



Position Paper

Improving Space Competence and New Business Ideas for NASA/Ames Research Center

September 5, 2006

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1. INTRODUCTION

It is surprising that NASA is being so under-funded to do so many things - all in a time when so many countries are launching satellites and where India, China, Japan and Europe have launched, or are planning to launch, robotic spacecraft to the moon and places beyond. Europe's Small Mission for Advanced Research and Technology (SMART)-1 spacecraft had been orbiting the Moon since November 2004 and successfully impacted the Moon at 0542 GMT, September 3, 2006. One observation of this impact is at www.cfht.hawaii.edu/News/Smart1. Europe, India, China & Japan even have plans for sending humans to the Moon. Hostile nations have satellites in orbit. This current situation is far more of a concern than Sputnik ever was. A future, expected major threat is a recently rediscovered 400 meter Near-Earth Asteroid (NEA) that is predicted to pass extremely close to the Earth on April 13, 2029 (<http://www.spacedaily.com/news/deepimpact-04u.html>). It will pass Earth so close it could hit one or more of our higher altitude satellites. **Now is the time for the US to focus on improving space competence for the security of our nation and our allies.**

The most effective way to cope with change is to help create it.
I.W. Lynett

The purpose of this paper is to discuss space competence concerns and present some new business ideas and directions for Ames. The author realizes that Ames is pursuing some of these ideas already (some of these ideas belong to Pete Worden et al.) as well as other ideas not in this paper. I also realize I'm covering a lot of ideas. Over the past 28 years (starting with the end of any new Pioneer spacecraft after Pioneer Venus), Ames has lost many key responsibilities and work. Because of Ames severe budget cuts this year and meager Exploration work assignments and funding, it is essential that Ames aggressively try to reverse this trend and gain more work assignments and funding from NASA/HQ. Ames should consider aggressively becoming a major player to re-focus the US on space leadership, competence and productive growth for the security of our nation and our allies. Ames with other collaborators should consider establishing world class capabilities for rapidly developing, building & deploying low-cost, efficient small spacecraft and robotics. In addition, Ames should aggressively pursue new, non-NASA work opportunities with other funding sources from and including: other federal agencies, the State of California and the private sector including SF bay area partnerships. Private ownership in space needs to be established at an international level – this is key to major increased private sector participation. New growth at Ames based on NASA funding and other funding sources will benefit everyone and result in a much stronger, more resilient center. Let's go do it!

Intrinsyx Technologies Corporation would like to make major contributions in improving the center including areas such as: leadership, idea assessment, strategic & tactical planning, business strategies, assessment & implementation, organizing, systems engineering, design, software engineering and implementing new programs, projects and initiatives. I am especially interested in making significant contributions to the Ames Small Spacecraft Program Office for fast-paced and affordable missions in areas such as developing an effective and efficient “delivery system” for all “deliverable systems”.

The following is a description of some new business ideas and directions for Ames to consider.

2. SUPPORTING THE VISION FOR SPACE EXPLORATION (VSE)

The greatest gain from space travel consists in the extension of our knowledge. In a hundred years this newly won knowledge will pay huge and unexpected dividends.

Wernher von Braun

In June 2006, NASA announced the “Exploration Work Assignments” for robots and humans to the moon and for Mars exploration. The website, http://www.nasa.gov/mission_pages/exploration/spacecraft/work_assign.html, states “NASA’s Constellation Program is getting to work on the new spacecraft that will return humans to the moon and blaze a trail to Mars and beyond. Thousands of people across the agency are pulling together to meet this challenge, with work assignments that will sustain **ten healthy and productive centers.**” Another website, contains the work assignments document. www.nasa.gov/pdf/149779main_const_assign_centers.pdf The first page of this document contains work assignments for Ames. The sixteen Ames “work assignments” from NASA/HQ involves: limited support roles, one COTR role, some software development roles, several areas where scope is not clear, establishment of a Lunar Small Spacecraft Projects Office (scope unclear) and the Lunar Crater Observation & Sensing Satellite (LCROSS). Overall, it appears the amount of work and funding appears to fall very short of fully sustaining Ames. Because of current funding shortfalls some civil servants are being asked to perform work they are not trained to do such as in information technologies. Some tasks are not being worked on because of lack of money to hire qualified people.

2.1 GAINING ADDITIONAL VSE WORK

Because of Ames severe budget cuts and meager Exploration work assignments and funding, it is essential that Ames consider aggressively trying to gain additional work assignments and funding from NASA/HQ.

2.1.1 Get Better Representation in Washington

Ames should try to accomplish this by putting effective pressure on congressional representatives and also by having Ames people located “in-plant” at NASA/HQ.

2.1.2 Find VSE Teaming Partners

Ames should explore teaming with non-NASA partners that will bring something significant to the table that contributes to the VSE. JPL has been doing these kinds of actions and more for years. Additional innovative teaming arrangements with other NASA Centers should also be explored.

