

A New Paradigm for a New Vision of Space

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ABSTRACT

New political and economic forces will be brought to bear on the U.S. plan for human space flight in the next year. Most notable will be the election of a new Administration with different political priorities and the increase of budget tensions cited in the recent Government Accounting Office report. No American President is likely to actually cut out human space flight – but he or she might try to reduce the costs. The easiest political path would be to save money by scaling back science and exploration. A more productive alternative would be to internationalize the Vision by working with other nations and private interests, helping them take their first steps beyond Earth orbit. The U.S has been to the Moon and going back is neither American leadership, nor produces any major new accomplishment. Internationalizing the effort will create a new paradigm of sharing, providing a greater political and public purpose for the space program and raising American prestige. It will also free up the U.S. space program to focus on exploration goals beyond the achievements of Apollo.

INTRODUCTION

Space exploration was a hallmark of the 20th century. During the Cold War it channelled political conflict into a benign technological competition, culminating with the conquest of the Moon and the reconnaissance of the solar system. Access to space revolutionized not only scientific research, but also basic public services such as meteorology and weather-forecasting, communications, and navigation. The view from space made it possible to see and begin to recognize our own Earth as a planet, without borders and with global processes, from a new and previously impossible perspective.

But what will be the place of Space in the 21st century? We suggest it will be in an international framework.

THE PLAYERS

The decade of the 1990s witnessed a transformation in the relative importance of the nations involved in space activities.

1. The United States consolidated its leadership position in space exploration. It is the only nation for whom space is a national priority, with a budget vastly greater than any other nation or consortium of nations. The U.S. space program covers all domains, civilian and military, backed by solid user

- communities and, above all, unfaltering political support.
2. Russia, formerly a rival to the U.S., reduced its role to become primarily a contractor to others. It liquidated a large part of its assets, including the trove of technological experience accumulated by a generation of engineers.
 3. Europe concentrated on a low-key industrial effort. It ranks first in commercial satellite production and launches, and has developed a capable space and Earth science program with significant achievements.
 4. And now, in Asia: New players have emerged: China, India, and Japan, seeking the national prestige that comes with a successful space program, are replaying the 1960s space race by concentrating on development of launch vehicles, lunar missions and placing humans in space. Japan has also begun exploration of the solar system and is a major contributor to space science.

THE PROBLEM OF NASA

Following the Apollo triumph, NASA developed a three-phase strategy for the future: (1) Build the space shuttle, (2) Build the space station, (3) Send humans to Mars. This strategy survived the painful realization of the first two phases, followed by the indefinite postponement of the third. The result was a purposeless human space program resting entirely on an increasingly dangerous shuttle. In response, in January 2004 the present Administration issued the manifesto, *U.S. Vision for Space Exploration*, which aims to retire the shuttle in 2010 and return human spaceflight to the goal of exploring beyond Earth orbit.

Appraised realistically, this plan raises two main problems:

1. The required budget for the current *U.S. Vision for Space Exploration* implementation plan exceeds available resources, as shown by a recent GAO report (Oct 2007, GAO-08-51). Further cuts to space science and exploration may be required to compensate for this.
2. The current thrust of the *U.S. Vision for Space Exploration* to return humans to the Moon lacks political resonance. The public is basically uninterested: "Been there, done that" rules. As a result, after getting inadequate funding from the Administration that proposed it, the *Vision for Space Exploration* is unlikely to get more support from a new Administration.

Problem 1 can only be solved if problem 2 is addressed first. To arouse public and political interest in space a new space race could be invented, replacing the Soviet Union with China, but that makes sense, if at all, only in the narrow fields of the military use of space and the defence of space assets. A space race to the Moon, even if it were politically viable, is doomed. Why should the U.S. enter a race they already won? The U.S. and Soviet Union sent nearly a hundred spacecraft to the Moon at a cost (in today's money) in excess of \$200 billion to prove the Moon has no strategic, economic, or military value.

China has shown no interest in a space race – proceeding slowly and deliberately. For example, they wisely delayed their first launch of the Chang'E lunar orbiter, when it was not ready, rather than race to beat Japan. The U.S. should not respond to jingoistic or self-serving false alarms about China ambitions on the moon, but instead pursue a broad strategy serving its own public interests in space.

What could this strategy be? The novelty of space has worn off while the costs have not decreased, the proposed missions are repetitive rather than

inspirational, space-related services are considered routine, and only marginal improvements are needed to satisfy projected demands. The space shuttle, which was supposed to provide affordable and frequent access to space, is headed for retirement. Space is no longer the inspiration upon which young people are basing their education or forecasting their careers. What might reverse these trends and return space to its former place as an inspiring avenue to a positive future?

