USC ASTE-523 -- Spring, 2023
The Design of Low-Cost, Space Missions
A Near-Term, Income-Generating, Lunar Settlement

Homework Set #4 -- Due 2/16/23

This course is concerned with colonizing the Moon. However, one of the bigger topics in the colonization arena is whether to colonize the Moon or Mars. The first question is effectively a short survey of the people in the class. For Mars, the trip times and stay times are largely fixed by the syndoic period between the Earth and Mars -- i.e., you have to start and return when the planets are lined up so your target will be there when you get there. (There's no good way for you to hang around and wait for Mars or the Earth to show up, especially if they've already passed.) That's not a major problem for the Moon. I can go to the Moon and return almost any time. Of course, I would typically prefer to be on the Moon during the daylight for whatever location I'm at. Here's some basic data:

Mars tours:	
Tourist total round trip time	970 days (2.66 yrs)
Stay time on Mars	454 days (1.24 yrs)
Working on Mars:	
Probable minimum tour of duty	6.9 yrs
Moon tours:	
Tourist total round trip time	14 days or 36 days
Stay time on the Moon	7 days or 29 days
Working on the Moon:	
Probable minimum tour of duty	3 yrs (could vary)

For working on the Moon or Mars, we assume that you would take your spouse and kids with you and that communications back to Earth was quick and easy. (Not quite so quick for Mars. The time from when you say "Hi" to when they say "Hi" back varies from 10 min to an hour and a half, depending on where Mars and the Earth are in their orbit.) Answer all of the questions as though someone else were paying for the cost of the trip.

1. Your gender?
   Are you married?
   Do you have kids?
   Would you visit the Moon as a tourist? (1=No to 5=Yes)
   Would you visit Mars as a tourist? (1=No to 5= Yes)
   Would you consider getting a job on the Moon? (1=No to 5= Yes)
   Would you consider getting a job on Mars? (1=No to 5= Yes)
   Any comments on either trip?

   There is no right or wrong answer here. We are trying to collect people's opinions and ideas which we'll summarize it for the class.

2. In today's space business, small businesses appear to have an advantage in terms of reducing mission cost. Explain why they have an advantage in space, but don't appear to have a similar advantage in producing low cost automobiles. Do you believe that this advantage will extend to building settlements on the Moon? Why or why not.

3. The environment on the surface of the Moon is remarkably brisk with nighttime temperatures falling to about 100K (–280°F). Mars is not quite as cold, but is a much harsher thermal environment. Explain why. How might you design or operate hardware to withstand the cold lunar environment at low cost?

4. A particularly insidious problem for the cost of government space system programs is a time lag between mission phases caused by the decision making process (evaluate phase J before proceeding with phase K), the funding process (Congressional appropriations and flow-down), or simply bureaucratic inertia. Explain why this drives up cost and why it is particularly damaging within small organizations. Give four approaches for trying to solve this problem.

5. In your own words, explain both the advantages and disadvantages of using industrial, non-space-qualified hardware inside a space settlement on the Moon.

6. We are proposing a major paradigm change for space hardware by using normal commercial hardware inside a settlement on the surface of the Moon. Give 5 examples of products or services (not necessarily space-related) which have undergone a major paradigm change since ~1990 resulting in dramatic cost reductions per unit of performance. For each, briefly explain what has brought about the change.

7. In your own words, explain the principle differences in terms of cost between the Traditional Lunar Habitat, the O'Neill Lunar Settlement, and the O'Neill Space Colony. Why are these differences so large?

8. Explain why living in a large O'Neill enclosure on the Moon will dramatically reduce the time, cost, and challenge of lunar business, science, and living.