

An exploration architecture for the Moon and Mars

Top Priorities

Safety Long term vision Commercialization

Mission Success Sustainability

Priorities for each International Partner:

What is best for crew safety?

What is best for our nation?

What is best for our Space Agency?

What is best for our Space Program?

What is best for our contractors to commercialize space?

NASA can and should lead the exploration of the Moon and Mars.

Water Ice has been detected on the Moon.

Millions of pounds of propellant are needed for the Journey to Mars.

Ground Truth verification of plentiful Lunar Water Ice could lead to a business model to supply outbound spacecraft.

Plan the most efficient path forward to the Moon and Mars.

Zoom out to the “big picture” and outline the whole spectrum of activities from initial resource characterization to commercial exploitation.

Draw on the appropriate NASA/International Partner centers of excellence and corporate sponsors/partners.

Simplicity and efficiency is the overall goal.

NASA should focus and maximize commercial involvement with new non-traditional commercial partners and international contributions.

There is money to be made in space, not just corporate welfare or jobs programs.

The Moon should be a “dress rehearsal” for Mars.

Anticipate and facilitate a rapid handoff of lunar assets to commercial entities for exploitation.

Learning to live off the land should be the highest priority after crew safety.

Potential use of 3D printed (Earth/Orbital/Lunar or Mars surface) components should be part of the architecture.

Commonality, and standardization between systems is to be maximized, including Lunar and Mars variants.

Avoid dead-end single use or unique components.

The parts list should be as small as possible, with common fasteners, connectors, and interfaces.

Minimize the number of tools needed for routine maintenance/disassembly.

Repair and cannibalization of common hardware will enable high operational readiness and simplify the logistics stream.

The International Space Station (ISS) provides lessons learned for large scale system integration and a logistics/spares.

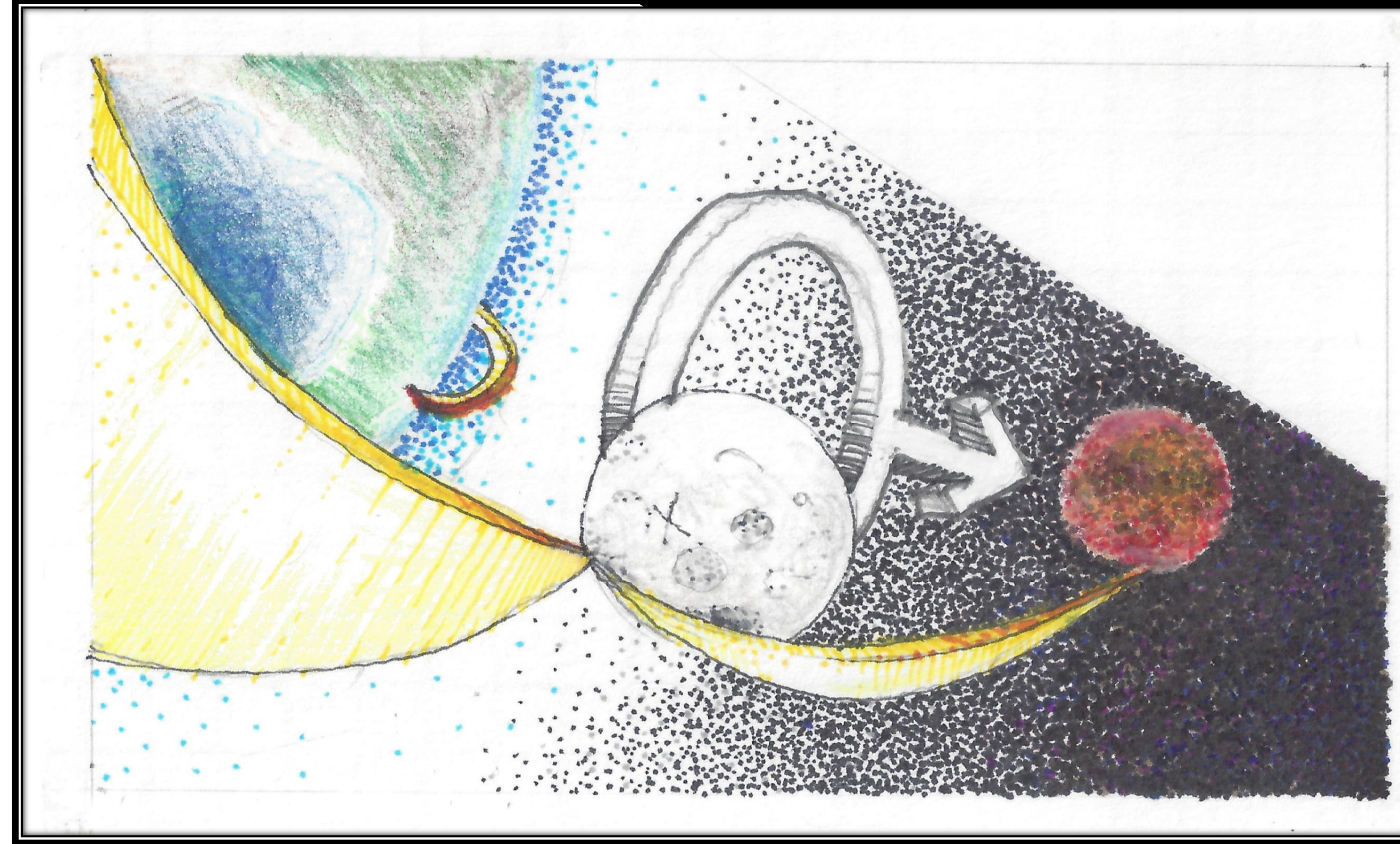
Perhaps the most important benefit of the construction of the International Space Station (ISS) is the establishment, and maintenance of international partnerships in space.

An international crew living and working in peace on ISS perhaps serves as a de-escalating force on earth regarding potential armed conflict between international partners.

A transition plan and schedule from government to the private sector needs to be part of the Mars and Moon campaign.

NASA and international partner space agencies need to characterize survival resources available and then quickly step out of the way to allow the free enterprise system to take root.

Prosperity can result from a thoughtful space policy for the expansion of commerce outward from planet earth to the Moon and Mars.



An accurate, integrated Computer Aided Design (CAD) model in a common CAD format and coordinate system is critical

- ISS hardware providers could and did provide CAD models in any CAD format, coordinate system and measurement unit system convenient to them
- Competing/conflicting requirements/teams adding hardware
- Future virtual design, real world assembly verified by 3D CAD virtual assembly and operation will provide maximum probability of success.

Making the 3D CAD model match flight hardware reality was and is a major challenge

The author played a role in assuring the first time fit of the assembly of the major ISS elements on orbit

- Charter ISS Digital PreAssembly Lead - First hand experience taking precision measurements of Space Shuttle and Space Station flight hardware
- Charter 3D CAD Assembly Analysis lead – assure fit between major elements as part of the End to end Berthing Integration Team (EBIT) which included astronauts or their aides
- Cable & Fluid line physical fit checks of cables performed with astronauts or their aides
- Stage Drawings (Incremental ISS Top Assembly Drawing) checker