2.1.3 Acquire Lead Roles in Teleoperations, Telepresence and Search Technologies

Since the round trip light time between the Earth-Moon is only about 3 seconds, Ames should aggressively consider acquiring:

- a) lead roles in teleoperations (machine remote operations) and telepresence (being present at a distance).
- b) lead roles in prototyping teleoperated robots that can build the core infrastructure of a moon base such as power and habitats. Ames recently conducted a lunar micro rover technology demonstration via teleoperations of a robot in the Atacama Desert in Chile from the Ames based Mission Control Center.
- c) lead roles in search technology via voice or other input that use AI & “artificial” Artificial Intelligence (AI). Because of the quick Earth-Moon round trip light time, artificial AI will

complement AI. For example, future Astronauts should be able to search for information verbally via speech recognition and get rapid response back from a combination of computers & humans. Artificial AI is used by amazon.com. They have launched a program called Amazon Mechanical Turk, through which a computer can ask humans to perform human intelligence tasks that it can't do itself such as evaluate beauty, translate text and find specific objects in photos.

Ideally funding should be both from the government & the private sector.

2.1.4 Lead Roles in Setting Standards for Communications Protocols

Ames should aggressively push to take lead roles in setting standards for communication protocols. Ideally funding should be both from government & the private sector.

2.1.5 Lead Roles in Providing Moon Communications, Navigation, Timing and Situational Awareness

Ames should aggressively push for lead roles to acquire lead roles in providing other moon infrastructure components such as communications, navigation, timing and situational awareness. Situational awareness could be realized via a *virtual synthetic world* described in Section 8.1.1 and 8.1.2 below. Ideally funding should be both from government & the private sector.

3. PURSUE NEW BUSINESS & NEW FUNDING - LET'S MAKE A DEAL

Because of the high uncertainty of being able to obtain additional NASA work assignments & funding, Ames should be a template for making deals with the private sector. Ames needs to aggressively pursue new non-NASA funding sources including: other federal agencies, the State of California, private investors, non-profit organizations and private industry including SF bay area partnerships.

Ames needs to “expand” other ways of doing business. The Space Portal Activity for Enterprise & Commerce, NASA Research Park and “to be built” Loral & Google buildings are a good start. These opportunities must not be lost due to lack of proper attention and organization. Other collaborations need to be formulated and actively pursued.

The sections below contain several ideas to consider.

4. OPERATE AMES MORE LIKE THE PRIVATE SECTOR

Part of strategic & tactical positioning for Ames is the ability to conduct rapid-response business in a manner like the private sector. This isn't just another exercise. Ames must “live” this every day.

4.1 CENTER VISION, STRATEGIC PLAN & ACTION PLAN

Ames should have a Center working plan that delineates *strategic & tactical approaches* as well as an *action plan & activities tracking*. The overall vision, center plans & status need to be regularly disseminated to the staff with adequate fidelity.

Vision is the art of seeing things invisible
Jonathan Swift

4.2 WAR ROOM & IDEA FARM

Ames upper management needs to establish a “*war room*” (physical and virtual) for strategic (out to fifty years), tactical planning & implementation. There needs to be identification, selection and implementation of appropriate business strategies. Present & anticipated future skill mix of staff needs to be known. Ames should know what its skill mix is and isn’t. Various key people from the center should participate in the war room, on a regular basis – otherwise the war room becomes “stale.” There should also be an “*idea farm room*” (physical & virtual) where ideas can be proposed, assessed, implemented and some grown further.

4.3 EFFECTIVE DELIVERY SYSTEM

Ames needs to have a rapid-response “*delivery system*” to “*deliver a system*”. A “delivery system” includes ability to deliver effective and quality:

- a) regular staff communication
- b) professional technical, management & cost proposals (filtered/coordinated/processed through a new business & marketing office in a timely manner)
- c) professional management of programs, projects, engineering & research (getting the job done right) –each project needs a “*delivery system*” process that shouldn’t have to be re-invented with each project
- d) professional management of budgets with full cost accounting and ability to perform some kind of logical earned value assessment if the customer requires it.
- e) professional systems engineering and software engineering (development of deliverables, wise use of tools, educated human judgment and common sense)
- f) professional engineering (the center needs to have strategic & tactical, hands-on engineering going on)

"A good engineer gets stale very fast if he doesn't keep his hands dirty."
Wernher von Braun, 1964

- g) basic research with appropriate direction and goals (playing in the sandbox and declaring success at end of each fiscal year is just not good enough anymore)
- h) appropriate development tools, facilities and a trained staff tuned into the Ames “pulse”
- i) an evolving, effective knowledge-base for the current and future “staff collective.” The Ames nx knowledge network was a start but is not well organized and incomplete. We should get from Google on this.

