How the space shuttle program was sabotaged

From its inception, enemies of man's exploration of space have sometimes changed their arguments, but always made sure the program didn't have enough funding. Marsha Freeman reports.

From the greatest heights of accomplishment, to the dog days of massive budget cuts, the U.S. space program has always been surrounded by individuals and institutions that have tried to stop man's exploration of space. The critics have changed their mode of attack, depending upon the circumstances and political environment in the nation, but their aim has always been the same.

Since Jan. 28, the nation's attention has been focused on the shock of the Space Shuttle Challenger loss, and the public circus of the Rogers Commission "investigation." The press, speaking for the space critics, has asked whether the Shuttle program should continue at all, whether it is safe, whether it is worth the money, ad nauseum.

But before manned exploration of space was even technologically possible, its opponents were amassing their forces. Once President John Kennedy had gone above the counsel of all of his advisers and started the race to the Moon, the focus of attack became the supposed negative "social impact" of such a large-scale science and engineering effort.

With Kennedy gone, the assault on the space program shifted, as opponents insisted that the United States could not afford the Apollo program, due to the high cost of the Vietnam war, and the poverty here on Earth. President Lyndon Johnson's Great Society replaced the Apollo project, thereby ushering in the anti-technology "paradigm shift" in the U.S. population, which has become so much more pronounced today.

The Nixon administration certainly did not buy the idea of cutting the space program to pay for more social programs, but the economic crisis of the early 1970s put the "conservative" budget-cutters firmly in charge of major policy decisions. Thanks to Budget Director George Shultz, "cost effectiveness" became the watchword for all federal programs—to the detriment of scientific rigor.

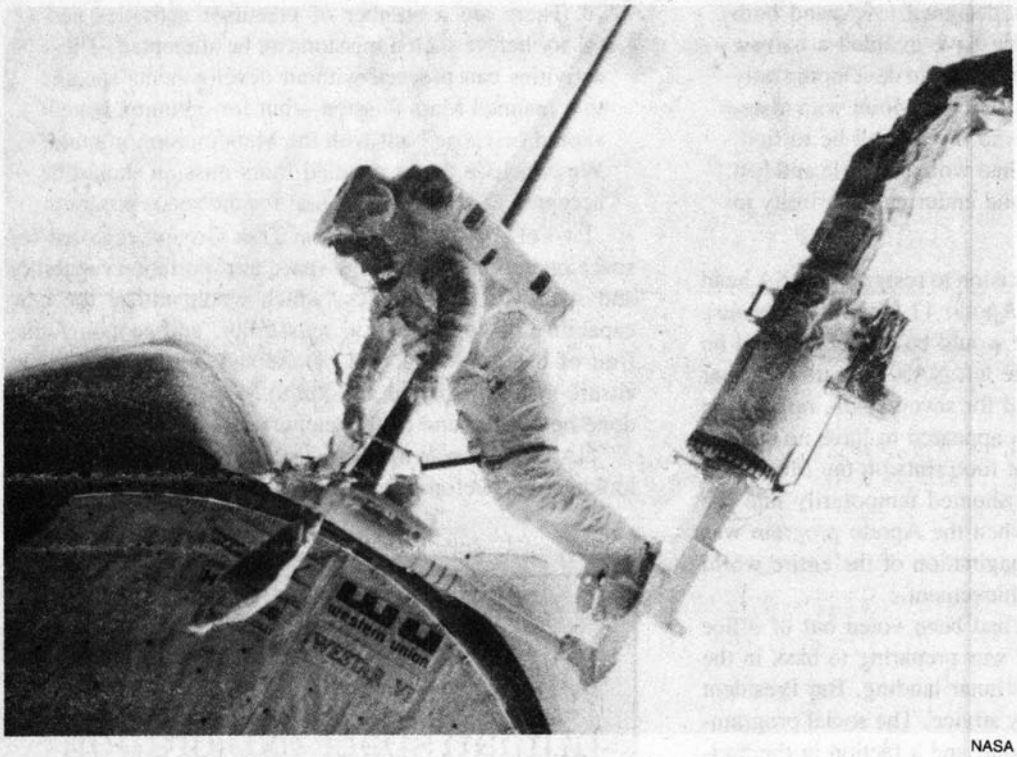
At the same time, the administration and the Congress were being convinced by Henry Kissinger (who was assistant to the President for national security affairs) and Shultz that rather than spend money on advanced technology for defense, the United States should sign the Anti-Ballistic Missile and SALT treaties. Since the Soviets had no intention of slowing down either their offensive or defensive science-and-technology weapons programs, these treaties, plus the slowdown of the civilian space program, were to lay the basis for the current strategic superiority of the Soviets.

