

My Background

- B.S. Theoretical Mathematics - MIT
- B.S. Aeronautics and Astronautics – MIT
- M.S. Aeronautics and Astronautics – MIT
- PhD – somewhere in between
 - Space transportation architectures for long-term space exploration
 - Non-traditional problem solving

Thinking about problems

- Problem formulation (modeling) is 50% of the solution
- Traditional reductionist approach: separate the problem into sub-problems and tackle them individually
- CDIO mantra – conceive, design, implement operate
- Modern approaches: Spiral development, multi-objective design optimization, lifecycle considerations

What are “hard” problems

- Gravity works against us – lifting 100s of tones in Earth orbit
- Complex tasks, remote environments
- Safety – humans in space
- Accident/hazard mitigation

Assumptions

- Heavy assumptions about existing technology
- Laws of Physics

Honored Expertise

- Deep technical knowledge is revered
- Ability to come up with a design/solution given limited components (think Apollo 13)
- Test-case oriented thinking
- Back-of-the-envelope expertise

Good or elegant designs

- “An engineer is someone who can do for a buck what any damn fool can do for 2”, Ed Crawley
- Traditionally: Simple, clean-cut, cheap, minimalist, satisfying requirements, something that works!
- Modern View:
 - Design works today and will tomorrow
 - Reconfigurable, smart, self-repairable
 - Can survive remotely
 - Systems (designs) can be extended as new technologies come in