The existence, effectiveness and quality of “delivery systems” at Ames in the past 28 years have been entirely dependent on the wisdom (or lack of) of only a few individuals, which have almost all left the center. These above areas need IMMEDIATE ATTENTION and effective center-wide policies and methodologies need to be established.

4.4 EFFECTIVE COMMERCIALIZATION OFFICE & LEGAL OFFICE

Over the years, the Commercialization Office and Legal Office have been so slow that many opportunities have been lost in the past. These areas need IMMEDIATE ATTENTION and effective center-wide policies and methodologies need to be established.

5. COLLABORATIVE TECHNOLOGY ACCELERATION CONSORTIUM

The NASA Research Park was a great idea and but there needs to be more engagement between its residents and Ames. We also need more residents. I also recommend that Ames, the NASA Research Park and others establish a Collaborative Technology Acceleration Consortium. By technology acceleration I mean **rapid technology development** via **smart planning** that leads to **rapid action** that leads to **awesome results** that would ideally “**accelerate**” new and improved deliverables. Here are some suggested areas to accelerate:

5.1 KNOWLEDGE DEVELOPMENT & KNOWLEDGE MANAGEMENT

Tackle the lack of knowledge development & knowledge management for NASA. Its one thing to prepare young engineers and stimulate them to get into aerospace and other disciplines, keep them in school and keep them in our profession. The other is capturing the knowledge of some of us who are a little older, who have accumulated a lot of knowledge and have left or are leaving the profession but have a lot to offer. With the availability of online information, it’s not about information, it’s how do you apply that information with a set of skills”.¹ Consider creating an infrastructure and ability for collective knowledge development and knowledge management – collaborate this with Google, academia and others. Ames is supposed to be the Center of Excellence in Information Technologies and that should include intelligent management of data, information, knowledge, and wisdom.

Just say know.

5.2 SATELLITE & ROBOTICS PRODUCTION

Ames should assess collaboration with the private sector & academia to: a) **revolutionize production of smallsats and various types of robots** and b) **prototype robots that build smallsats and other robots**. The exact scope of this effort is definitely to be determined. The goal should be practically “plug & play” sats & robots. Meetings should be considered with Toyota, AFRL, Loral, CMU, Lockmart and others on “satellite & robot production lines.” Perhaps part of the new Loral building could be dedicated this. I visited the original 1984 Macintosh factory shown below in Fremont, California. It was the first of its kind for the computer industry, featuring advanced automated technology with a Just-In-Time manufacturing system. It was Steve Jobs’ decision to make this kind of factory for the first Macs. This factory was able to produce a 128k Macintosh every 27 seconds.



5.3 ROBOTICS TECHNOLOGIES

Ames should assess getting involved in other robotic systems:

- a) With other collaborators such as CMU et al., establish a robotics new technologies showcase & development center that includes commercial robots. Perhaps collaborations could be made with Professor Sankai, Univ. of Tsukuba / Cyberdyne Inc. on the Robot Suit (Hybrid Assistive Limb). Refer to <http://sanlab.kz.tsukuba.ac.jp/HAL/indexE.html>.
- b) Many autonomous vehicle missions require small robotic systems that can operate in complex, difficult terrain. Draper Labs has developed numerous special-purpose robotic vehicles, including throw-able wheeled and rotary legged robots, a micro UAV capable of withstanding high-g gun launches, a ducted fan micro air vehicle with variable pitch control, robots for explosive ordnance disposal, and a snake-like robot for search and rescue operations in rubble-strewn environments. Perhaps Ames should collaborate with Draper and others and also be involved in developing Micro Air Vehicles (MAVs) and “micro-helicopters.” Refer to <http://www.draper.com/technology/autosys/autonomous.htm>.
- c) Perhaps Ames should get involved in industrial robots and commercial robots as simple as the Roomba home vacuum robot (per Forbes Sep 6, 2006, this is one of the best selling robots in history).

5.4 UNCONVENTIONAL TECHNOLOGIES

Ames should consider collaborating with others and be much more engaged & involved in developing unconventional technologies & possible products for the future. The SciFi Channels fictional products website for the TV series called Eureka has some cool & very imaginative ideas for products that don't exist. <http://www.scifi.com/eureka/madeineureka/>

6. URGENCY FOR IMPROVED SPACE COMPETENCE & SERIOUS THREATS

Ames should consider aggressively becoming a major player to help re-focus the US on improving space competence² for the security of our nation and our allies. As mentioned previously, Ames should develop world class capabilities for rapid & efficient small spacecraft development. Ames needs to aggressively go after work & funds which will make significant contributions towards re-focusing the US towards space competence. Private ownership in space needs to be established at an international level – this is key to major increased private sector participation.