The same situation exists today, in that the first cuts that will be made in defense spending, under the guise of balancing the budget, will be the leading-edge laser and other technologies in the Strategic Defense Initiative programs, giving the Soviets the final superiority.

Under President Carter, as "small is beautiful" became the stated policy of the White House, the decision was made that no new large programs for space would be started, while billions of dollars would be wasted on energy conservation, welfare, and "appropriate technology."

Although President Reagan would like to have a space program with challenging goals and a future, he is ending up with the "Richard Nixon" approach to cost-benefit analysis and "private enterprise" for the National Aeronautics and Space Administration (NASA).

Let us be clear about the current situation. If there are



Astronaut Bruce McCandless II tests a "cherry picker" device during historical extravehicular activity, Feb. 7, 1984.

NASA

safety compromises that have been made in the design and fabrication of the Space Shuttle system, or in the launch rate or other operational procedures, the blame does not fundamentally lie with the management of the space program, or the contractors. Over the 15 years of the development and first flights of the Shuttle, the wrong criteria were used in making crucial choices. When you straightjacket a research and development agency, and instruct it to build a capability spending half as much money as it should spend, you can hardly complain when it does not function according to your expectations.

When fundamental engineering considerations, such as the frequency of launch, are determined not by readiness but by political pressures and the requirement to bring down the "cost" of the system, there is pressure put on the agency to increase the launch rate. Combine that with a constant media campaign that has made NASA look "like a bunch of idiots who can't even handle a launch schedule," as Kennedy Space Center Director Richard Smith recently charged, and you are increasing the risk in the program, and potentially compromising safety, as senior astronaut John Young has pointed out.

The two questions facing the Congress—the elected representatives of a nation, three-quarters of whose citizens insist that they want the Shuttle program to continue—are first, whether we are willing to commit the resources to actually have the kind of Space Shuttle capability the nation requires; and second, whether we will make the same budget-balancing mistakes with the upcoming space station that was made in the Shuttle program.

The lost opportunity in space

Plans for what should follow the Apollo program, after man had landed on the Moon, started years before astronaut Neil Armstrong took that famous first step, on July 20, 1969. By 1965, much of the hardware for the lunar voyages had already been ordered, built, and had begun testing, and NASA was ready to begin planning for the exploration of the next frontiers.

By 1965, however, NASA was under a barrage of attacks from the "social" think-tanks such as the Brookings Institution, the Tavistock Institute in London, and the self-proclaimed Aquarian Conspiracy (see box). President Johnson's State of the Union address on Jan. 4, 1965 was the first since Sputnik (1957) that did not even mention the space program.

As the NASA budget began to decline, program planners fought to keep open the space frontier. German-American space pioneer Wernher von Braun, for example, penned articles and books on lunar colonization, the exploration of Mars, and other projects that required an Earth-orbital space station, and a shuttle-type vehicle to service it.

NASA Administrator James Webb refused to operate with the notion that NASA had been created just to go to the Moon. In motivating the NASA budget request for Fiscal Year 1965, Webb stated:

> The policy on which this budget is based is the mastery of space, and its utilization for the benefit of mankind. This mastery and the relation of our position to those of other nations will not be determined by any single achievement.

The NASA program is designed to expand both science and technology. We have avoided a narrow program, one limited, for example, to developing only the technology needed to reach the Moon with state-of-the-art hardware. To do so might well be to find, some years hence, that we had won the battle and lost the war as far as utlimate and enduring superiority in space is concerned.

Webb made the painful decision to resign as NASA head in 1968, just months before Apollo 11 lifted off, because it had become clear that there would be no budget, and no post-Apollo plan for space. He left NASA before the lunar landing which he had prepared for seven years, rather than preside over an agency which appeared to have no future.

But when man put his first footprints on the Moon, the anti-science lobby was again shunted temporarily into the background, as it had been when the Apollo program was begun by Kennedy, as the imagination of the entire world was captured by this great achievement.

The Great Society crowd had been voted out of office in 1968, and a new President was preparing to bask in the glory of the upcoming Apollo lunar landing. But President Nixon was to get contradictory advice. The social programmers in the Congress, the media, and a faction in the "scientific" community, accelerated their campaigns to make sure that Apollo would mark the *end*—not the beginning—of man's exploration of space.

In February 1969, President Nixon established a Space Task Group headed by Vice-President Spiro Agnew, to establish goals in the post-Apollo era. The Task Group consisted of NASA Administrator Tom Paine, Secretary of the Air Force Robert Seamans, and Presidential Science Adviser Lee Dubridge. Robert Mayo, who directed the Bureau of the Budget, had only an observer status.

