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HW # 9: Trade Study: Long-Stay vs. Short-Stay Mars Mission
Group 4: [redacted]
Due: Friday, April 11, 2008

-3 for No sentence format

1. As a group, provide the following:
   a. Do you agree with the trade study recommendation? Why or why not?

      - Yes, we agree.
      - Long stay missions
        - Longer stay!
        - Maximizes mission return
          - Most favored to optimize scientific yield
          - Maximal use of human "on site" capabilities
          - 100 kg's surface mobility
          - Drilling
          - Lab studies on site (in situ)
        - Gives greater mission flexibility
          - Ability to handle any off-nominal events
          - Time for re-planning and contingencies
          - Ability to reach ranges at greater distance from the landing site
          - Operations don't have to be highly scripted
        - Mission Mass, vehicle size, cost, and overall risk are comparable to short term mission

   b. What particular criticisms does your group have with the analysis?

      - Human Health & Performance
        - Explored but not complete
        - Need to be reviewed for a more complete analysis to be done
        - If the health aspects prove to be debilitating for a long-stay mission it might end the feasibility of using this approach.
          - When talking about Physiological Countermeasures, the trade study says, "The surface phase is outside experience base, but will be mitigated by Lunar Outpost experience". However, this has not yet been done, and they are justifying the long term stay based on something that has not yet occurred.

good pt

        - More information on how the neurological and other medical risks were assessed (reference to studies)
      - Inconsistent terminology
        - Conjunction vs. Long-Stay vs. 500 days vs. 550 days

    - Opposition vs. Short-Stay vs. 30 days vs. 40 days
- Ambiguous terminology
    - Ample
    - Inadequate
    - Goal Satisfaction
    - Useful
- Not enough numerical data

-5

c. What additional information would your group have liked included in the trade study?

war in g.e. a provided to your group

- How many missions are planned/Are future missions dependent upon initial success?
- What do we want out of the mission?
- What science missions are planned or expected?
- References to where they got their information (studies, papers, etc)
- More numerical data to support decisions (aside from the graphs)

↳ on what particular topics?

d. Was the trade study data adequately displayed? Good example and/or bad example? (examples in slide show)

- Graphs
    - Good amount of graphs
    - Provided a good amount of information
    - Followed text summaries
- Could not always determine the accuracy of the graphs
    - Where did the data come from? (experiments, NASA guidelines, etc.)
- Inherent positive bias existed for the Long-Stay mission, and a negative bias for the Short-Stay mission

good pt quality of data comes into question

e. Did your group agree with the selected figures of merit? Why or why not?

- Yes, we agree.
- However:
    - Weighting scale is not clear
        - Was each FOM weighted the same or were some FOM's weighted more heavily?
        - FOM "values" should be more quantitative for certain FOM's (i.e. Cost should be in $, not "Somewhat more")

yes

- Probability of Loss of Crew/Mission
  - Did not seem to factored into decision
  - Even though the differences were small, they should still be factored in because "Loss of Crew/Mission" is extremely important, and is likely weighted heavily (even a 2 or 3% difference makes a major impact in the final decision)
  - Graphs appear to show a notable difference
  - "Loss of Crew/Mission" requires more analysis before a decision can actually be made

exactly that's what my new team thought

a. Do you agree with the trade study recommendation? Why or why not?

Long-Short Recommendation

- **Based on the Figures of Merit and Other Considerations, the study team recommends that the Long-Stay mission be used as the approach in Design Reference Architecture 5.0**
  - Maximizes mission return
  - Greater mission flexibility
  - Similar total mission mass
  - Equal / constant vehicle size
  - Slightly greater cost with greater mission return
  - Similar overall risk (slightly greater mission success risk for greater mission return)