- a) The ability to affordably replace damaged or inoperable space systems on short notice with satellites and low-cost launchers is currently not possible. The use of space to support tactical operations (scientific, commercial or military) is largely not possible. Our launch/satellite industry deployment capabilities needs to be moved from an *artisan-like environment* to a *production-oriented environment*. As noted in section 5.2 above, Ames should consider collaboration with others to: a) revolutionize production of smallsats and various types of robots and b) prototype robots that build smallsats and other robots
- b) The global space based information system and other space assets are unprotected and vulnerable to threats from hostile nations, and also from unexpected astrophysical phenomena such as solar flares or Near Earth Objects. In 2001, the Commission to Assess U.S. National Security Space Management and Organization (the "Rumsfeld Commission") warned of a

"Pearl Harbor in space" that could result in the United States losing its vital space capability through a foreign sneak attack.²

Comprehensive space situation awareness (SSA) and defensive and offensive counterspace capabilities are the foundational elements of our Space Superiority efforts.
The U.S. Air Force Posture Statement, 2006

Hostile nations such as North Korea or Iran could launch payloads to explode in a random manner and cause extreme havoc to space assets. Recall during World War II, the Japanese sent thousands of hydrogen gas filled paper balloons traveling at 30,000 ft guided only by the jetstream, carrying bombs primarily designed to cause massive forest fires in America. Except for killing six persons who tampered with a bomb near Lakeview, Ore., perhaps causing two small fires, and diverting manpower for their investigation and control, the balloons flopped badly as a war weapon (fortunately many of our forests were soaked from rains). However, several hundreds reached American soil.

A future and expected real threat is a recently rediscovered 400 meter Near-Earth Asteroid that is predicted to pass very close to the Earth on April 13, 2029 (<http://www.spacedaily.com/news/deepimpact-04u.html>). It will pass Earth so close it could hit one or more of our higher altitude satellites.

- c) In the "space race" of the early 1960s, when reporters asked Wernher von Braun what he expected to find on the moon, he jokingly replied: "Russians." Nowadays, his answer might be: "Indians, Chinese, Japanese and Europeans." "India, China, Japan and Europe are busy launching, or planning to launch, robotic spaceships to the moon and points beyond."³

Europe's Small Mission for Advanced Research and Technology (SMART)-1 spacecraft had been orbiting the Moon since November 2004 and successfully impacted the Moon at 0542 GMT, September 3, 2006. One observation of this impact is at www.cfht.hawaii.edu/News/Smart1.

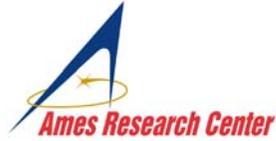
"Smart 1 will now rest in peace on the Moon. We are now collaborating with the international community, preparing the way for the future exploration of the Moon - the next fleet of orbiters, landers; leading to **robotic villages and human bases**."
Spoken on 9/3/06, by Professor Bernard Foing the missions project scientist from ESA

India, China, Japan & Europe all have plans for sending humans to the Moon. Their goals will include tasks ranging from mapping minerals to seeking ice from which future astronauts might extract drinking water. More distant goals include looking for a mineral called ilmenite that some experts think is rich in an isotope called helium-3. *In theory, that isotope could be shipped to Earth and burned in futuristic nuclear fusion reactors*".³ **Shouldn't the US be getting this mineral first?**

6.1 COLLABORATIONS WITH OTHER FEDERAL AGENCIES & PRIVATE SECTOR

Ames should consider collaborating with the NASA/HQ, DOD, & other federal agencies to make significant accomplishments to focus the US towards space competence. For example, besides working towards developing rapid response sats & robots, perhaps Ames could contribute to the development of the DODs internet in the sky (T-Sats being the space element), the global information grid (GIG) including net centric assets that include increasing numbers of autonomous or semiautonomous systems such as unmanned aerial vehicles (UAVs) and micro UAVs.

7. AMES AND CALIFORNIA NEED TO “FLEX” THEIR POWER



7.1 CALIFORNIA CONSORTIUM

California has an enormously productive economy, which for a nation would be one of the largest in the world (rated somewhere between 6-10 depending on the source). Both Ames and California need to pool and organize a federal-state government/private sector/academia “army of Californians” to blaze new trails and create significant achievements that benefit the Earth and contribute to the exploration of our solar system & beyond. Perhaps this consortium of implementers could be called the “California Aeronautics and Space Administration”

7.2 CALIFORNIA COLLABORATIONS

a) Ames needs to have strong inter-Californian collaborations in areas that could include: agriculture, advanced hardware/software technology, biotechnology and even entertainment industries. For example, Ames, et al., should consider helping California in long term planning & solutions for water resources – this is a serious problem in desperate need of a solution. Another example, perhaps Ames could collaborate with video war game vendors and the DOD. The soldiers of the future will increasingly be using a keyboard, mouse and other input devices. In many cases already a “mouse click” has replaced the “trigger” of a gun.