The Group's report, titled, *The Post-Apollo Space Program: Directions for the Future,* was released two months after the Apollo 11 landing. It projected an exciting vision of a Mars landing before the end of the century, at the latest.

The lunar landing, the authors said, was "only the beginning of the long-term exploration and use of space by man." They continued:

> We see a major role for this nation in proceeding from the initial opening of this frontier to its exploitation for the benefit of mankind, and ultimately to the opening of new regions of space to access by man.
>
> We have found questions about national priorities, about the expense of manned flight operations, about new goals in space which could be interpreted as a 'crash program.'
>
> to decisions about a manned mission to Mars. We conclude that NASA has the demonstrated organizational competence and technology base to carry out a successful program to land a man on Mars within 15 years.
>
> There are a number of precursor activities necessary before such a mission can be attempted. These activities can proceed without developments specific to a manned Mars mission—but for optimum benefit should be carried out with the Mars mission in mind. We conclude that a manned Mars mission should be accepted as a long-range goal for the space program.

Two of the systems that the Task Group suggested for space operations were a new space transportation capability and space station modules, which would utilize the new capability of commonality, reusability, and economy, the fruit of the Apollo success. These capabilities would then ensure that the manned mission to Mars could certainly be done before the end of this century.

NASA, too, was working furiously to put such forward-looking goals before the Nixon White House, after the lunar

Who's out to kill human space exploration

As early as President Kennedy's 1961 announcement of the Apollo program, thinktanks such as the London-based Tavistock Institute and the Brookings Institution were "warning" that the space program was driving America in the dangerous direction of "technological and cultural optimism." The fledgling anti-science environmentalist movement pitted the space program against the needs of the "ghettos" and pollution. NASA was under continuous assault. Here are a few of the leading spokesmen who set out, on various pretexts, to prevent man from exploring space.

Barry Commoner, *The Nation,* Dec. 16, 1962.

Other undertakings are more important than space. At this moment, in some other city, a group may be meeting to consider how to provide air for the first human inhabitants on the Moon. Yet, we are meeting here because we have not yet learned how to manage our lives without fouling the air man must continue to breathe on Mother Earth.

Tavistock Institute, *Human Relations,* 1966.

The space program is producing an extraordinary number of "redundant" and "supernumery" scientists and engineers. "There would soon be two scientists for every man, woman, and dog in the society."

landing. Also released in September 1969 was a space agency report titled, "America's Next Decades in Space." It presented four scenarios through which new space capabilities could be developed. By 1975, the United States could have a 12-man space station, it proposed, which could be expanded to house 80 people by 1980.

A station orbiting the Moon would be put into place, with the first permanent lunar surface base to be established in 1978. At the fastest pace, NASA stated that the first manned Mars expedition could be in 1981. Even if the NASA budget were limited to a ceiling of $4 billion per year, these missions could all be achieved, if a few years later.

NASA estimated that by 1975, an Earth-to-orbit shuttle vehicle would be operational, and a year later a tug could take passengers from Earth orbit to the Moon. By 1978, a nuclear-propelled orbital transfer vehicle would be ready. All it took was the will to set NASA to work.

But there was no chance that the rational deliberations of the space agency itself, or the past accomplishments of space exploration, would determine the future of the effort. Even before the task force reported its recommendations to the President, Budget Director George Shultz slashed the NASA FY 1970 budget request by $45 million!

The Office of Management and Budget dictated to NASA, and the President, that they would have to operate with no major increases in the budget; that the OMB would have to be satisfied that "cost-effective criteria" were met before any large project could be developed; that any new program, like the Space Shuttle, would have to use as much Apollo-developed technology as possible; and that there would be no "crash" programs. Similar constraints have been made upon President Reagan's space station initiative.

Tavistock Institute, *Social Indicators,* 1966.

Measures of social performance are all the more important in a "postindustrial" society, one in which the satisfaction of human interests and values has at least as high a priority as the pursuit of economic goals. . . . The Great Society looks beyond the prospects of abundance to the problems of abundance.

Father Theodore Hesburgh, Council on Foreign Relations, Trilateral Commission, President of Notre Dame, November 1962

The preoccupation of scientists with space and military research is prostituting science to something far below its capacity for abolishing disease, hunger, and illiteracy on a worldwide basis. Should we pioneer in space and be timid on Earth and leave man in bondage below?