Apollo was an inspiring goal, but it was funded and supported because it dealt with the threat of the Cold War. The space program of today can also provide an inspiring goal: exploring the unknown. But its political relevance will depend on its contribution to the major task to humankind: insuring our survival on a habitable planet. There are two, maybe three, major threats we must deal with in this tasks:

1. Lack of unifying goals with which to build international partnership. It is crucial to build global partnerships to establish peace and trust, creating hope for a positive future.
2. Coping with global climate change: The public understands that the threats to the environment require that science, and especially space tools, be mobilized to combat the looming perils.
3. The possibility of a global or large regional catastrophe resulting from the impact of a Near-Earth object. This threat we label “maybe,” because while it is real, the public acceptance of it depends on more knowledge about its likelihood.

Space exploration deals specifically with these threats and human space flight directly respond to the first. An approach of broad international cooperation in a human space flight venture could inspire

worldwide excitement and provide political decisions makers with a compelling rationale for the needed investment in a space program – especially if that space program is also dealing with the critical issues of humankind survival on a habitable world.

In this paper we focus specifically on the major policy and budget issues related to human spaceflight and exploration. Earth science and the critical need for Earth observations from space are important policy issues, but separate from the human spaceflight program.

INTERNATIONAL COOPERATION

The difficulty in extricating US space policy from its current doldrums rests on its very superiority above all other players. With little competition from other space programs, the U.S. has little incentive for a dramatic change of course. But as we learned from the Cold War space race, as well as from the creation of the International Space Station, the only path to the realization of a major program is to allow it to serve geopolitical objectives.

NASA policy regarding international partnerships is exemplified by (1) instruments provided by US experimenters to the missions of other space agencies (2) the International Space Station.

The first item is simply a variant of the approach “plucking the raisins in your pie” which takes advantage of favorable opportunities for involvement in international missions, without any involvement in the partner's interests or long term strategies. More serious exchanges are strongly limited by the ITAR rules, passed by Congress and enforced enthusiastically by the Administration, which forbid transfer of

American technology to foreign persons or institutions.

The second item – the space station – consists of a 100 billion dollar program entirely conceived and managed by NASA, to which foreign contributors from Europe, Canada and Japan have been coerced to participate often with extreme diplomatic pressure. NASA has made all the decisions, and now intends to quit in 2015 soon after international operations begin.

For NASA, "international cooperation" has generally been conceived as the acceptance by other partners of a program conceived, planned and directed by NASA. As a matter of principle the U.S. does not want to relinquish responsibility for a critical element in a mission or in a program to an outside partner. This attitude was in evidence as far back as 1971, when the U.S. rejected any serious European participation in the development of the space shuttle. That, in turn generated the European resolution to develop the independent launch capacity of Ariane. Ironically, the International Space Station has become dependent on a Russian launcher.

A June 7th, 2004 article by Douglas Barril and Robert Wall in *Aviation Week and Space Technology*, describing current transatlantic defense-industrial relations, described the differing points of view between satisfied U.S. officials and their unhappy and frustrated foreign associates. The same is true about international "cooperation" between NASA and foreign agencies, and in particular with regard to the space station, where the architecture was dictated by the U.S. and foreign partners where, more or less told where to fit in. For example, imagine the potential foreign partners' reaction to this statement from the NASA Administrator, "We hope to enlist international partners, to bring

some of the elements that we won't be able to afford to build."¹

AMERICAN LEADERSHIP

Often we hear American analyses of world problems accompanied by proposing "American leadership" as a solution. This cliché frequently serves as a euphemism for "command."

To lead is not necessarily to command. The relationship between a leader and his or her followers differs from the link between a master and a servant. A good example of leadership in space is provided by the method used by the French Space Agency, CNES, to develop the launcher Ariane. Though France paid 66% of the development costs of Ariane-1 and 50% of the Ariane-5, and managed the program. The rocket is not considered to be French but European, and rightly so, because all the partners felt they were members of a team in which they took part in all major decision, and their interests were carefully taken into account.

A leader has to show respect for the sensitivities of his associates, even if they seem petty to him; he has to display generosity by giving much more than he receives. In other words, he has to inspire complete trust in his word and in his attitude. All too often, these qualities have been absent in what is called "American leadership," and the U.S. has consequently paid a price. In the special case of localization by satellite, the London newspaper "The Observer" wrote on March 3rd, 2004 "The U.S. has breached too many international treaties and shown such a disregard for anyone's interests but its own that we cannot trust it over satellite positioning strategy".

¹ Interview with Michael Griffin, Administrator of NASA, with *space.com*, 29 August 2006.