b) Ames needs to aggressively leverage the rich SF bay area assets including the private sector and academia. Opportunities with Loral & Google must not be lost due to lack of attention. Let’s get deals with others such as: Microsoft, Adobe, Protostar, Oracle, Lawrence Livermore, Stanford, Intel, Northrup, Lockheed & others.

c) Ames should consider collaborations with Richard Branson and Burt Rutan. Branson is chairman of Virgin Group, a privately held company that generated \$8B in revenue in 2004, with 35,000 workers. In 2005 Burt Rutan (President of Scaled Composites, Mojave, CA) signed an agreement to launch the Spaceship Company to build SpaceShipTwo/White Knight Two launch systems for “spaceline” company Virgin Galactic, offering “economical” flights into low Earth orbit. Refer to Appendix II for Branson’s “**best practices**” for business, taken from his writings and speeches.

d) The Aerospace Corporation (with William Ballhaus as CEO and former Ames Director) and Ames signed a memorandum of understanding in 2/05 to collaborate on the development of new small, lightweight, low-cost reentry systems and related nano and pico spacecraft technologies, including miniature sensor systems. I hope these collaborations are progressing.
www.aero.org/news/newsitems/NASA Ames MOU 2-14-05.html

e) Perhaps Ames should contact Steven Dorfman, on the board of directors for Protostar, a Bermuda corporation with principal U.S. operations in San Francisco, California. ProtoStar was formed to acquire and operate high-power geostationary satellites optimized for direct-to-home (DTH) satellite television services in the Asia-Pacific region and is funded by leading private equity investors New Enterprise

Associates (NEA) and SpaceVest. Steven Dorfman retired as the Vice Chairman of Hughes Electronics and he was also the Hughes **Pioneer Venus** Program Manager. I had the privilege of working with him. ProtoStar's planned footprint will reach over 3 billion people in India, Indonesia, China, the Philippines and South East Asia. The company's system will enable in-country partners to offer subscribers a technically advanced, reliable, cost effective satellite television package, providing a robust subscriber experience. A first satellite is planned for launch in early 2007. Perhaps some kind of collaboration could be created. <http://www.protostarsat.com/news.htm>

8. ADDITIONAL AMES COLLABORATIONS WITH GOOGLE

8.1 GOOGLE SECURE

Create "Google Secure" for sensitive data for both government & the private sector.

8.1.1 Google Synthetic Civilian (SYN CIV)

Create a virtual synthetic world of all on-going human & non-human *civilian* activities & objects in space. This would be incredibly useful for the VSE plus it would be handy to be aware what the rest of the world is doing. This would be part of Google Secure. This synthetic world could:

- a) allow users capability to add non-existent activities & objects in space to greatly enhance future planning.
- b) offer various combinations of filtered views.
- c) allow temporal control (looking at the past, present, various near present scenarios and various future scenarios
- d) would work with Google: Moon, Earth & Mars and future Google releases of other space objects
- e) would work with future add-ons such as:
 - data from a future Lunar communications & positioning systems orbiters allowing specific tracking of people & equipment
 - data from future tracking of people & equipment in other places besides the moon such as the ISS (ISS folk have had trouble keeping track of their equipment)

8.1.2 Google Synthetic Non-Civilian (SYN NCIV)

Create a virtual synthetic world of all on-going human & non-human *non-civilian* activities & objects with similar features in 8.1.1. This would be part of Google Secure.

8.2 GOOGLE SCIENCE DATA

Provide effective solutions of how NASA and other organizations deal with the avalanche of new & old science data and rescue of old science data. Data would include everything from the ground, aircraft, balloons & space.

8.3 GOOGLE EARTH ORBITAL

Collaborate with the Air Force Maui Optical & Supercomputing (AMOS) folks, et al., in keeping track of the Earth's orbital debris cloud of over 12,000 objects (some lost track of) orbiting Earth. This would be realized via Google SYN CIV & Google SYN NCIV. Google STN CIV data could be handled in the same way that aircraft data is managed with some data only available to select people, after it has been de-identified.

8.4 GOOGLE AMES KNOWLEDGE DATABASE

Create an evolving “effective” Ames knowledge database. This would be part of Google Secure. The Ames nx knowledge network was a start but is not well organized and incomplete. There is a serious lack of a complete & accessible knowledge database for the current and future staff collective at Ames in support of Programs, Projects, Systems Engineering, Engineering and Research including:

- Version Controlled Documentation including: agreements, contracts, program plans, project plans, requirements, designs, interfaces, maintenance & ops manuals, reports and assessments (I&T,V&V, and Requirements Analyses), procedures, processes & methods, change requests/assessments
- Best Practices
- Flight Heritage of Parts and Sub-systems
- Engineering Reports, e.g., analyses, trades, modeling and simulations
- Papers
- Review Item Discrepancies
- E-Mails
- Correspondence
- Lessons Learned
- Proposals
- Cost Information
- images, video, sounds, drawings, artwork

8.5 GOOGLE ATC KNOWLEDGE DATABASE

Lack of knowledge management is also a real problem in other agencies such as the FAA.

