AIAA Technical Symposium 2016

Mars Future Exploration Lunch Panel

AIAA Houston Section

Since 1962

Friday May 6th 2016
at twelve noon to one thirty PM
Gilruth Center Alamo Ball Room
Houston, TX
77058

Jack Bacon, Ph.D. P.E.

NASA Orbital Debris Program Office (Panelist)

Jack Bacon has often been called "A New Carl Sagan." He is an internationally-known motivational speaker, a distinguished lecturer (emeritus) of the American Institute of Aeronautics and Astronautics (AIAA), and one of the most requested speakers in the world for topics concerning technology and the factors that shape human society. A noted futurist and a technological historian, he has written three popular books entitled "My Grandfathers' Clock," "My Stepdaughter's Watch," and "The Parallel Bang," with many thousands of copies sold of each. A fourth: "Killer Apps for the Green Global Village" is in the works. In his daily work, he analyzes the survivability and resulting ground risks of spacecraft re-entries for the NASA Orbital Debris Program Office.

Special Thanks to our Vice Technical Chair for outstanding leadership.

Justine Wiles

AIAA Houston-Section
Vice Technical Chair

Justine graduated from Michigan Tech with a BS in Biomedical Engineering and has been a contractor at JSC since 2010. She currently is a project engineer for the ISS Advanced Resistive Exercise Device (ARED). Her interests include systems engineering and human factors engineering.

Special thanks to the panel members for their time, talent, and to Anita Gale for her innovative ideas for this scenario.

Thanks to the AIAA Houston Section and all those who volunteered their time for ATS 2016.

Thanks to all who supported the AIAA Houston Section to make the Technical Symposium and this fourth annual lunch panel possible.

Welcome to all the Engineer for Educators who are participating in the workshop this afternoon.

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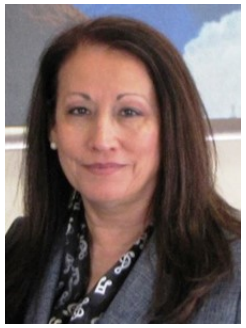

Beatriz Kelly-Serrato

AIAA Houston Section-Space Operations Technical Chair, Pro-Certified Executive Leadership Coach, Aerospace Consultant (Moderator)

BeBe was born in Monterrey Mexico and raised in the US, she has always been a star gazer and grew up watching the Apollo Moon launches. She has worked for the space program most of her career, and in the IT cyber security industry. She is the president and Co - Founder of Mars Astronautics Science Technologies, MAST. She lives in Houston, TX close to her family.

Anita Gale

Co-Founder, Aerospace Education Competitions (Moderator)

*Anita Gale recently retired as a Senior Project Engineer in Payload & Cargo Integration, for The Boeing Company in Houston. Her professional career started 1974 on the Space Shuttle program for Rockwell International in Downey, CA. She holds three US patents on launch vehicle payload technologies. In 1984, Anita co-*founded Space Settlement Design Competitions*, industry simulation games that engage high school students world-wide in designing future space settlements. Anita is a past Chair of the* AIAA Space Colonization Technical Committee*, Executive Committee member of the National Space Society,* organizer of conference tracks on space settlements, and author of technical papers on space infrastructure. *Anita earned both a BS and MS in Aeronautics and Astronautics from the University of Washington, and a Certificate in Systems Engineering from Cal Poly Pomona.*

Carl Carlsson, P.E., Q.E.P.

Project Management Office Director (Panelist)

Carl Carlsson was born and raised in Florida, where the Apollo Moon landings were intertwined with his earliest memories. He has co-authored the novel In the Shadow of Ares *and three short stories with Thomas L. James. Carl is an environmental engineer and power industry project director, and lives in Houston with his family.*

Thomas L. James

Aerospace Engineer, Denver, CO (Panelist)

Thomas L. James has been an aerospace engineer since 1997, working on human spaceflight projects and spacecraft large and small. He has been reading science fiction since fifth grade, and writing genre short stories since 1987. Thomas is the mechanical engineering lead of a Denver-based aerospace engineering company. Thomas has co-authored In Shadow of Ares *and three short stories with Carl Carlsson.*

Jack Gafford

Senior Systems Engineer (Panelist)

Jack Gafford was raised in Pennsylvania and Michigan and started his aerospace career near the beginning of the Space Shuttle program. He has been an engineer on several NASA programs for over 30 years and is currently a senior systems engineer working on the next American manned commercial space vehicle.

