

SPACE SYSTEMS SYMPOSIUM (D1)
Lessons Learned in Space Systems (5)

Author: Mr. Gregory Dubos
Georgia Institute of Technology, United States, greg.dubos@gatech.edu

Mr. Alexander MacDonald
National Aeronautics and Space Administration (NASA), Ames Research Center, United States,
alexander.c.macdonald@nasa.gov

TRACKING COST AND SCHEDULE GROWTH OF UNMANNED SPACECRAFT: LESSONS
LEARNED FROM NASA'S CADRE DATABASE**Abstract**

Predicting and controlling cost and schedules of space missions is a perennial challenge in space programs around the world. While general hypotheses concerning reasons for cost and schedule growth have been formulated and single case analyses have been conducted, very few studies have approached this problem from a statistical perspective. The main reason for the scarcity of detailed studies concerning space systems is the difficulty in obtaining cost and schedule data for a large number of missions in a systematic and consistent manner. Partly in response to this need, NASA initiated the Cost Analysis Data Requirement (CADRe) studies, to collect and record the cost and schedule history of NASA missions.

This work uses CADRe data to investigate what lessons can be learned regarding cost and schedule growth of NASA's space systems. First, we identify trends in engineering and programmatic cost growth by considering their estimates at different milestones of the development of the space systems in the database. Second, we explore the reasons for schedule growth, by looking at the difference between the actual post-launch schedule and the estimated schedule at various mission milestones. We then discuss the possible correlation between the derived scheduled and cost estimates and various design parameters, such as mass, nominal power, and design lifetime. We find a number of interesting phenomena including: an inverse correlation between schedule growth and the number of instruments on a spacecraft; evidence for "rush to failure" behavior in the detailed design phase; and a trend in "soft" program elements (e.g. project management and software) that sees cost estimates reduced going from PDR to CDR followed by a strong increase from CDR to launch. We also identify the extent to which cost and schedule growth are coupled phenomena in our data sample. Finally, we make recommendations on how to record cost and schedule information for the CADRe database more consistently based on our experience in collecting the data used for this study.