Brookings Institution, *Proposed Studies of the Implications of Peaceful Space Activities for Human Affairs,* March 1961

The exploration of space requires vast investments of money, men and materials and creative effort—investments which could be profitably applied also to other areas of human endeavor, and which may not be so applied if space activities overly attract the available resources.

Senator William Proxmire, Aug. 20, 1962.

I think there is great waste in this program. This latest single increase in the space budget will result in a tax of $70 for every American family—of all of our 50 million American families—for the nondefense program. I wonder if most people approve of spending at that rate for this kind of program.

Senator J. William Fulbright, *Washington Post,* May 5, 1963.

Fulbright said that he found it "strange" that "in a world which bears an intolerable burden of hunger, disease, poverty and animosity among its people, we should devote so many of the best minds of both Western and Communist worlds to achieve a landing on the Moon, where, to my knowledge, no solutions to our problems await us."

New York Times, John Finney, April 7, 1963.

With the appreciation of the cost have come questions as to whether the space agency needs so much money and whether some of the funds could not be spent more profitably on earth or even not be spent at all.

Dr. Philip Abelson, American Association of the Club of Rome, editor of *Science,* April 19, 1963.

NASA has sought examples of technology fallout in its program. To date, those cited have not been impressive. The problems of space are different from the earthly tax-paying economy. . . . I believe the program may delay conquests of cancer and mental illness.

Newsweek, Sept. 30, 1968

Now as NASA draws close to the time when it either fails or fulfills that commitment [to land on the Moon] the U.S. space program is in decline. The Vietnam war and the desperate conditions of the nation's poor and its cities—which make spaceflight seem, in comparison, like an embarrassing national self-indulgence—have combined to drag down a program where the sky was no longer the limit.

Skylab circles the earth. NASA

On Capitol Hill, many of the same cast of characters who today are clamoring for the dismantling of the space program, were also doing so then. Thus, Sen. Edward Kennedy (D-Mass.), speaking at the dedication of a new Goddard Library at Clark University on May 19, 1969, called for a slow-down of the space program. NASA historian emeritus Eugene Emme described this as a "profanity to the memory of John F. Kennedy, who had set Apollo in motion, if not also to the memory of Robert H. Goddard." The landing of Apollo 11 was just two months away.

NASA planners were determined, however, to use the giant Saturn V rocket and the Apollo technology for at least a temporary space station. Skylab was launched in 1973, and produced stunning results in space science, astronomy, biology, and materials processing. Designed for only temporary service, Skylab 1 was to be followed by a second U.S. space station.

That station, Skylab 2, sits today as an exhibit in the National Air and Space Museum in Washington, D.C., never having been launched. Skylab was a larger station than the entire series of Soviet Salyut stations used for the past decade.

Space station: déja vu?

In his State of the Union address in 1984, President Reagan asked NASA to build an Earth-orbital space station, to begin operations within a decade. In a replay of the Nixon Shuttle decision, the OMB immediately cut NASA's funding request for the new initiative.

Originally, the space community had hoped to bring the station on-line, for the 500th anniversary of Columbus' discovery of America, in 1992. With the budget cuts in the past two years, NASA is now uncertain it can even meet the 1994 deadline that the President had given the program.

Colonel Gilbert Rye, who is director of space programs on the National Security Council staff, wrote in 1985: "President Reagan believes a space station can stimulate a boom in the commercial development of space, much as the railroads opened the western frontier." In September 1984, according to Rye, Reagan said, "Bringing into full play America's greatest asset—the vitality of our free enterprise system—will do more to spur the development of space for the benefit of man than any of us can now imagine."

Both Rye and President Reagan seem to have forgotten that it was only *President Lincoln's* commitment to link the transcontinental railroads that got the job done, and laid down the infrastructure for the real growth of, not some mystical "free enterprise," but American industry and agriculture.

A different view of the importance of the space station project has been stated by former NASA Administrator James Beggs. In 1985, Beggs stated that, "A space station is the logical expansion of our activities into space. Indeed, a look back at the origins of our planning for the Space Transportation System shows that we had two things in mind. One was efficient, routine, and economical transportation into space with the Shuttle."

"The other was a space station to provide a continuous manned presence in orbit. While the Shuttle allows us to do many new things in space, it is not an end in itself. Rather, it is an enabling mechanism toward other ends, which together with a space station, will promote broad-reaching expansion of the space program over the next century and beyond."

In 1975, former NASA head Tom Paine, "one of the most innovative thinkers," according to Beggs, laid out a 100-year scenario, which included the Space Shuttle and Spacelab; an Earth-orbital station, then moving the space station capability further out to geosynchronous orbit; then a lunar orbiting station, a lunar colony; and then a station and colony on Mars. Those are the reasons to build a space station.