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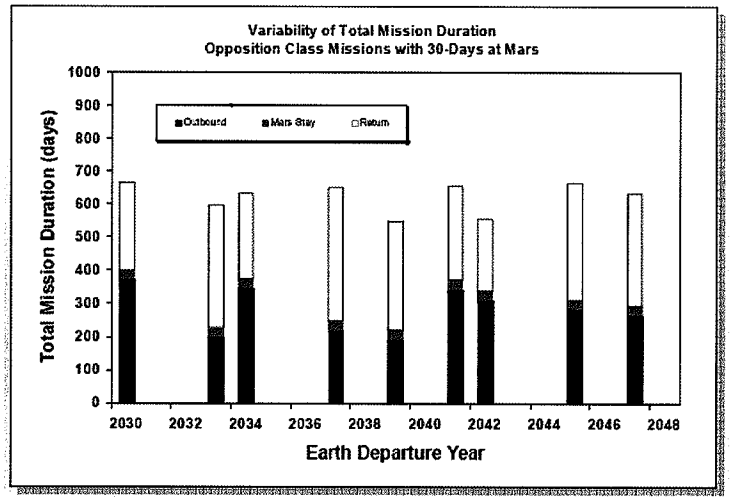
Good Graph

Opposition Class Missions

(Short-Stay)

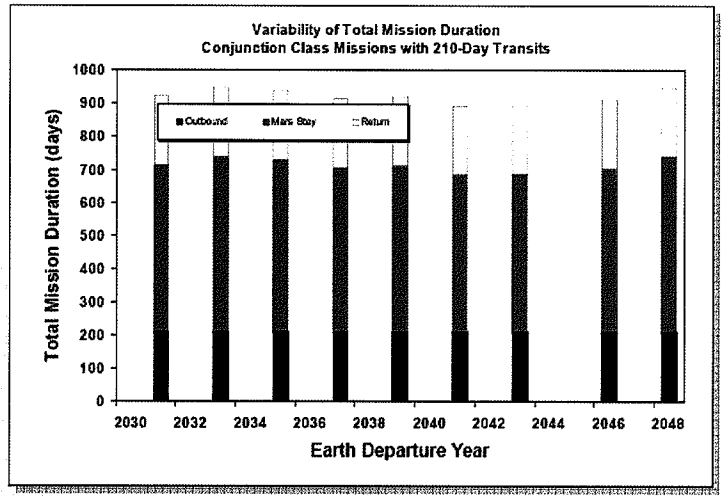
Total Mission Duration



Conjunction Class Mission

(Long-Stay)

Total Mission Duration



This graph provides a lot of information, and does a good job at conveying the amount of time of the mission spent either in transit or on the Mars surface.

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Bad Graph

Architecture Gear Ratio (kg/kg)

	Short-Stay		Long-Stay	
	NTR	Chemical	NTR	Chemical
Cargo: $\Delta M_{IMLEO}/\Delta M_{MO}$	2.09	3.39	2.09	3.29
Crew: $\Delta M_{IMLEO}/\Delta M_{MO}$	2.90	5.67	2.14	3.99
Crew: $\Delta M_{IMLEO}/\Delta M_{TE}$	4.35	13.89	2.58	6.42

ΔM_{IMLEO} = Initial Mass in LEO ΔM_{MO} = Mass in Mars Orbit ΔM_{TE} = Round-Trip Mass LEO/MO/Trans-Earth

It is not clear why this table is useful. It does not convey information clearly and no trend can be observed because of the way the data is presented. What are we supposed to take from this chart?

e. Did your group agree with the selected figures of merit? Why or why not?

Figures of Merit Summary

Human Exploration Of Mars

Long Surface Stay (Conjunction Class)	Figure of Merit	Short Surface Stay * (Opposition Class)
Similar	Total mass in Low-Earth Orbit (mt)	Similar *
Similar	Number of Ares-V Launches	Similar *
45% Smaller	LEO Complexity / Size of Crew Vehicle	Larger
~3100 crew-days	Expected Useful Crew Days on Surface (mission return)	~84 crew-days
Best	Exploration Goal Satisfaction (range, depth, frequency)	Lower
3 / 6 kg/kg	Architecture Sensitivity (gear ratios: NTR/Chem)	4 / 13 kg/kg
No Clear Advantage	Probability of Loss of Crew	Somewhat Less
Somewhat Less	Probability of Loss of Mission	No Clear Advantage
950	Total Mission Duration	650 days
500 days	Mission Flexibility (contingency replanning)	Few days
Less	Crew Exposure to Radiation	More
200 / 500 / 200	Crew Exposure to Zero-G (days out / surface / back)	180 / 30 / 360
Available	Backup Lander and Surface Habitat	None
Somewhat More	Cost Through First Mission	Slight Advantage
Somewhat More	Cost Through Third Mission	Slight Advantage

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