Larry Toups

NASA -JSC Mars Exploration Division (Panelist)

After practicing architecture for 10 years, Larry Toups received a Master's Degree in Space Architecture from the U of H, Sasakawa Institute for Space Architecture in 1988. He worked with Lockheed in various projects finally returning to future exploration work in 2004 and has been the lead in various NASA studies related to future habitation that will be required on the surface of the moon (and eventually Mars) to support future NASA missions. Currently he leads

Mars Future Exploration Scenario

By Anita Gale

A commercial space economic boom started with suggestions in the mid-20-teens that there was a business case for repairing, refurbishing, and upgrading satellites on orbit-launching just the lightweight parts needing replacement or upgrade, and installing them on heavy satellite structures with lifetimes limited only by what can be installed on them in the future. In the late -20-teens, at the encouragement of and with partial funding from the U.S. government, several major aerospace companies pooled corporate resources to develop space infrastructure components enabling and inducing expansion of the human economy into cis-lunar space. As projects gained momentum, non-U.S. companies and governments joined into cooperative agreements for deriving economic benefits from space. The companies built two new LEO space stations serving as ports for transfer of terrestrial exports and imports between launch/entry and inter-orbital vehicles, with one specializing in Maintenance, Repair, and Overhaul (MRO) of space assets and the other providing orbital assembly services for large spacecraft requiring multiple launches. A fleet of space tugs moves disabled satellites and provides boost and relocation services for on-orbit customers.

Government partnership in space infrastructure development came with a requirement-motivated by environmental groups- to use extraterrestrial resources as much as possible for space construction projects. Lunar materials were considered more accessible than NEO asteroids, and techniques for refining and building with lunar ores were readily developed. Science interests got involved early to discourage increasing the fragile lunar atmosphere with rocket exhaust, causing mass drivers to become the early choice for launching vehicles; guidance avionics enables landing vehicles to accurately target for and decelerate on mass driver tracks. Due to power requirements for lunar mass drivers, mining, and refining operations, and with a reluctance to shut down operations during long lunar nights, Solar Power Satellites (SPS) long envisioned to provide environmentally friendly electricity on Earth were instead first developed for lunar operations.

Scenario Continued...

With a modest research and development effort, lunar silica compounds and perovskites at first proved to be adequate, and with further development superior, to Earth-sourced materials for making solar cells. After proof of the SPS concept for lunar operations, a steady business developed to build SPS systems for Earth orbit, using lunar materials.

Given historical issues with debris in Earth orbit, the plan for lunar orbit infrastructure started with a lunar port at the Earth -Moon L1 libration point. With rare exceptions, lunar landing craft are based at the L1 port, and inter-orbital spacecraft delivering cargo and passengers to the Moon dock at the L1 port. Orbital refining and manufacturing were considered risks for producing orbital debris, resulting in a "space zoning code" that locates raw-materials industries (e.g., orbital refining of lunar materials, harvesting of asteroid materials, and heavy manufacturing) in Earth-Moon L4 orbit, and "clean" industries (e.g., research, education, commerce and banking, and light manufacturing or assembly) in Earth-Moon L5 orbit. Inter-orbital spacecraft provide regularly scheduled transportation services between LEO, L1, L4, and L5. The first true space settlement, where families have established permanent homes, is in L5 orbit. As humans spend more time in space, and have leisure time in space and on the moon with access to research facilities, new products and processes are being developed to fulfill the objective to expand the human economy throughout cis-lunar space.

With a vibrant cis-lunar infrastructure in place, humans are now--in the year 2038--looking to expand the human economy to encompass Mars. Exploration missions so far have been independent endeavors, not establishing infrastructure around and on Mars that can be applied for diverse purposes. Visitors to Mars have so far had very little leisure time; cis-lunar experience shows that new products and capabilities capitalizing on unique environments cannot be foreseen or planned, but result from people having access to resources and time to tinker. It is now time to plan for effective infrastructure to enable humans to work on and profit from the planet Mars.