

Tentative Title: Revolutionizing Access to the Martian Surface

Point of contact: Abigail Fraeman (Abigail.a.fraeman@jpl.nasa.gov, 626-616-5071); Paul Niles (paul.b.niles@nasa.gov)

Authors (not necessarily in order): Abigail Fraeman (Jet Propulsion Laboratory, California Institute of Technology), Paul Niles (NASA Johnson Space Center), Chris Culbert (NASA Johnson Space Center), Bethany Ehlmann (Caltech), Many Others

Link: [Google Document Draft](#)

Link: [Keck Institute for Space Studies Workshop Page](#)

Brief description: Mars exploration has progressed to a point where many of the most pressing scientific questions and needed measurements can only be addressed by missions to the surface. These measurements include compositional, sedimentological, and isotopic studies of Mars rock stratigraphies to search for life and decipher drivers of changing habitability, the drilling and study of subsurface ice, and study of active geophysics and near-surface meteorology.

This white paper will explore new cost-efficient approaches that could enable the cadence of multiple landed missions at Mars that are demanded by the key science questions. Historically, NASA missions to the Martian surface have thus far had a high per-unit cost because they are one-of-a-kind and push the envelopes in many technical areas simultaneously. Costs might be lowered by employing multiple craft builds that were hallmarks in the earliest NASA missions and successfully echoed with twin Mars rovers in 2004. In addition to enabling enormous scientific return and unexpected discoveries, multiple mission approaches would be beneficial to mitigating programmatic risk (e.g. no failure could adversely affect a single multi-billion-dollar mission effort), allow some budgetary flexibility by spreading costs over time, reduce cost risks related to new technology development required for spacecraft operations, and shift technology development efforts to scientific instrumentation.

Innovations driven by the commercial sector may also provide a mechanism for reducing per/mission cost of surface Mars missions. This approach is already being explored for Lunar Science in the Commercial Lunar Payload Services (CLPS) program, and lessons learned through these efforts may be applicable for changing the paradigm of how we explore Mars.

Finally, our ability to manufacture and operate fleets of spacecrafts in orbit is improving through increased systems autonomy, reduced launch costs, shrinking instruments and spacecraft size, the emergence of secondary launch opportunities, and the growing role of the commercial sector in scientific space exploration. The advancements may also be applied to reduce costs of future Mars surface missions.

Some of the authors of this white papers are organizing and participating in a workshop through the Keck Institute of Space Studies (KISS) that will also study the question of how to substantially reduce the cost associated with landed missions to Mars in depth. Participants in this workshop include scientific and engineering experts across academia, government, and commercial industry partners, and the group will examine novel system designs (e.g., for delivery to Mars, entry-descent-landing, landed asset design, operations) and cost models, institutional/project management processes, and non-traditional partnerships with industry. The three primary goals of the workshop will be: (1) Identify the most important measurements related to Decadal survey science questions that require distributed measurements at the Martian surface, and what instruments/platforms/mobility are required to achieve them, (2) Conceive the mission architecture to access the Martian surface (entry-descent-landing; EDL) and conduct efficient operations of multiple Mars assets, and (3) Identify how/if emerging commercial lunar capabilities can be leveraged to break the mass-cost dependency for Mars surface missions.

Although findings from the in-person workshop will be not available by the Decadal Survey White Paper submission deadline as originally hoped (Workshop postponed due to COVID-19), relevant discussions during preliminary planning telecons may be integrated into this submission.

Status: Paul Niles has been leading group discussions on this topic for several months, and there is currently a white paper rough draft on this topic. Planning for the KISS workshop began several weeks ago, but has slowed due to workshop postponement.

Involved/collaboration: Looking for people to both contribute ideas and co-signatories on the effort being lead by Paul Niles.