There exists however a different kind of American leadership, both valuable and hopeful, which has rarely been seen in joint space ventures. This is the leadership of American ingenuity, the health of its scientific community, the inventiveness of its engineers, and the strength of its institutions and its economy. These confer on the United States a true leadership in world affairs, not a forced one. The chain of development that began with advancements in solid state physics and led to the Internet is an example of this kind of American leadership. It is not characterized by domination, but by mutual self-interest and cooperation. The leader is accepted as one among peers, not one above others.

A NEW PARADIGM

We arrive at the idea that the two concepts of “international cooperation” and “American leadership,” which are essential for the pursuit of space exploration, have to be revisited in depth. Perhaps the first task would be a return to the philosophy that prevailed at the end of World War II. At that time, the American Administration conceived and imposed on the Allies an ambitious policy of cooperation among nations: the organization of the United Nations, the World Bank, the International Monetary Fund and, in the supreme example of American leadership, the Marshall Plan. These initiatives shaped history; and the spirit that inspired them was still alive in 1959 when the newly born NASA offered to foreign scientists a place on its satellites. This offer, and its implementation in practice, was crucial to the development of space activities in England, France and Italy.

That was leadership, and that tradition was unfortunately lost when the space race created the flag-bearing Sputnik and Apollo. Today it is buried under many strata of prejudice and arrogance. But

having once existed, this attitude can return to prominence once again given the right conditions. The recent evolution of the e-economy provides just a model for this.

In recent years a new economic model is arising, based on a new approach to intellectual property. More and more private businesses in electronics or biotechnology have come to the idea that the classic defence of their intellectual capital restrains their capacity to create value. Sharing data with a large number of innovative people through modern information technologies provides managers with the potential to tap the crowd’s hidden knowledge in return. This is a win-win situation. A new mode of innovation called “production per peer” or “collaborative” emerges when a large number of persons or enterprises collaborate freely to generate growth in a sector of activity.

MySpace, YouTube, Linux and Wikipedia have just begun, and already they have changed the landscape of human creativity. What is Wikipedia, but the sharing of knowledge among millions of people to accomplish a project, the building of an encyclopaedia, to the benefit of all? Organized sharing and exchange of information and even of technology,² provide a positive impetus to collaboration and international cooperation. This new “wikinomics”³ is, to an extent, a modern extension of the traditional norms governing exchanges and cooperation within the scientific community. But in space matters, it has been largely ignored or inhibited.

² We recognize that transfer of technology is an anathema to those dedicated to enforcing ITAR rules in the U.S. However, many are coming to realize that those rules are self-defeating, both economically and for security. Restricting access drives others to the competition.

³ This word was introduced by Don Tapscott and Anthony Williams in their book with that title.

The lack of international leadership, or even coordination, in space matters shows in the multiplicity of planned lunar missions: Japan, China, India are preparing or already flying their spacecraft. South Korea, Brazil and even Italy, Germany and England (despite being part of the European Space Agency!) are all talking about building their own lunar spacecraft. In this field, an American initiative, conceived wikonomically, could restore order.

We propose to introduce this new attitude into space policy. Instead of protecting and monopolizing space exploration, we propose to internationalize and share it. The first step could be this: the U.S. would help, work with, and participate in the lunar missions of other nations and the private sector by buying data, supplying scientific instruments, and providing technical assistance. The international partners would reduce U.S. costs and requirements to create its own lunar infrastructure, and free American resources to pursue more distant objectives in technology, science and exploration. The international partners would be working “for” U.S. development, just as the U.S. was working for theirs.

It is often said that international cooperation does not save money – it increases costs. We agree. But the increased costs must be weighed against increased returns, on the value of accomplishing more than would otherwise be possible. This happened on the International Space Station, and on Cassini-Huygens, and on Topex - Poseidon; it can happen on the Moon as well.

This new approach to space policy could be called the Wiki paradigm – advancing national space interests by sharing them globally, and making the U.S. a real leader among a host of nations contributing to space exploration and

reaping space benefits. The Wiki notion is that a rising tide lifts all boats, and that advancing other national interests in space advances one’s own.

As the post-war rebuilding of Europe and Japan enhanced the U.S. economy, so, too, will global space cooperation enhance the U.S. space presence and increase U.S. opportunities. It is in the best interests of the U.S. to come back to the tradition of the 1940s and 50s, but with a modern paradigm. This would certainly not be a Marshall plan redux, but an adaptation of the 1945 spirit to our Internet century.

POSSIBLE ACTION

In the preceding analysis, it becomes clear that a new paradigm should be adopted by the scientific establishment. It appears therefore natural that the American Space Studies Board of the National Academy of Sciences should undertake an in-depth look at the proposed two concepts: cooperation and leadership. If the Wiki paradigm were seriously considered, space exploration would be completely transformed.

