



Planning the post-Apollo space program: Are there lessons for the present?

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ABSTRACT

The current debate over the future of human spaceflight in the USA has been a fascinating, and troubling, exercise in futility for those inextricably committed to an expansive vision of human exploration and development of space. The retirement of the Space Shuttle, originally set for the end of 2010 but later extended into 2011, the technical and funding problems of the Constellation follow-on program that led to its cancellation in 2009, and the emergence of commercial vendors who might be able to offer human access to Earth orbit have all complicated the current environment. In view of this situation, the question may be legitimately asked: what might we learn from earlier efforts to develop a human spaceflight capability the last time such a transition took place? Using the post-Apollo transition from the ballistic capsule to a winged, reusable vehicle as a case study, this article seeks to illuminate the planning, decision-making, economic, and political issues that have arisen in this policy debate. It suggests that a web of interlocking issues—only one of which was technical—affected the course taken. Instead, politics, economics, social and cultural priorities, values, and institutional considerations all helped to frame the debate and shape the decision.

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1. Post-Apollo planning and the Space Task Group of 1969

In the spring of 1970, even as the Apollo Moon landing program was underway, President Richard M. Nixon refused to endorse NASA's planned approach to long-term space exploration. Advocates of an aggressive space program have accordingly condemned Nixon for this action. In addition to his other faults and missteps, the space community disliked his response to the Space Task Group report of 1969, when it recommended a stepping stone approach to ever more sophisticated missions ultimately leading to the human exploration of Mars before the end of the 20th century.¹

The Space Task Group came about because of the need to pursue something after the completion of the Moon landing program. During the late 1960s declining budgets at NASA ensured that there were almost no “new starts” and nothing on the order of a new piloted launch system. Although there were attacks in Congress on the NASA budget every year beginning in 1963, with slowing growth for NASA programs, fiscal year 1965 was a high-water mark

in funding for the agency. The 1966 budget started a decline that would not bottom out until 1974. The NASA budget for fiscal year 1968 had been \$4.6 billion, but was reduced to \$3.99 billion in FY 1969.² In this environment NASA Administrator James E. Webb labored unsuccessfully to obtain a presidential mandate for a post-Apollo program. In May 1966 he reported to Johnson, “I have done my best to obtain support in Congress for the reductions you have had to make and to minimize any political risk to your Administration from the fact that we are operating substantially under what would be the most efficient program.”³

1968 would be a turning point in NASA history, Webb suggested, and only a commitment to future space activities would preserve the technological gains of the past few years. Nonetheless, out-year budget projections looked particularly bleak, prompting the NASA administrator to go on the offensive. Although previously cooperative with the White House in budget matters, when Webb was more or less forced by the president into announcing his retirement from NASA effective 7 October 1968, he had nothing left to lose in

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¹ See Joan Hoff, “The Presidency, Congress, and the Deceleration of the U.S. Space Program in the 1970s,” Roger D. Launius and Howard E. McCurdy, eds., *Spaceflight and Myth of Presidential Leadership* (Urbana: University of Illinois Press, 1997), pp. 92–132.

² Appendix E-1, “Space Activities of the U.S. Government, Historical Budget Summary—Budget Authority,” in: *Aeronautics and Space Report of the President, 1989–1990 Activities* (Washington, DC: NASA, 1991), p. 161.

³ James E. Webb to Lyndon B. Johnson, May 16, 1966, White House Central Files, LBJ Library, Austin, TX.

publicly complaining about the lack of American resolve to continue aggressive spaceflight funding.⁴ A discouraged Webb warned in his retirement announcement that NASA's retrenchment ensured that the USA would fall behind the USSR in national prestige.⁵

To reduce tensions between NASA and the White House, as well as to buy time, President Nixon appointed a Space Task Group almost immediately after taking office in early 1969 to study post-Apollo plans and plot a course for the space program. Under the leadership of Vice President Spiro Agnew, the group met throughout the spring and summer. Intense politics, bureaucratic priorities, and longstanding allegiances surrounded the process of determining how to proceed.

NASA lobbied hard with the group, especially Agnew, for a far-reaching program that included a Moon base, a mission to Mars, a space station, and a reusable Space Shuttle. Thomas O. Paine, then the NASA administrator, worked closely with Agnew to try to ensure that such recommendations were included in the report. Paine largely succeeded in convincing the vice president of the wisdom of this direction. Little did he know, however, that Spiro Agnew had no real entrée to the White House and, of course, Agnew resigned in disgrace a while later. The task group included NASA's priorities in its final report, but only over the objections of senior White House officials.⁶

Nixon was silent on the future of the US space program for several months after receiving the Space Task Group's post-Apollo planning report. Paine described a somber meeting with the president in January 1970 in which Nixon told him that both public opinion polls and political advisors indicated that the mood of the country suggested hard cuts in both the space and defense budgets. Indeed, a Harris Poll in 1969 reported that 56% of Americans believed the costs of the Apollo program were too great and 64% believed that \$4 billion a year for NASA was still too much.⁷ Nixon said he regretted making cuts based on this analysis, adding: "You can certainly tell your people that the cuts in NASA were made most reluctantly, and that I am committed to the space program for the long-term future."⁸ Nice words, perhaps, but it did little to reassure those affected by these reductions in the program.

