measure values, the designers enter the range and most likely value for each measure and concept. The data can be entered at the system or subsystem level. System level data can be calculated as either sum, maximum, or product functions of the subsystem data. For each concept, the probability distributions are approximated for each measure and the total score for each concept as either constant, triangular, normal, or log-normal distributions. Based on these distributions, formulas are derived for the probability that the concept meets any given constraint, the probability that the concept meets all constraints, and the probability that the concept is within a given amount of the best score. Formulas are also derrived for the probability that one concept's total score is within a given amount of a second concept's total score. These probabilistic calculations provide more realistic data entry and output information for designers, enabling designers to better determine which concepts to eliminate and which concepts to retain at the decision points of each design phase.