One interesting approach considers that all national space exploration activities, taken together, comprise an inherently global enterprise. Such a virtual program of programs was considered at the American Institute for Aeronautics and Astronautics 7th Workshop on International Space Cooperation, held in Anchorage, Alaska, May 3-6, 2004. A working group on “International Co-operation in the Context of a Space Exploration Vision” had as a mandate to discuss how to define and implement an exploration vision as a coordinated international endeavour.

Rather than trying to develop a cooperative concept for exploration as a whole, such a virtual program would be composed of a coordinated set of

individual activities, with each activity employing the most sensible international arrangements, as determined by the specific partners involved. Not all partners would be involved in all activities, and all activities would not necessarily be cooperative.

The adoption of a Wiki paradigm would trigger an evolution beyond this *coordination* model considered by the American Institute for Aeronautics and Astronautics, moving towards a new and more substantial concept of *cooperation*. The following items show what is meant by cooperation under the new paradigm.

1. Give purpose to the International Space Station by concentrating on the training of international crews for long-duration interplanetary flight.
2. Redirect the lunar program from establishing a nationalistic and wasteful lunar base to an international endeavor that would advance all spacefaring interests. The Moon is a steppingstone into the solar system, and today it is considered a primary objective of many spacefaring nations. It is magnificent to imagine all of them working with NASA to return to the Moon, this time truly “for all mankind.” The U.S. could support an international lunar base in many ways consistent with national objectives and end up spending much less money than by doing it all themselves. U.S. roles, as the Vision for Space Exploration so clearly

states, could then be directed for the bigger and longer-range move outward of humans to Mars.

3. Make Mars the avowed goal, as it was in the original Vision for Space Exploration. It is exciting, it alone relates to extraterrestrial life. This would keep public interest high and tie the international space effort to the principal questions of space exploration: the presence of life in the universe and the possibility of extending human presence to other worlds. The goal of Mars can keep the public involved in all of the precursor steps, robotic and human, without committing now to a specific spending plan or timetable.
4. With the Mars goal keep the human spaceflight program focussed on achieving long-duration planetary flight. This starts with the International Space Station, progresses to surface operations on the Moon, and creates the need and interest in precursor flights to a near-Earth asteroid. Because Near-Earth objects are a known threat to Earth, the human flight will be relevant to gaining about the physical characteristics of NEOs. This makes it scientifically useful as well a step toward Mars. The flight to a near-Earth asteroid would require 3-8 months, a duration far more

representative of a mission to Mars, but still shorter than stays on space station, and it would not require a costly landing system as is required on the Moon.

5. Let the robotic science programs serve the international community by meeting these broader objectives:

a. Research and development. Many specific capabilities for space exploration, such as components, instruments, and systems, must continuously evolve. This

burden could be shared among partners outside national and industrial restrictions.

b. Operations: Agreements could be reached among the various Deep Space Networks making all existing facilities available for partners' missions and open to international contributions of new capacities, such as software.

c. Assets: A major goal of cooperation could be the joint development of "planetary facilities" under integrated management. Example would be :

1. Geostationary telecommunication network and navigation/localization network (GPS style) around Mars
2. International automatic stations on the Moon or Mars

3. International mobile laboratories on the Moon and Mars

4. Interplanetary Internet.

d. Partnership in missions: Possible joint ventures, such as sample return missions, could be agreed upon, with major tasks or systems distributed among the participating partners.

e. Access to space: Global agreements with the industries possessing launch capacities could lower rocket prices.

All these ideas have been discussed before, but with conditions prevailing today none of them seems realistic. But if a Wiki paradigm were adopted and promoted by the U.S., it could give space exploration a real international purpose under the true leadership of the U.S. It would be less expensive than a national lunar base, and it would allow priorities to be redirected for both Earth observations and planetary exploration. It would also build on the positive elements of the Vision for Space Exploration by replacing the shuttle with a new rocket, completing the space station, and focusing human spaceflight on exploration. It would support international partners and give a purpose to the International Space Station.

Returning to our original question concerning the place of space in the 21st century, we propose it be put in the international framework described here. We suggest some options as examples, and emphasize the synergy of a strong robotic exploration program, managed by expanding traditional rules of coordination among Agencies. It serves both the precursor necessity of gaining information for human exploration and enables team building among international participants,

most notably with lunar objectives and with a Mars sample return. Exploration of other worlds is the popular *raison d'être* for space programs – but not the political one. To build the political and popular consensus for the expense and risk of human space flight requires serving larger international cooperation needs for planet Earth, and responding to the public interest exploring the unknown and seeking to understand humankind's place in the universe. With multiple nations now players in human space flight, we need this new paradigm for this new century.