It is interesting that the Nixon White House dealt so gingerly with NASA in the 1969–1972 period. The agency had been created

in a crisis environment in the latter 1950s, and it had responded to the president's call for aggressive action in space in 1961 as a result of foreign policy setbacks and cold war complications. It successfully navigated both political shoals and technological challenges in making the first Moon landing by 1969. Accordingly, the stock for the agency was quite high as it participated in the Space Task Group report. Although there is no evidence to suggest that there was a wish to do so, NASA's status in the aftermath of the Moon landings was such that no one could just shutter the agency at the conclusion of the Apollo program. As the late comedian Sam Kinison once ranted to other nations seeking to replicate the "greatness" of the USA demonstrated in the Moon landings: "You really want to impress us! Bring back our Flag!"⁹ This trope of national exceptionalism and triumph was present throughout the post-Apollo debate.¹⁰

Even so, Nixon left the matter of future human space initiatives on the table thereafter. Finally, on 7 March 1970 he issued a statement that clearly announced his ambivalent support of NASA's proposed space exploration agenda: "we must also recognize that many critical problems here on this planet make high priority demands on our attention and our resources."¹¹ He refused to endorse any aspect of the report. Paine put relentless pressure on President Nixon for a greater commitment to NASA's post-Apollo initiatives, and this led to hard feelings between the White House and senior NASA managers that would eventually make decisions about the space program contentious.¹²

During this time, White House staffer Peter M. Flanigan commented that "NASA is—or should be—making a transition from rapid razzle-dazzle growth and glamor to organizational maturity and more stable operations for the long term." Unfortunately this did not seem to be the case, and Nixon's advisors sought to turn off this pressure by ousting Tom Paine as NASA administrator and replacing him with someone "who will turn down NASA's empire-building fervor and turn his attention to (1) sensible straightening away of internal management and (2) working with OMB and White House to show us what broad but concrete alternatives the President has that meet all his various objectives. In short, we need

⁹ See "Bush to announce goal of returning to the moon," on-line at <http://forums.pcper.com/printthread.php?threadid=277513>, accessed 4/19/2004.

¹⁰ Representative works include, Frutkin, *International Cooperation in Space*; Roger Handberg and Joan Johnson-Freese, *The Prestige Trap: A Comparative Study of the U.S., European, and Japanese Space Programs* (Dubuque, IA: Kendall/Hunt Publishing Co., 1994); Brian Harvey, *The New Russian Space Programme: From Competition to Collaboration* (Chichester, England: Wiley—Praxis, 1996); Dodd L. Harvey and Linda C. Ciccoritti, *U.S.—Soviet Cooperation in Space* (Miami, FL: Monographs in International Affairs, Center for Advance International Studies at the University of Miami, 1974); Joan Johnson-Freese, *Changing Patterns of International Cooperation in Space* (Malabar, FL: Orbit Books, 1990); Joan Johnson-Freese, "Canceling the U.S. Solar-Polar Spacecraft: Implications for International Cooperation in Space," *Space Policy* 3 (February 1987): 24–37; Joan Johnson-Freese, "A Model for Multinational Space Cooperation: The Inter-Agency Consultative Group," *Space Policy* 5 (November 1989): 288–300; John M. Logsdon, "U.S.—Japanese Space Relations at a Crossroads," *Science* 255 (January 17, 1992): 294–300.

¹¹ "Space Program Text," *Congressional Quarterly* (March 13, 1970): 768–779, quote from p. 768.

¹² Evidence of the pressure placed on the president can be found in a memorandum written by Paine to President Nixon a month after he took office urging the president to initiate a "general directive to define the future goals of manned spaceflight in the next few months, prior to your final decisions on the plans that will be recommended to you on September 1 by the members of the Task Group you have established." See, Thomas O. Paine to President Richard M. Nixon, "Problems and Opportunities in Manned Space Flight," February 26, 1969, NASA Historical Reference Collection. The Bureau of the Budget recommended to the president that he resist Paine's entreaty and opt for reductions in NASA's budget. See Robert P. Mayo to President Nixon, "Proposed Budget Amendment for the Space Program," March 3, 1969, Record Group 51, Series 69.1, Office of Management and Budget, Box 51-78-31, National Archives and Records Administration, Washington, DC.

