Abstract for IAA International Conference on ow-Cost Planetary Missions

Advanced Technology-Based Low Cost Mars Sample Return Missions"

By

Richard A. Wallace, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91 109;
R. Terry Gamber, Benton C. Clark, Lockheed Martin Astronautics, Denver, CO 80201

Mars Sample Return (MSR) has for many years been considered one of the most ambitious a-s well as most scientifically interesting of the suite of desired future planetary missions. Previous studies have ended with cost estimates for MSR of several billion dollars. Proposals for large budget planetary missions do not fare well in today's low cost exploration environment. This paper defines low-cost MSR mission concepts based on several exciting new technologies planned for space missions launching over the next 10 years. The new Mars Exploration Program is a series of planned missions requiring on the order of $125 million dollars per year, a modest budget considering planned launches of Mars missions over the next five available Mars opportunities. The technologies and infrastructure developed for Mars Surveyor by 2003 will enable low cost MSR missions. Several of these low cost MSR mission concepts might fit within the Mars Exploration Program's annual budget and still maintain the desired frequency of launch schedule.

Key to reducing cost for the low cost MSR mission concept is the use of advanced technology. A presumption at the outset is that advanced spacecraft and electronics technology will allow significant reduction in Earth-injected mass by the time of the first MSR launch. This presumption is referenced in the paper to on-going technology programs. Some advanced technologies covered in the paper that could permit cost reductions are integrated electronics, low mass/low power spacecraft subsystems, sample handling and transfer technologies, propulsion advances, and precision landing. Such mass reductions will allow use of low cost launch vehicles such as the Med-Lite and other Delta-derivative launch vehicles.

Payoff parameters for judging the worth of the different MSR options are cost, science return, new technology transfer/ infusion for later space program and civilian/commercial use, and risk. Sample collection, technology choice, and surface stay-time are significant mission/system design drivers and are parameters varied among the options described in the paper. Mission options described range from simple courier service of samples collected by previously launched mission landers in the Mars Exploration Program to concepts that manufacture their own propellant on Mars for the sample return to Earth.

The ideal MSR mission might be one costing a total of $250 million or less (including launch vehicle), with a short mission duration, excellent science sample selection, and low risk both in technical implementation and technology development. Various concepts described in the paper are compared to this ideal, with most excelling in one or more category.

* The research described in this paper was performed at the Jet Propulsion 1. aboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration and at Lockheed Martin Corporation under JPL Contract # 959902.