SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems (4)

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FORMULATING DISCRETE EVENT SIMULATION FOR DEVELOPMENT AND ACQUISITION COST ANALYSIS OF REUSABLE LAUNCH VEHICLES

Abstract

Future reusable launch vehicles are considered to have potential benefits compared to existing and/or expendable systems. These benefits are likely to arise from reductions in turnaround time and recurring operations costs in labor and materials, potentially at the expense of additional development and acquisition cost. Quantifying these operability and affordability benefits and associated non-recurring cost penalties, in some manner beyond using historical analogies, has proven difficult for the systems analysis community. To fully quantify whether these potential recurring advantages translate to overall programmatic benefits requires analysis of design, development, test and evaluation times and costs, along with total first unit and related acquisition cost metrics. SpaceWorks Engineering Inc. (SEI) has developed, through research and quantitative modeling, a discrete event simulation framework referred to as Descartes-Hyperport to predict turnaround time, recurring ground operations cost, and other operations metrics for future launch vehicles. The authors are now attempting to leverage this model to develop a similar model for Design, Development, Testing, and Evaluation (DDTE) and Theoretical First Unit (TFU) costs. This type of modeling goes beyond traditional historical modeling efforts by focusing on subsystem-level processes and how the resources required for these processes are utilized. The models are implemented in the discrete-event simulation software Arena, commercially available from Rockwell Automation. Inputs for the model include descriptions of the basic vehicle concept of operations, mission models, and performance information. Outputs presented include estimated times and costs. This paper presents some of the initial work by the authors in conceptualizing how a discrete-event simulation framework could be used for development and acquisition cost modeling. Strategies used for the modeling effort are described. These include capturing current aerospace manufacturing practices within the military/commercial aircraft, expendable launch vehicle, and satellite manufacturing communities. Additional insight is also provided by leveraging of non-aerospace industrial engineering techniques.