⁴ *Aeronautics and Space Report of the President, Fiscal Year 2008* (Washington, DC: NASA Annual Report, 2008), Appendix E; James E. Webb, NASA Administrator, to the President, October 1, 1968; E.C. Welsh to the President, September 30, 1968; Lyndon B. Johnson memo to Dr. Hornig, n.d. [September 30, 1968]; James E. Webb, NASA Administrator, to the President, "Letter from Dr. Edward C. Welsh with Respect to My Statement on US and USSR Positions in Space," October 5, 1968, all in NASA Historical Reference Collection.

⁵ Donald Hornig to Lyndon B. Johnson, September 26, 1968; Johnson to Hornig, September 26, 1968, both from Executive Office Series, White House Central Files, LBJ Library.

⁶ President's Space Task Group, *The Post-Apollo Space Program: Directions for the Future* (Washington, DC: Government Printing Office, 1969); *New York Times*, September 16, 1969, p. 1; D.E. Crabill to Director, Bureau of the Budget, "President's Task Group on Space—Meeting No. 2," March 14, 1969, Record Group 51, Series 693, Box 51-78-31, Nixon Presidential Library, Simi Valley, CA; Clay Whitehead to Peter Flanigan, June 25, 1969, Record Group 51, Series 693, Box 51-78-31, Nixon Presidential Library, Simi Valley, CA; Robert Mayo to Richard Nixon, "Space Task Group Report," September 25, 1969, Record Group 51, Series 693, Box 51-78-31, Nixon Presidential Library, Simi Valley, CA; John Ehrlichman, *Witness to Power: The Nixon Years* (New York: Pocket Books, 1982), pp. 123–124.

⁷ Louis Harris, *The Harris Survey Yearbook of Public Opinion, 1970* (New York: Louis Harris and Assoc., 1971), pp. 83–84. See also Timothy B. Kyger, "President Nixon, Public Opinion, and Post-Apollo Planning", Senior Thesis, University of San Francisco, 1985, pp. 53–56.

⁸ Memo by Thomas O. Paine, "Meeting with the President, January 22, 1970," January 22, 1970, NASA Historical Reference Collection, NASA History Office, Headquarters, Washington, DC.

someone who will work with us rather than against us, and will seek progress toward the President's stated goals, and will shape the program to reflect credit on the President rather than embarrassment."¹³ Because Paine had made himself *persona non grata* in the White House, very little in the way of policy decisions were forthcoming during his tenure at NASA. It took his successor, James C. Fletcher, to salvage even one aspect of the grand strategy for NASA as it finished its Moon landing program.

Two years later, on 5 January 1972, Nixon finally agreed formally to approve a Space Shuttle, the least expensive element of the Space Task Group report; even so that was a much-compromised decision in and of itself. He adamantly refused to commit to other initiatives. The Shuttle did proceed from that, but it was certainly not the vehicle that NASA engineers envisioned at the start of the project.¹⁴ The space agency proposed a \$10 billion program, less than half the cost of Apollo, but could only obtain permission to proceed with the program if it agreed to a budget of \$5.5 billion; having done so it then immediately found the White House budgeteers further reducing the program to \$5.15 billion.¹⁵

NASA officials promised all sorts of positive developments for the Space Shuttle in the post-Apollo era. They thought of the Space Shuttle as a national Space Transportation System that would provide one-stop space access for everyone. It would be both inexpensive and reliable. Accordingly, it would become the achievement of a one-size-fits-all vehicle, in this instance providing all orbital services required by any users. Indicative of these broad expectations throughout the 1970s, NASA officials claimed that the Space Shuttle would greatly increase the utility of operations in low-Earth orbit while decreasing the cost of space access by an order of magnitude. In 1983 NASA published a marketing brochure entitled *We Deliver*, which touted the vehicle as "the most reliable, flexible, and cost-effective launch system in the world."¹⁶ NASA also pursued support for this concept from other federal agencies, convincing them that the Space Shuttle could satisfy all their launch needs. NASA gained the right to launch all US government satellites and tried to sell commercial satellite deployments to any company or other nation that might need them, often for very low prices, based upon a mission model of more than 30–40 flights per year. When the Shuttle program was declared operational by President Ronald Reagan after the first four flights in 1981 and 1982, NASA went to work to obtain commercial orders for the deployment of satellites and other activities that would keep the program busy for years.

Over time the Shuttle proved to be neither inexpensive nor reliable, both original selling points, and it has become clear that NASA should never have used those arguments in building a political consensus for the program. Therefore, by 1985 it was obvious that the shuttle was at best a mixed success. The Shuttle program was also essentially a continuation of space spectacles, as Apollo

had been, and its much-touted capabilities, while demonstrated and used, were possible only with high levels of risk and cost.¹⁷ In the aftermath of the *Columbia* accident on 1 February 2003, it became clear that many aspects of the shuttle program should be considered a failure.

