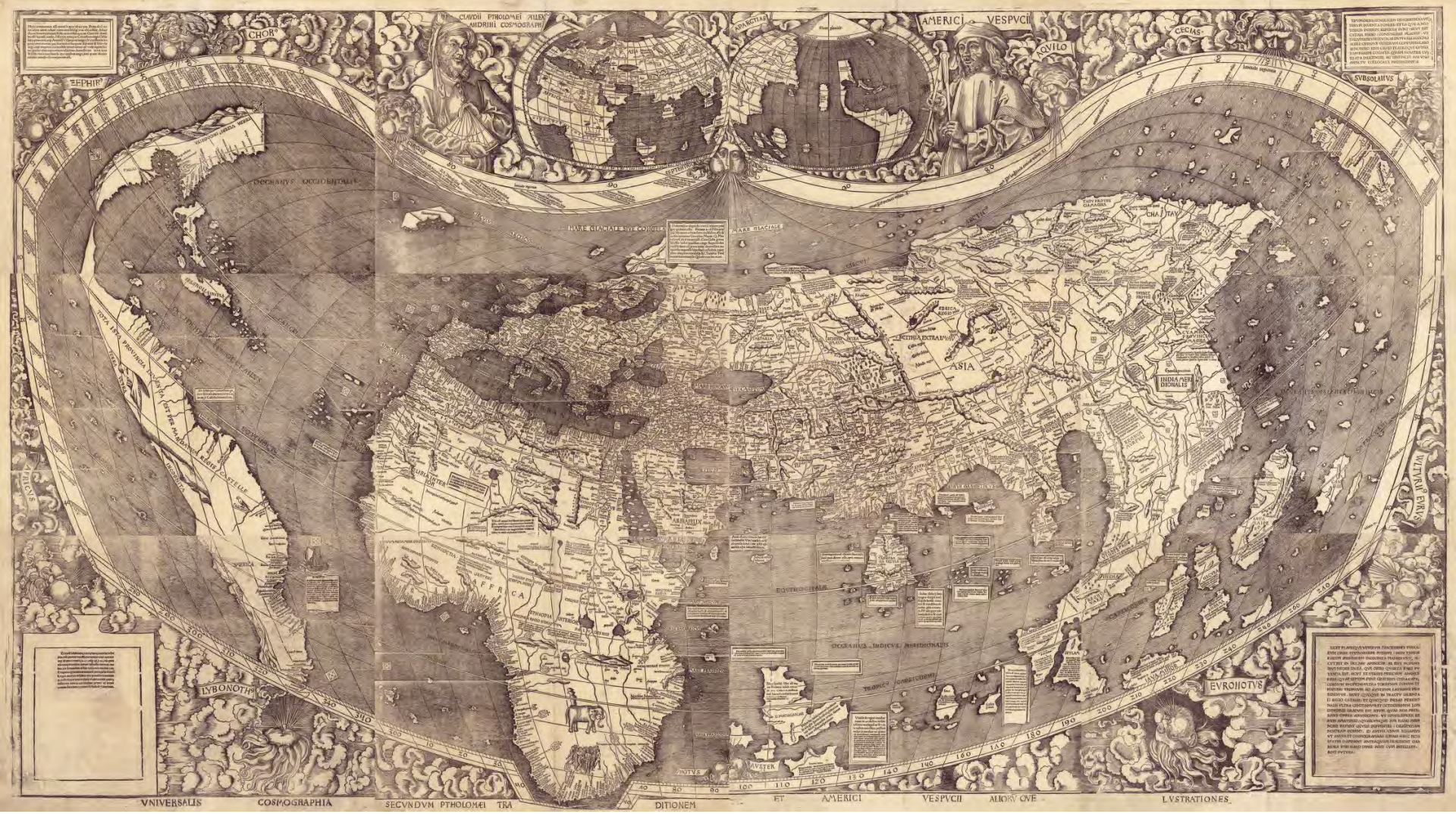

Why Return to the Moon?

John Cook
President, Cook & Chevalier Enterprises, Inc.
apollo11@earthlink.net

Why return to the Moon?

"Now, I understand that some believe that we should attempt a return to the surface of the Moon first, as previously planned. But I just have to say pretty bluntly here: We've been there before." [1]

- What if the same comment had been made about the New World when Christopher Columbus returned?
  - How long would our knowledge of the world stagnated (state of the art understanding shown on previous page)?
  - Who would have discovered the New World?
  - How would the world be different if they had?
- The moon has many valuable resources that can enable infrastructure buildup and aid exploration.
  - This can be funded as a partnership between Government and Private Enterprise - commerce can fund or at least supplement funding exploration and science.
    - Pay as you go

Title Page Graphic: 1507 Martin Waldseemuller's Map of the World, Library of Congress

[1] President Obama, 2010 KSC Address

Value Proposition

"The first trillionaire will be a space miner" [2]

A trillion dollars would fund NASA at current level for ~55 years

It takes Less Delta-V (change in velocity) to get from the Lunar Surface to Low Earth Orbit (LEO) than it takes to get from the Earth's surface to LEO

- Water Ice has been found (approximately 1 Billion tons at each pole[3]) in the craters of the North and South poles of the Moon
  - Water to drink, Air to Breath, Rocket Fuel, Oxidizer, and radiation shielding
    - Permanently shadowed craters are near areas of near permanent sunlight
    - There are other valuable resources on the Moon; Helium-3, Aluminum, Titanium, Silica

Why not build a Low Lunar Orbit, Lagrange point, or Low Earth Orbit staging depot to supply outbound spacecraft?