*Even worse than snakes on a plane.....*in about 3 more years there will be a mass exit of highly trained air traffic controllers – knowledge management here will be essential (and needs IMMEDIATE attention). Our air traffic control towers are already understaffed using equipment ranging from state-of-the-art to “museum” grade equipment still running on vacuum tubes! The “*band-aid*” holding this mess together is air traffic controllers. Ames is already well connected with Air Traffic Controllers & the FAA. Ames has been developing cutting edge, vital tools for aircraft in the air and on the surface. Lack of proper surface management led to wrong runway being chosen for Comair Flight 5191 that crashed on takeoff killing 49 people at the Blue Grass Airport in Lexington, Ky., on Sunday, Aug. 27, 2006. Ames has had over 10 years of experience in Surface Management at airports. The surface domain is the main bottleneck of air traffic and a place full of safety hazards. Ames collaborations in this area should be increasing not decreasing! Ames & Google could also collaborate with the FAA on an ATC Knowledge Database. This would be part of Google Secure.

8.6 GOOGLE SPACECRAFT

Create a “complete” database of all past & present civilian spacecraft. To my knowledge, nothing like this exists. TRW, The Aerospace Corporation and others have partial databases. Should be part of Google SYN CIV & Google SYN NCIV.

8.7 GOOGLE ASSETS

Innovative & effective management of NASA hardware, software, network assets. Almost brand new equipment shouldn't be heading for surplus. This would be part of Google Secure.

8.8 GOOGLE HR

Innovative & effective management of Human Resources – NASA should know what it's skill mix is and isn't. This would be part of Google Secure.

8.9 GOOGLE IT SERVICES

Services Science is a multidisciplinary field that seeks to bring together knowledge from diverse areas to improve the service industries operations, performance and innovation. Services science melds technology with an understanding of business practices. "Services" now represent 80 percent of the US economy. According to IBM, China's service sector has grown 191 percent during the last 25 years and now makes up about 35 percent of the nation's economy. And services account for more than 50 percent of the economies in countries such as Brazil, Germany, Japan, Russia, and the UK.

Lets consider having Ames/Google get some IT services back to California! In 2005, the big three Indian IT services firms—Infosys, Tata Consultancy Services (TCS), and Wipro—surpassed \$2B in revenue and reported an astounding compound annual growth rate of more than 30 percent.⁴

8.10 GOOGLE DATA-VIZ

Assess revolutionary ideas for "data visualization" for use with the Ames Columbia Supercomputer. Something other than an array of flat-screens should be considered.

a) *Getting the big picture.....*For example, computational scientists at Sandia, a National Nuclear Security Administration lab, believe a huge display system will enhance the ability of its scientists to visualize and gain insight from massively complex data sets that can be understood only through human intuition, ranging from supercomputer-generated physics simulations to high-resolution satellite imagery.
www.nnsa.doe.gov/docs/newsletters/2005/nl_2005Feb_NNSA_News.pdf
<http://www.sandia.gov/news/resources/releases/2004/comp-soft-math/bigpicture.html>

b) *Personal Display System.....*Another potential area to investigate is the virtual visor such as 3dVisor. The Z800 3DVisor is the world's first personal display system to combine two organic light-emitting diode (OLED) microdisplays with stereovision 3D capabilities, stereo audio, a noise-canceling microphone, and an integrated head tracker. The eMagin Z800 3DVisor uniquely provides a view equivalent to a 105-inch screen at twelve feet with 3D capability. Its high-speed head tracker enables full 360-degree virtual-surround viewing. Completing this experience is an integrated, stereo audio system with high fidelity ear buds and a built-in noise-canceling microphone. The Z800 3DVisor delivers this experience while drawing its power from any standard USB port with no additional power sources.

Ideal for computer gaming, the Z800 3DVisor also supports PC-based simulation, graphics, design, and personal entertainment programs. It can be used as the primary display or as an extended dual-monitor with a laptop. In addition to providing a compelling gaming experience, the Z800 3DVisor is ideal for high-resolution private viewing of DVDs from your computer and viewing proprietary work while traveling or in tight spaces.

www.3dvisor.com

9. OTHER IDEAS

Ames should form partnerships with excellent players such as: AFRL, Loral, Lockhart, The Aerospace Corporation, APL, Ball, DARPA, LASP, SAIC, ESA, Lawrence Livermore, Surrey Satellite Technology Ltd., Stork Fokker, CMU, Stanford, Draper Labs, Spaced & others. Below is a list of other ideas:

9.1 PART OF OUR MARKETING - CONFERENCES, MUSEUMS & EPO

This stuff is a valuable part of our marketing!