As an extreme statement of this perspective, in the fall of 2005 the NASA administrator, Michael D. Griffin, publicly called the Space Shuttle a mistake. He asserted that NASA had pursued the wrong path when it was conceived in the 1960s and developed in the 1970s, and persisted with it long after its flaws had been discovered. That poor decision required correction. "It is now commonly accepted that was not the right path", Griffin told *USA Today* in an interview that appeared as a page one story on 28 September 2005. "We are now trying to change the path while doing as little damage as we can." When asked explicitly if the Shuttle had been a mistake, the NASA Administrator responded, "My opinion is that it was... It was a design which was extremely aggressive and just barely possible."¹⁸ Griffin's assertion that the Shuttle had been the "wrong path" pursued for more than a generation set off a firestorm of debate within the spaceflight community.¹⁹ But his point was valid, at least to the extent that the Shuttle had been a creature of compromise that did not live up to its hype.

2. Comparing policy making in the post-Apollo era and the present

One might conceivably draw several lessons or conclusions from this story of the Space Task Group and the Space Shuttle decision. I will enumerate three basic points that I think have importance in the current political environment as Americans consider the future of human spaceflight at the end of the Space Shuttle program:

1. Those leading NASA have a vision of what should be undertaken in human spaceflight that is always more expansive and less popular than what society as a whole, represented by the political leadership of the USA, is willing to undertake.
2. The technological challenge of bringing a new human space vehicle to reality is always greater than perceived at the time of the program's approval.
3. Over-promising what might result from a particular program always has significant negative repercussions. That was certainly the story of the Space Shuttle, and we have seen it in numerous other settings as well.

One could make the case that this very same situation is present today as well. I shall discuss each of these issues in turn.

2.1. Less popularity for human spaceflight than envisioned

Relating to the first issue, all too often those in the space community take it for granted that public support for their program is widespread in society. It is—most Americans are broadly supportive of NASA and its exploration efforts and want to see the nation advance in this arena, but that broad support only tells a small part of the story. At some level it is like the characterization of the Overlanders traveling westward on the Oregon Trail in the

¹³ Clay T. Whitehead, White House Staff Assistant, to Peter M. Flanigan, Assistant to the President, 8 February 1971, Record Group 51, Series 69.1, Box 51-78-32, National Archives.

¹⁴ This is discussed at length in Roger D. Launius, "NASA and the Decision to Build the Space Shuttle, 1969–72," *The Historian* 57 (Autumn 1994): 17–34.

¹⁵ Peter Flanigan to James C. Fletcher, December 11, 1971, James C. Fletcher Papers; James C. Fletcher to Caspar Weinberger, January 4, 1972; George Low, "Meeting with the President on January 5, 1972," January 12, 1972; James C. Fletcher interview by John M. Logsdon, September 21, 1977, all in NASA Historical Reference Collection, NASA Headquarters, Washington, DC; Claude E. Barfield, "Technology Report/Intense Debate, Cost Cutting Precede White House Decision to Back Shuttle," *National Journal* 4 (12 August 1972): 1289–1299.

¹⁶ The quote is from page 2 of the *We Deliver* brochure, reproduced in John M. Logsdon, gen. ed., *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Volume IV, Accessing Space* (Washington, DC: NASA SP-4407, 1998), 4:423.

¹⁷ Roger D. Launius, "Assessing the Legacy of the Space Shuttle," *Space Policy* 22 (November 2006): 226–234.

¹⁸ Traci Watson, "NASA Administrator says Space Shuttle was a Mistake," *USA Today*, September 28, 2005, p. 1A.

¹⁹ NASA Press Release, "NASA Memo: Griffin Point Paper on USA Today Article, 9/28/05," September 29, 2005, NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC.

1840s who opined that the Platte River they had followed was a “mile wide and an inch deep”. Support for human space exploration has been broad but not deep and it almost always loses out when anyone is faced with supporting it versus another national initiative. For example, in public opinion polls taken in the 1960s a majority of Americans ranked the space program as the government initiative most deserving of reduction, and its funding redistributed to any of a number of other federal programs. While most Americans do not oppose space exploration per se, they certainly have long questioned spending on it when other issues appear more pressing.²⁰

Since the heyday of Apollo during the 1960s little has changed in this support for NASA and its space exploration agenda. Many on the political left view spaceflight, too often characterized as the human space program only, as a waste of resources that might be more effectively deployed to support other good ends. Many find themselves nodding in agreement with Leo McGarry, the White House Chief of Staff in the recent fictional *West Wing* television series when asked about NASA’s overreach: “Where’s my jet pack, my colonies on the Moon? Just a waste.”²¹

Those on the political right have been no less questioning of this expansive space exploration agenda. Though distinctive in many respects, critics from the right have wondered why the public treasury should engage in activities that have no national security or practical application. This is seen in at least one criticism of space exploration from the political right when former speaker of the House and now Republican presidential contender, Newt Gingrich, criticized NASA as having too much power and becoming muscle-bound. He said that, while he generally favored science and technology investment by the federal government, he always believed that NASA should have been dismantled after Apollo. In the aftermath of the Moon landings, Gingrich said, NASA had become a bureaucracy in the worst sense of the term. “If you keep people there”, he contended, “they become obsolescent”.²² That was a metaphor for the whole of NASA as it moved beyond the Moon landings.