[2]Art Dula, Space Lawyer - Lecture at Gilruth 2-12-16
[3]Spudis, The Value of the Moon

Risk takers and Explorers

- Exploration and risk taking are the essence of America
  - Christopher Columbus
  - Lewis & Clark
  - The Gold Rush
  - The Transcontinental Railroad
  - Transatlantic telegraph
  - Hollywood
  - Silicon Valley
- Space is a new frontier, just as the West was.

Risk Takers and Explorers

- Christopher Columbus
  - 25% friends and family funded
  - Tremendous sailor
  - Passion for exploration
  - The fact that his geographic assumption was incorrect is beside the point – it was a “happy accident”
- Lewis & Clark
  - Government funded expedition initiated by Thomas Jefferson
    - Blazed trail
    - Opened gateway to the West
    - Led to Louisiana Purchase – expanding US territory

Risk Takers and Explorers

- Gold Rush
  - People became extremely excited about the gold rush and left behind jobs and family to “strike it rich”
  - Just getting to the West was a life or death proposition - grave personal risk
  - Financial risk for potential immense wealth– Bust or Boom
    - Vigorous economic activity supporting logistics and provisioning – towns sprouted up rapidly to support prospectors and settlers
- Transcontinental Railroad
  - Immense amount of speculation (Risk)
  - If the train went through a town, it was a tremendous economic boost
  - The railroad infrastructure enabled further commerce by moving goods and people
  - Spinoffs – surveying the nation
- The Moon is the only next town!

MARS is a Stretch Horizon Goal

- Mars = ~35 Million miles, minimum distance in 2035
- Moon ~ 250,000 miles – much closer (scale drawing below – planet size emphasized for visibility)

Risk Aversion

- There is currently an extreme amount of risk aversion and apathy, as compared to the early days of exploration, aviation or space travel
- This risk aversion has two main components
  - Fear for physical safety
  - Fear for financial safety

Risk Aversion

- NASA has become too safety risk averse[4]
  - How did the Apollo guys handle risk?
    - "the Original Technical Culture (OTC) of NASA: a commitment to research, testing, and verification; to an in-depth, in-house technical capability (the old Army Arsenal concept); to the belief that engineers had to keep their hands dirty, or a hands-on discipline; to the "normalization of risk", the acceptance of failure, and the anticipation of trouble [which] led to an atmosphere in which these things could be discussed openly" (or wide-open communication); "to the belief that NASA recruited exceptional people; and to a "frontier" mentality" [5]
- Financial Risk Aversion
  - NASA is legislatively prohibited from advertising/commercialization
  - I can't think of a successful business model where advertising is prohibited

[4] Walt Cunningham, Apollo 7 astronaut, lecture at University of Houston 2016

[5] Managing Risk and Complexity Through Open Communication and Teamwork, Philip Tompkins

Risk Aversion

- Big Business has become very risk averse. They want the sure deal. They are waiting to be spoon –fed a multi-billion dollar contract from NASA.
- NASA does not or is not allowed to think entrepreneurially (as ESA does – e.g. Omega Skywalker endorsement)
- This situation has stifled creativity and competition and created a log-jam of status quo

Big Business

- Big business should get out in front of NASA
- Show initiative and be proactive
  - A consortium could share risk/rewards and contribute/sponsor their specialized niche product/service
- Hold a carrot out by showing NASA what is possible
- Build the gas stations to enable the highway

Notional Consortium

Caterpillar	General Electric
Wal-Mart	British Petroleum
Circle K	Omega
Shell	John Deere
IBM	HP
Holiday Inn	Evian
Airstream	Winnebago
Michelin	Pirelli
North Face	Nike
Apple	Sony
ALCOA	Perrier
Anicott Steel	Kellogg
L.L.Bean	Patagonia
REI	Starbucks
Pioneer Brand	Kraft
McDonalds	Pizza Hut

Unfinished Business

- We have unfinished business on the Moon.
  - President Kennedy skipped Wernher von Braun's master plan in favor of "Flags & Footprints" to beat the Russians
  - The Apollo program was prematurely cancelled.
  - Apollo just scratched the surface.
    - We should endeavor to create a Moon/Mars exploration architecture that builds on lessons learned from Apollo and the International Space Station and should include as much commonality of hardware as possible.
    - As much as possible, we should strive for simplicity and adaptation/evolution of proven hardware and operational concepts wherever possible and avoid the "Clean Sheet" tendency of reinventing the wheel.
      - Have a Master Plan of the evolution of hardware, instead of a series of disjointed starts and stops of programs.

Lessons Learned/Opportunities

- Key Technical Lessons Learned from Apollo and ISS
  - Apollo style technical excellence, leadership and communication down and up to rapidly identify and solve problems
  - Standardization of interfaces
  - Standardization of software, especially CAD software (there were multiple CAD formats used on ISS)
  - Standardization of coordinate systems and units (on ISS there was/is a U.S. analytical CSYS and a Russian CSYS – NASA contractors deliver models in arbitrary coordinate systems)
  - Program Architect/Large Scale System Integrator – someone needs to have the “Big Picture” as well as familiarity with the details
    - Apollo relied on 1:1 fit checks but ISS assembly verification was largely done by CAD analysis (the author participated in that) or master tooling
  - Warts and All, ISS is the best model we have for International program integration – but it could be better (fewer warts)

Summary

- A lunar outpost can and should serve as a "dress rehearsal" for Mars (practice makes perfect).
- Hardware design, surface operational concepts and logistics can and should have commonality for the Moon and Mars, resulting in cost savings and system robustness.
- Minimize “Dead End” Technology development.

Forward Work

- NASA/Industry
  - Legislation to allow public/private partnership
    - Without being socialistic or dependent on lobbyists and corporate welfare
- Build the infrastructure
  - Models/lessons learned
    - Transcontinental railroad
    - Telegraph/Telephone
    - National Highway System
    - Internet
    - GPS