- a) Conduct yearly conferences at Ames on space craft, launch vehicles, robots, teleoperations & telepresence. Get donations from rich companies like Lockheed.
- b) Perhaps Ames and other collaborators could help the Computer History Museum become the Computer History & Robotics Museum. Get donations from rich companies like Lockheed.
- c) Expand education and public outreach (EPO) activities. Collaborate with excellent organizations such as the Astronomical Society of the Pacific (ASP) (largest general astronomy society in the world) in the promotion of science and astronomy. Get donations from rich companies like Lockheed.

9.2 SMALLSATS

9.2.1 Collaborations with AFRL et al.

Enable rapid construction & test from prequalified components of smallsats.

9.2.2 Air Launched Fed Express Sat for Small payloads to ISS & beyond

Imagine an astronaut who is desperate need of medicine or the ISS is desperate need of a small part – *when they absolutely, positively need it ASAP*

9.2.3 Debris Sats

-would allow direct detection and characterize the debris cloud of over 12,000 objects orbiting Earth.

9.2.4 Air Launched Webcam Sats

- a) could allow public and/or non-public views of Earth in near real time in visible or other spectral ranges; could allow viewers to change preset view
- b) could fly computational cameras - would use unconventional optics and software to produce new forms of visual information, including wide field-of-view images, high dynamic range images, visible, multispectral and hyperspectral images, and depth images.
- c) could allow exterior inspection of satellites <http://www.llnl.gov/str/Ledebuhrhi.html>
- d) webcam sats could be flown in formations depending on customer needs

9.2.5 Mutation Sat for Small payloads

This sat would allow serendipitous mutations of seeds or other small biological payloads. For example, Chinese officials are planning to launch over 2,000 seeds into orbit for a two-week trip. Exposed to cosmic radiation and micro-gravity, it is hoped that some seeds will mutate to such an extent that they may produce much higher yields and improved quality

9.2.6 SmallSat to measure Pioneer 10/11 Anomaly (very tiny blueshift)

- would love to see Ames have some involvement with an experiment to study this anomaly⁵
- ESA is considering investigating the anomaly onboard a non-dedicated exploration mission

- ESA has received 5 proposals (as of August 06) to investigate this anomaly.

<http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=35202>

See also: <http://physicsweb.org/articles/world/17/9/3>

9.3 SMALLSAT/MICROLANDERS/ROVERS

9.3.1 Air Launched Telemetered Small Sat Lander to scoop small sample from NEO and deliver it to ISS

Would allow almost “in-situ” examination and testing of NEO material on the ISS

9.4 LUNAR PROJECT OFFICE

9.4.1 ComOrbiter

Provides TCP/IP, positioning information, allows tracking of people & equipment

9.4.2 Microlunar Landers

This is just a rough list...

- in-situ science and teleoperations from Earth
- on surface in-situ characterization of radiation (solar, galactic)
- on-surface characterization of dust size/toxicity & surface micrometeorites
- drill & subsurface data collection for water detection
- set of landers for seismic characterization with 3 axis seismometers

9.4.3 Air Launched Telemetered Small Rovers to explore the Moon

9.5 BALLOONS

9.5.1 As a kind of partial replacement for Airborne Astronomy (that Ames lost) run a high altitude balloons program

9.5.2 Balloon launched Green algae Experiment to assess/measure how well green algae absorb CO₂ in-situ in Earth Atmosphere.

This would be good knowledge for future planetary engineers.

9.6 TESTBEDS

9.6.1 In-situ Testbed

Develop In-Situ Testbed for low-cost, early in-situ environmental testing of processors and other devices from high altitude balloon and/or smallsat.

9.7 INVESTIGATE LAUNCH ALTERNATIVES

9.7.1 Develop optimal air launch capabilities

- a) Perhaps the rocket & space craft could be integrated at Ames and aircraft flown out of Moffett Field.
- b) Could a balloon do an air launch?

9.7.2 Electromagnetic Rail Gun

Investigate readiness of a rail gun launch for a small sat. An electromagnetic rail gun could be the easiest and least costly way of launching small communications satellites by theoretically eliminating the need for the huge quantities of fuel, multistage rockets and redundant systems necessary to lift a payload into space. The rail gun may prove so effective that networks of satellites could be launched at low cost--and if one fails, another would quickly be sent up in its place.⁶

9.7.3 Laser

“Lightcraft” fly atop a beam of laser light, harnessing its energy and converting it into propulsive thrust.

http://www.space.com/business/technology/laser_propulsion_000705.html

9.8 COLLABORATE WITH OTHERS TO DEVELOP PROPULSION SYSTEMS FROM LEO AND BEYOND

9.8.1 Systems for micro-landers for Moon and asteroids

9.8.2 Water propulsion

9.8.3 Light sails

9.8.4 Pulsed Plasma Thrusters

9.8.5 Ion Engines

9.9 DEMONSTRATE CHANGING (SAFELY) THE TRAJECTORY & VELOCITY OF A SMALL NEAR-EARTH ASTEROID

9.9.1 Trajectory Change

This would be incredibly useful technology to develop to prevent a future larger object: impacting the Earth, passing very close to Earth or impacting the Moon. NEA MN4 is scheduled to pass Earth 4/13/2029, so close it could impact one or more orbiting satellites.