A similar complaint recently emerged from Apollo 17 astronaut and former Senator Harrison Schmitt. Schmitt commented on May 25, 2011:

When a new President takes office in 2013, he or she should propose to Congress that we start space policy and its administration from scratch. A new agency, the National Space Exploration Administration (NSEA), should be charged with specifically enabling America’s and its partners’ exploration of deep space, inherently stimulating education, technology, and national focus. The existing component parts of NASA should be spread among other agencies with the only exception being activities related to US obligations to its partners in the International Space Station (ISS).

Schmitt’s belief was that NASA was both moribund and bureaucratic; that it should in essence be blown up, such as in a log jam, to get activities moving again. As he put it, “NASA itself would be downsized to accommodate these changes. It should sunset as an agency once the useful life of the International Space Station (ISS) has been reached.”²³

While Americans both individually and collectively like space exploration and are generally supportive of NASA’s initiatives, for ideological, political and economic issues few, regardless of party allegiance, are willing to expend resources much beyond about one-half of one percent of the federal budget; this is a remarkably stable level of funding for the American space agency since the end of the Apollo program. About one-half of one percent seems to be the equilibrium point; that is what Americans in the democratic processes of the USA have decided is an appropriate level of spending for NASA. Anything that NASA does within this context is mostly acceptable to the American public, but much beyond it is unsupportable. Efforts to reach for greater funding have repeatedly been challenged and brought back down. There is only one instance where this was not the case—the Apollo program—and that was fundamentally because of its unique place as a cold war initiative.

What made the Space Shuttle initiative succeed, even if it was not all that NASA and the larger space community sought, was the ability of the project management team to bring its R&D effort to completion—when adjusted for inflation—on a relatively modest budget. That team’s success in taking the Space Shuttle to flight status on a very tight budget should not be minimized when assessing the program’s legacy. The cost from program approval through first flight was \$5.974 billion (when adjusted for inflation to 1972 dollars), a 17% overrun above the \$5.15 billion budget originally approved. For the development effort, NASA did not do too badly in estimating costs in an era of rampant inflation. Even so, the human spaceflight program stood down between 1975 and 1981 to make room in the budget for Shuttle development, despite having parts for three additional Saturn Vs and disassembled Apollo spacecraft that might have been used. The marginal cost of flying those missions, both in terms of dollars and risk, was too great to continue the program.²⁴ Moreover, cost overruns have been cited repeatedly as an indication of the failure of the Space Shuttle program and NASA management of it.²⁵

2.2. Technological challenges are greater than perceived at the start of a program

This brings to the fore the second challenge suggested by the experience of post-Apollo space planning, the enormous technological challenge of bringing a new human space vehicle to reality always proves greater than perceived at the time of the program’s approval. NASA’s current dilemma is how to fly the Space Shuttle until retired in 2011—and expending the budget necessary to accomplish its operations—while also supporting the International Space Station and pursuing a new space vehicle to replace the Shuttle as the budget remains flat, at best. The technological and budgetary challenges of the Constellation program, announced in 2005 as an effort to modify Shuttle technology into the next human spaceflight initiative that would eventually take America back the Moon, and the new Obama administration

²⁰ Roger D. Launius, “Public Opinion Polls and Perceptions of U.S. Human Spaceflight,” *Space Policy* 19 (August 2003): 163–175.

²¹ “The Warfare of Genghis Khan,” Episode #513, *West Wing*, broadcast: February 11, 2004.

²² “Gingrich Says NASA Should Have Folded,” *New York Times*, February 5, 1995, p. 24.

²³ Harrison Schmitt, “Space Policy and the Constitution #4,” May 25, 2011, available on-line at <http://americasuncommonsense.com/blog/2011/05/25/46-space-policy-and-the-constitution-4/>, accessed 6/15/2011, 1:38 PM.

²⁴ These calculations were based on budget data contained in the *President’s Report for Aeronautics and Space, Fiscal Year 2004 Activities, NASA Pocket Statistics, 1997*; and project summaries, all available in the NASA Historical Reference Collection.

