Paper ID: 14238
oral
student

SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Space Technology and System Management Practices and Tools (4)

Author: Mrs. Shari Keller
University of Alabama in Huntsville, United States

Dr. Paul Componation
University of Alabama in Huntsville, United States
Dr. Paul Collopy
University of Alabama in Huntsville, United States

# WHAT IS WRONG WITH SPACE SYSTEM COST MODELS? A SURVEY AND ASSESSMENT OF COST ESTIMATING APPROACHES

**Abstract**

U.S. space program costs exceed estimates by 45% leading cost analysts to tweak a 50 year-old mass-based parametric model, or continue to search for the elusive cost drivers thought to be intricately woven into such complex systems. The problem is approaching critical mass as space and defense programs fall under scrutiny from financially constrained governments seeking to justify the expense of delayed and over-budget programs. Similarly, cost and schedule performance continues to deteriorate for the International Space Station with total cost approaching $134 billion, and the UK Gray report indicates that managing the cost of complex programs such as space exploration is endemic in all countries.

University of Alabama at Huntsville's Center for System Studies is conducting fundamental research toward understanding cost in complex systems, using NASA's Space Launch System as a test bed. Can cost be made mathematically tractable like flight dynamics or heat transfer, where a set of equations connect cause to effect? This research intends to discover those equations or relationships, if they exist.

This paper documents an early step in that research, a search to identify and summarize different approaches to cost estimating. To achieve this purpose, a structured literature review surveys techniques, approaches, models and conceptual tools related to space program cost estimating. Some of the useful approaches include 1) Lifecycle Cost, 2) Work Breakdown Structure, 3) Physical, Performance and Program Parameters, 4) Root Cause Analysis, 5) System Decomposition, and 6) Process-Based Modeling. Conceptual tools and models set forth by Barry Boehm, Dan Galorath, and Christian Smart, and models such as COCOMO, SEER, PRICE, and NAFCOM address many of the key cost drivers and sub-system cost drivers in these categories.

The analysis maps the models and techniques to categories of cost estimating approaches, revealing strengths, weaknesses, and gaps in the existing framework of methodologies. The results provide insight to why the existing models are inadequate. The paper concludes with recommendations for areas of focus to improve prediction and control of space program costs.