

Flight Software Trends and Patterns in the Aerospace Industry: JPL Lessons Learned

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The Engineering Cost, Risk and Systems Analysis Group at NASA's Jet Propulsion Laboratory has been collecting software cost metrics, developing parametric cost models and performing cost analysis since 1986. As in industry, JPL over the years has experienced numerous changes in how we develop both flight and ground software. Software languages, design methods and development processes have all changed from what they were in the early to mid 80's. It used to be that our spacecraft were primarily flying hardware with a minimal computer on board. Today our spacecraft are more and more becoming flying computers especially with the advent of sophisticated fault protection and auto-navigation software.

Because software is playing a more critical role in our deep space missions there has been a significant increase in interest in software at JPL. Recently the Software Quality Improvement (SQI) Project has been formed to achieve and sustain excellence in software engineering at JPL to enable mission success. It will enable and promote software best practices, and leverage JPL experience in software engineering in support of major software projects, throughout the entire software life-cycle. The goal of the SQI Project is to establish an operational software improvement program that results in the continuous measurable improvement of software quality at JPL. Its objectives include improving cost and schedule predictability, improving the quality of mission-critical software, reducing software defect rates during testing and operations, increasing software development productivity, promoting software reuse, and reducing project start-up time.

In support of the SQI project, we are validating and calibrating commercial parametric tools such as COCOMO, SEER-SEM and Price S as well as developing our own models. There is a major focus on developing a JPL version of the COQUALMO model to provide defect introduction and removal estimates as part of our cost estimation activities. As a result of integrating our cost databases and engaging in an extensive data collection activity it has also become possible to analyze the historical datasets for trends in software development cost, productivity rates, as well as some schedule and quality-related metrics. In this paper we will summarize our activities as well as the software trends and their impact on the cost of developing flight and ground software.