²⁵ Alex Roland, “The Shuttle: Triumph or Turkey?” *Discover* (November 1985): 14–24; Alex Roland, “Statement before the Subcommittee on Science, Technology, and Space of the Senate Committee on Commerce, Science, and Transportation,” April 2, 2003, available on-line at http://history.nasa.gov/columbia/Troxell/Columbia%20Web%20Site/Documents/Congress/Senate/FEBRUA~1/roland_statement.html, accessed 02/02/2006, 5:45:22 PM.

determined it had to take action.²⁶ There was, of course, a growing concern that President George W. Bush's "Vision for Space Exploration" (VSE) and the Constellation program designed to carry it out, was not sustainable because of the pressures of the budget, technology, and time. It appeared increasingly throughout 2009 that the VSE could well follow the path of the aborted Space Exploration Initiative (SEI) announced with great fanfare in 1989 but quietly ended in the early 1990s. The new administration realized that the Constellation program had run into technological and budgetary problems and took action to end it in February 2010.²⁷

Technological challenges may, of course, be overcome with sufficient funding, but the political will to make that investment has not existed for human spaceflight programs since the Apollo era. Without a willingness to increase budgets sufficient to overcome technological challenges, NASA has been asked repeatedly to do more with less. The more becomes more every year, and the less shrinks in real terms as well. The comments of Daniel S. Goldin, NASA administrator between 1992 and 2001, are instructive on this score. He commented to a recent NASA gathering that he was surprised by a meeting with Senator Fritz Hollings (Democrat–South Carolina) during his Senate confirmation process in 1992 in which Hollings drew a graph that tracked over time the budget NASA had requested, showing that it went up at a steady rate into the future. Hollings then drew for Goldin the budget that Congress—and presumably the White House as well—envisioned for NASA. It was a flat line as far as the eye could see.

The point was clear. NASA was not going to get any increase in its budget, despite its pressing for one and despite the recommendations of the Augustine Commission in 1990 that made a case for increases to the NASA appropriation. The same was true in January 1993 when Goldin talked with officials of the new Clinton administration, as Office of Management and Budget director Leon Panetta drew the same graph, showing what NASA wanted and what the White House could support—a flat line budget. If NASA could undertake and succeed in completing its expansive goals within the confines of its flat line budget everyone would cheer, but there was no place to go for additional funding to solve technological challenges.²⁸

Since human beings are at the core of any R&D project, the complexity of the effort expands even further to include chance and non-linear factors endemic to the real world of people. The relationships among technological innovation; various space institutions; innovative concepts, practices or organizations; and the people associated with each are intrinsically complex. Essentially non-linear, these relationships allow innovation to take place, no doubt, but there does not seem to be a way to guarantee it. Those who seek to command innovation find that changes in inputs to various aspects of the systems, themselves designed to yield innovative alterations, do not necessarily ensure

proportionate positive developments in output. It is non-linearity writ large.²⁹

This is a real problem, for the ability to predict in advance the problems associated with developing a new technological system; it is a task not without difficulties. But the recognition that the technical hurdles in building space launch vehicles have proven more daunting than anticipated has always been the case. The central reality in all R&D is uncertainty; one simply cannot guarantee success once a project is undertaken.³⁰

2.3. The wages of over-promising

This places NASA in a unique position as it seeks to develop some of the most sophisticated technology ever envisioned, and relates to my third observation about over-promising what may be achieved with flight projects. The problem with over-hyping is that, when expectations do not square with reality, negative reactions result. This might be forgiven once or twice on big projects—after all errors do happen on occasion—but a history of over-promising leads first to skepticism about the promises and then over time to a rejection of the source making the promises altogether. This seems to be NASA's reputation at present, as numerous politicians have said privately—and some not so privately—that NASA's projects must live up to their hype. Perhaps the classic statement came from Representative Ralph M. Hall (then Democrat–Texas), speaking at the American Astronautical Society's Goddard Memorial Symposium in 2001. He focused in this instance on the International Space Station (ISS) and its utilization. He chided NASA, "After all of the taxpayer dollars that have been invested in the Space Station, we will need to ensure that we wind up with the world-class research facility that we have been promised." As an aside to his prepared remarks, Hall warned that NASA had better find a way to use the ISS effectively. He cautioned that some astounding scientific discovery had better be forthcoming—and specifically mentioned a cure for cancer—or the agency's stock will sink even further and it could lose critical political support.³¹

Clearly, space launchers and orbital vehicles operate at an extreme unnecessary in most other settings and therefore overtax the system that seeks to produce them. This necessitates increased investment to defeat technological hurdles. Without that cushion, and even the funding envisioned in an overambitious R&D scenario, NASA has fallen back on the extensive hyping of systems to gain approval, and it has suffered the resultant disappointment and loss of credibility when it fails to deliver on the promises of those advocating them. Results that do not meet expectations lead to a loss of credibility and support. Despite all its very real successes, for instance, the Space Shuttle has long been widely viewed as a failure when this has been only partially true. Many have condemned NASA for "overselling" the Space Shuttle program as