9.9.2 Velocity Control

In the future, an asteroid could also be effectively stopped or greatly slowed down by some kind of active counter-propulsion and then perhaps placed in suitable place such as a Earth-Sun lagrange point, perhaps L2. Then it could be converted into a space station and/or mobile long duration spacecraft (like to Mars) that would offer residents some micro-meteor protection and some radiation protection. Spinner asteroids would offer stabilization and some artificial gravity.

9.10 OPERATE THE MOFFETT RUNWAY AS A REVENUE PRODUCING SMALL AIRPORT

Perhaps allow certain cargo carriers to fly in and out at specific times.

9.11 SPACE ELEVATORS

Collaborate with Los Alamos on Space Elevators using nanotube materials – smallsats & other sats climb to orbit (via material 100 times stronger than steel and one-sixth the weight, an ultra thin ribbon stretching 62,000 mi.)

9.12 HYPERSONIC FLIGHT RESEARCH

Collaborate with the DOD on hypersonic flight research

- a) use our windtunnels to support this kind of work
- b) for example, explore the use of magnetic fields for plasma aerodynamics and hypersonic applications.

-Analysis of various hypersonic system concepts (e.g., space X-planes and Dual Fuel Mach 7 to 10 (DF-7) vehicles) indicates that the benefits of magnetic field systems are significant. A number of areas have been identified where this technology can be applied for hypersonic systems

-These include leading edges for the X-37, large surface area ramp, edge, and combustor magnets for the DF-7, and DF-7 scramjet magneto hydrodynamic (MHD) power concepts.

9.13 MICROFLUIDICS AND BIOMEMS RESEARCH

Pursue micro fluidics and BioMEMS research. Recent progress in MEMS technologies now permits fabrication of structures with feature sizes that range from millimeters to nanometers. Today, BioMEMS and micro fluidics applications are quite diverse and are focused primarily in three areas: life sciences, point of care POC medicine, and environmental applications.

9.14 SPIN-OFFS FOR EARTH-BASED TELEOPERATIONS & TELEPRESENCE

- Imagine collaboration with others in the development of robotic coalminers. No humans should be in coalmines
- Imagine how much of a moon base could be constructed teloperated by robots

10. REFERENCES

¹ “Examining the US,” Aerospace America, August 2005, Page 22

² High anxiety, Forget about space dominance -- U.S. interests should start focusing on space competence. By Simon Worden, March/April 2006 pp. 21-23 (vol. 62, no. 02) 2006 Bulletin of the Atomic Scientists

³ World's nations will shoot for the moon in the next decade - Keay Davidson, Chronicle Science Writer Sunday, March 5, 2006

⁴ IEEE Computer Society July 2006, Page 43 IT Services

⁵ “Options for a nondedicated Mission to Test the Pioneer Anomaly,” Journal of Spacecraft and Rockets, Vol.43, No.4, July-August 2006.

⁷ Defense Technology International, NAVAL RAIL GUNS, Scientists Hope Rail Gun Could Launch Satellites, Aviation Week & Space Technology, 07/31/2006, page 533

APPENDIX I

RICHARD BRANSON'S NON-FORMULA FORMULA (FROM AW&ST, October 2005)

Richard Branson is adamant to point out that there's no hard and fast formula guiding the way he launches and nurtures his many businesses. "Some people say that my vision for Virgin breaks all the rules and is too widely kaleidoscopic," he writes, "others say that Virgin is set to become one of the leading brand names (this century); others analyze it down to the last degree and then write academic papers on it. As for me, I just pick up the phone and get on with it." That being said, he does leave plenty of crumbs for the rest of us to pick up.

The following is a compilation of what might be considered his **"best practices" for business**, taken from his writings and speeches.

- Must sound like fun
 - Profit potential not paramount; Creativity is just as important
- Must offer customers simple, honest and transparent pricing, high standards and attention to detail and professional, but "unincorporate" customer service
- If there's a duopoly, there's room for competition
- Launch conditions:
 - Must have the "right" people
 - Must be "positive use" of the Virgin brand
 - Must have protection of "downside"
- 50/50 financing is best. "When something goes wrong, as it invariably will at some point, both partners have an equal incentive to put it right."
- Keep the portfolio diversified, with each management team focused on its own business and entrepreneurial goals. Brand is the unifier.
- Keep the employees happy: "Our priorities are the opposite of our large competitors'. Convention dictates that a company should look after its shareholders first, its customers next, and last of all worry about its employees. Virgin does the opposite."