MARS SURFACE MOBILITY: COMPARISION OF PAST, PRESENT, AND FUTURE ROVER SYSTEMS. G.R. Wilson[1], J.M. Andringa[1], L.W. Beegle[1], J.F. Jordan[1], G.S. Mungus[1], D.A. Muliere[1], J. Vozoff[1], and T.J. Wilson[1]. [1]Jet Propulsion Laboratory, 4800 Oak Grove Drive, MS 183-501, Pasadena, CA 91109 USA (gwilson@jpl.nasa.gov).

Introduction: The future robotic and human exploration of Mars will rely heavily on mobile system to meet exploration objectives. In particular, the next decade of exploration (2009-2020) will utilize rovers and other mobile surface platforms to conduct a wide variety of tasks, including in the search for water and life, characterization of terrain and its geology, and conduct precursor measurements prepare for future human exploration.

Objective: The objective of this study was to explore past, present, and future Mars rover concepts and compare their cost, size, and performance metrics in the context of the goals and objectives of the Mars Exploration Program. Numerous rover designs and concepts have been developed at the Jet Propulsion Laboratory, including the successful Mars Pathfinder Sojourner rover, the Mars Explorations Rovers Spirit and Opportunity, and the next generation Mars rover MSL. In addition to these rovers, numerous concept studies have also been conducted and are included for comparison purposes. The goal of this study was to explore the "continuum" rovers designs over the widest possible range so that decision makers and mission planners can understand, to first order, cost and performance of future mobility system.

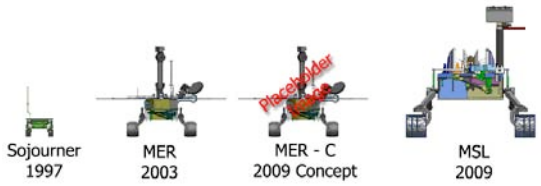

Figure 1. A scale comparison of four JPL rovers. (L to R) Mars Pathfinder Sojourner, Mars Exploration Rover (MER), a 2009 nuclear powered MER follow-on mission called MER-C, and the 2009 Mars Science Laboratory.

Analysis: Figure 1 shows the relative sizes of four rover concepts developed at JPL. Table 1 compares the rover mass, mass of instrumentation, number of instruments, and the number of samples that can be analyzed by an analytical laboratory by the four rover concepts. As requirements on mobility, sample analysis, and number of instruments increase, so does the size of the rover. The exact dimensions and mass of the rover depend on the type power source and mobility requirements.

Table 1- Mass of the rovers as compared to the instrumentation. Note: Mass of the instruments does not take into account arms, masts, and drill. "# of Samples" represents the number of samples analyzed by analytical instruments.

	Sojourner	MER	MER-C	MSL
Mass of rover (kg)	10.6	183.5	226.6	??
Mass of instruments (kg)	~ 1 kg	5.5	23.6	49
# of instruments	1	6	9	11
# of Samples	0	0	8	25-75

Table 2 compares the scientific objectives of the rover mission. Note that MER-C and MSL rover objectives are identical and that differences in mass are functions of the mission performance, particularly the number of sample that can be analyzed.

Table 2- Mission goals of the four rovers compared in this work.

Rover	Mission goal.
Sojourner (Pathfinder)	The mission seeks to demonstrate technology, and determine the elemental abundances of surface rock.
MER	The mission seeks to determine the history of climate and water at a site on Mars where conditions may once have been favorable to life.
MER-C	The mission seeks to explore and quantitatively assess Mars as a potential habitat for life, past or present.
MSL	The mission seeks to explore and quantitatively assess Mars as a potential habitat for life, past or present.

Figure 2 shows the cost per kilogram of rover mass as a function of rover mass for 18 rover concepts. Not surprisingly, as the mass of a rover system increases, the cost per kilogram decreases due primarily to increases in system efficiencies. For

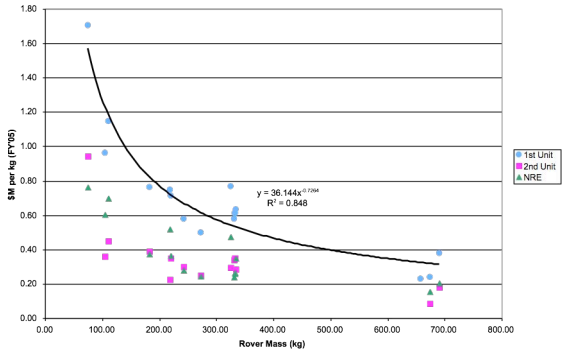

Figure 2. Cost per unit mass as a function of total rover mass for 18 rover concepts studies at JPL.

future rover concepts, a balance must be struck between the total rover cost and system efficiencies desired. Current analyses show that rovers between 300 and 400 kg have the most overall affordability.

Conclusions: Eighteen past, present, and future rover concepts were compared. Data indicate that a "continuum" of rover cost and performance exists.

As the Mars Program prepares for the next decade of exploration it is imperative that we understand the cost and performance of future mobility system.