²⁶ On Constellation see, Frank Sietzen Jr. and Keith L. Cowing, *New Moon Rising: The Making of the Bush Space Vision* (Apogee Books, 2004); Craig Cornelius, "Science in the National Vision for Space Exploration: Objectives and Constituencies of the 'Discovery-Driven' Paradigm," *Space Policy* 21 (February 2005): 41–48; Wendell Mendell, "The Vision for Human Spaceflight," *Space Policy* 21 (February 2005): 7–10.

²⁷ Office of Science and Technology Policy/National Aeronautics and Space Administration Fact Sheet, "A Bold New Approach for Space Exploration and Discovery," February 1, 2010, copy in possession of author.

²⁸ Remarks of Daniel S. Goldin, "Seeking Signs of Life: A Symposium Celebrating the 50th Anniversary of NASA's Exobiology Program," October 14, 2010, webcast on-line at <http://www.livestream.com/astrobiology50th>, accessed 10/15/2010.

²⁹ The complexity of non-linearity in historical study has been discussed in its larger context in Bryan D. Palmer, *Descent into Discourse: The Reification of Language and the Writing of Social History* (Philadelphia, PA: Temple University Press, 1990), pp. 188–206; Brook Thomas, *The New Historicism, and Other Old-Fashioned Topics* (Princeton, NJ: Princeton University Press, 1991), pp. 24–50; Peter Novick, *The Noble Dream: The "Objectivity Question" and the American Historical Profession* (New York: Cambridge University Press, 1988), pp. 415–628, passim.

³⁰ I have discussed this at length in my "Introduction: Patterns of Innovation in Aeronautical Technology," in: Roger D. Launius, ed., *Innovation and the Development of Flight* (College Station: Texas A&M University Press, 1999), pp. 3–18.

³¹ Hon. Ralph M. Hall, speech to the AAS Goddard Memorial Symposium, March 27, 2001, Greenbelt, Maryland, published as "A Time of Transition": Remarks to the American Astronautical Society's Goddard Memorial Symposium," *Space Times: Magazine of the American Astronautical Society* 40 (September–October 2001): 12–15.

a practical and cost-effective means of routine access to space and then failing to deliver on that promise.³²

Since the Space Shuttle began flying there have been numerous attempts to replace it, and each one has failed because of technological overstretch and budgetary miserliness. The landscape is littered with failed projects in space access, ranging from the National Aerospace Plane to the X-33 to the Orion/Ares I launch system.³³ In every case NASA's image has suffered, making it just that much more difficult the next time to gain approval for a major project.

3. Conclusion

This situation has led some to suggest that perhaps the best answer to the human spaceflight effort is to advocate a portfolio of R&D concepts with a diverse range of risk, cost, and potential payoff, rather than NASA building and flying its own vehicles. NASA might, of course, make rather large investments at some points when justified by the potential reward. In this way, the nation might find reason to fund a small-scale program in any number of breakthrough technologies without the need to affix them to a vehicle, while putting proportionally more funds into evolutionary technologies. In such a scenario, the central policy challenge would not be in "what" new vehicle to invest R&D dollars, but "how" to make many investments in smaller efforts that might find eventual use.³⁴ This was the model Newt Gingrich proposed in the mid-1990s, with NASA stepping back from its "owned and operated" approach to human spaceflight to one that returned to its National Advisory Committee for Aeronautics (NACA) roots as a technology development organization.

It was obvious in the era of post-Apollo planning that the Moon exploration program was not sustainable. In 1970 Richard Nixon declared that the priority of the space program had to be determined by 'normal' politics. That has remained the case for 40 years, and continues to be the case into the indefinite future. There remains no political support for a continued large-scale space program focused on human exploration. The systems developed for Apollo had to be abandoned, but the Apollo era NASA institutional base and organizational culture persisted. This created an environment in which more and more funds went to institutional support rather than for missions. NASA and its supporters in Congress and industry still have not adjusted to this reality, and have continued to hope for another Apollo-like effort. But it is not about to happen.

At some level the approach the Obama administration has proposed could break the cycle, invoking change as something more than semantics. It envisions a major shift in the way NASA will accomplish human spaceflight. In this new approach NASA could return to its roots as a research and development organization to develop the transformational technologies, while private industry will operate the systems built, just as Gingrich proposed. Turning low-Earth orbit over to commercial entities might empower NASA to focus its attention on deep space exploration.

