

## Managing Risk in Cost-Capped, Time-Constrained Robotic Space Missions

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Over the past decade of robotic space exploration, NASA has been transitioning from the paradigm of implementing a few "large" (> \$1B) projects to that of more "smaller" (< \$600M) projects. NASA's 2003 Strategic Plan for the Space Science Enterprise now employs a strategy that lowers mission costs while preserving, to the greatest extent possible, mission performance. To do so, NASA "will accept prudent risk, shorten developmental times, explore new conceptual approaches, streamline management, and make other changes to enhance efficiency and effectiveness." In other words, cheaper, faster, better are still fundamental. However, with the objective of more projects with shorter developments at lower cost, change in the risk metric is a corollary. The subjective key word is "prudent" as the adjective for risk. To find the prudent risk management approach to robotic space projects involves consideration of a number of the project implementation processes. For example, there are crucial relationships between baseline task planning, the significant risk list (SRL), probabilities of occurrence, the engineering change process, reserves release, configuration management, earning value, and contracts. This paper describes the key process interactions and techniques for effective risk management developed during the author's experience as project manager for NASA's *Stardust* mission to collect and return dust from comet Wild-2. *Stardust* launched on time, February 7, 1999, with a little over one million dollars remaining in the development reserve. This was transferred to increase reserves in the flight phase. *Stardust* has logged over 4.5 years of successful flight and is in excellent condition to make a successful flight through the dust cloud of Wild-2 next January. The key lessons in designing-to-cost and managing-to-budget with prudent risk are continuing to flow into JPL project processes and practices.

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Ken, former project manager of NASA's *Stardust* mission, retired in February 2002 but continues part-time providing mentoring/education for project managers. Ken's career spans mission analysis, power systems, avionics systems, and project management Ken's background: 33 years JPL, PhD-University of Illinois ('74), 9 years as USAF officer/pilot.