To make this possibility a reality, however, NASA would have to undergo significant shifts in programs and operational practices. The Constellation program, behind schedule and severely strapped for funding, has proven a chimera that sought to relive past glories. Even though it relied on legacy technologies from the Shuttle program, many observers pronounced it too aggressive an effort for its budget. Constellation's cancellation, therefore, was a courageous admission on the part of the Obama administration of the need to hit the reset button for human spaceflight; especially so because there was no political support on either side of the aisle to invest additional dollars in this program. And this despite a recommendation by the Augustine Panel to invest an additional \$3 billion more per year for five years to return Constellation to health. This lack of support for additional funds suggests how far down the national priority list NASA's human spaceflight program has sunk; when one considers that the US federal budget has been expanded significantly in the past three years to stimulate the economy, rescue financial institutions, and support national security, failure to accept this recommendation to add to the NASA budget suggests just how low a priority the human space program holds in the public's perceptions.³⁵

More importantly, for the new approach oriented toward commercial space operations in low-Earth orbit to have any chance of success, NASA must change itself. For 50 years it has dominated all aspects of human spaceflight, developing technologies for its own use. In planning the post-Apollo program no one seriously questioned that NASA should take the lead in the development of the new technology envisioned. While few were willing to grant the space agency the budget it wanted for its expansive plans, the idea of NASA returning to its R&D roots never gained any credence. Perhaps it would have been appropriate at least to have had that debate, even if it might have been rejected.

The path chosen set NASA up as the dominant organization, calling all the shots associated with space exploration, for better or worse. While NASA relied on contractors for assistance, there was never any doubt about who was in charge. Many now believe it is time for this to change 40 years after the fact; NASA now needs to develop more equal partnerships with outside entities, especially the commercial sector, to carry out its space exploration mandate. This shift will be difficult, but it is critical for future efforts. NASA stands on the cusp of reinventing itself in ways that it never did in the post-Apollo planning era, and if it is successful it may thrive in this new ever-changing world. Will it successfully do so, or will it retrench and wait for the next administration and the next blue ribbon review? Reinvention may well lead to a hopeful future for human space exploration; retrenchment suggests that the same difficulties NASA has been facing for many years will continue and perhaps get worse.

The three observations emerging from this consideration of the post-Apollo planning process—there is less political and monetary support for NASA's activities than those inside the space community believe appropriate, the technological challenges of developing new vehicles are greater than envisioned, and over-promising

³² Greg Easterbrook, "The Case Against NASA," *New Republic*, 8 July 1991, pp. 18–24; Alex Roland, "Priorities in Space for the USA," *Space Policy* 3 (May 1987): 104–114; Alex Roland, "The Shuttle's Uncertain Future," *Final Frontier* (April 1988): 24–27.

³³ This problem is discussed in some detail in Roger D. Launius, "After Columbia: The Space Shuttle Program and the Crisis in Space Access." *Astropolitics* 2 (July–September 2004): 277–322; John M. Logsdon, "A Failure of National Leadership: Why No Replacement for the Space Shuttle?" in: Steven J. Dick and Roger D. Launius, eds., *Critical Issues in the History of Spaceflight* (Washington, DC: NASA SP-2006-4702, 2006), pp. 269–300.

³⁴ Scott Pace to the author, September 10, 2000, copy in my possession.

³⁵ Major analyses of this transformation may be found in Marcia S. Smith, "President Obama's National Space Policy: A Change in Tone and a Focus on Space Sustainability," *Space Policy* 27 (February 2011): 20–23; John M. Logsdon, "Change and Continuity in U.S. Space Policy," *Space Policy* 27 (February 2011): 1–2; Gérard Brachet and Xavier Pasco, "The 2010 U.S. Space Policy: A View from Europe," *Space Policy* 27 (May 2011): 11–14; Yasuhito Fukushima, "An Asian Perspective on the New U.S. Space Policy: The Emphasis on International Cooperation and its Relevance to Asia," *Space Policy* 27 (May 2011): 3–6; Sergey Avdeyev, Jean-Francois Clervoy, Jean-Marc Comtois, Takao Doi, Jeffrey Hoffman, Mamoru Mohri, and Gerhard Thiele, "Human Space Exploration – A Global Trans-Cultural Quest," *Space Policy* 27 (May 2011): 24–26.

results have significant negative repercussions—remain valid in considering the current efforts to retire the Shuttle and replace it with a follow-on human launcher. Collectively, they represent an iron triangle of reality that challenges success.

Perhaps it is time to try something new. Following the path of post-Apollo efforts has gotten human space exploration stuck in

low-Earth orbit for 40 years. Could NASA's talents be deployed more effectively developing high technology solutions to the problems of spaceflight, not to mention other challenges facing humanity? Whatever the decision, the observations about public support, technological verisimilitude, and the dangers of over-promising remain just as valid in 2011 as they were in 1970.