In an interview in *Sky and Telescope Magazine,* on the occasion of the 25th anniversary of the space age, Beggs stated, "When you come down to it, the bottom line is what they allow you to do in the budget. What I would like to see during the period I occupy this chair is the establishment of a policy and precedent that says the country will continue to do research and technology development on a long-term basis, at a level commensurate with the benefits that we receive from the program.

". . . With another billion dollars in the program, we would be able to do a lot of things that we or even the scientific community would like to do. We would like to see some new beginnings because this program lives by stepping up so often to something new. That's what keeps our people thinking, creating."

Because Skylab II was never orbited, and the building of

a space station has been postponed, the Shuttle has had to do double duty as a space laboratory and a transport vehicle.

Convinced, as President Reagan is today, that an economic "recovery" would be obtained by slashing government spending, President Nixon crippled the very federal agency that could lead a recovery by extending the frontiers of science and technology.

Years with no vision

By 1978, it was becoming clear that the underfunding of the program, which led to cutbacks in testing of key components and replacing tests with cheaper computer simulations, plus the difficulty of the technologies themselves, meant that either NASA would have to ask the Congress for more money, or it would never complete Shuttle development. As the program schedule slipped further behind, the NASA leadership refrained from an aggressive lobbying effort to get more money, fearing that the entire project might be scrapped.

But in 1978, President Carter was persuaded that the Shuttle was needed to verify any violations of the SALT II treaty. Former astronaut Schmitt recalled: "I was serving in the Senate at that time, and it became clear to me, and to others, that the day of reckoning had come for the early underfunding of the Shuttle program."

Carter administration presidential science adviser (and current head of the National Academy of Sciences) Frank Press and Carter-era NASA head Robert Frosch made clear that NASA would get no budget relief, no planned fifth orbiter, and no new space project during their tenure.

That the frontal assault was against NASA, and *not* simply against all federal spending, can be seen in **Table 1.** While social welfare and "soft" technology boondoggles were growing by leaps and bounds, NASA's budget increased by a mere 4%, between 1967 and 1980. It would have had to increase by 147%, just to keep up with inflation. It is indeed amazing that NASA was able to build the Shuttle at all.

Though federal aid to higher education began skyrocketing in the early 1970s, the peak year for the graduation of new physicists was 1969, close to the NASA peak funding year. All of the billions of dollars in federal aid to education has never produced as many scientists and engineers as NASA did.

Table 1

Budget increases for various federal government agencies (1967-80)

NASA	4%
Transportation	193%
Education	344%
Energy	888%
Income security	481%
Health	685%

The same is true for developing new energy technologies. NASA-supported projects throughout the 1960s in advanced nuclear technologies for propuslion, new energy conversion techniques such as magnetohydrodynamics, and other programs contributed more to the nation's energy R&D than the billions of dollars spent on solar energy by Carter's Department of Energy.

Speaking at the annual conference of the American Astronautical Society in 1982, then staff director of the House Subcommittee on Space Science and Applications, Darrell Branscome, stated, "Inflation has had a significant impact on NASA spending power. Whereas in 1982 the actual dollar amounts are increased slightly above the 1966 funding level, in terms of purchasing power, the current NASA budget is less than one-third the 1966 level." Former NASA head James Beggs has repeatedly made the same point.

Some have charged that President Carter's interest in the space program stemmed from his report in 1969 that he had seen a UFO. Be that as it may, look at his niggardly approach to space exploration, as conveyed in an October 1978 speech at the Kennedy Space Center:

> We have invested some $100 billion over the history of our American space program. It is now time to capitalize on that major investment.
>
> The first great era of the space age is over. The second is about to begin. It will come into its own with the new space shuttle, the heart of our new Space Transportation System, when it becomes operational. Paradoxically, the most exciting thing about the space shuttle is that it will make our use of space in the future routine and perhaps not very exciting[!]"

Carter described his policy as the "evolution of our space program from exploration to operations."

General Robert Rosenberg, speaking for the Carter National Security Council, stated that since the Shuttle will be less expensive, the "freed funds and talent can be applied to important space efforts we cannot afford today." Shuttle optimization and increases in productivity, he said, "perhaps can only be found through forced fiscal restraint."

NASA began to bring the Shuttle into the public eye with the aerodynamic tests of the prototype orbiter Enterprise during the Ford administration. Finally, the agency had "something to show for the money." But the advent of the Reagan presidency in 1981 did not change the direction of the Shuttle program—it merely rationalized the miserly approach toward space that the previous administrations had institutionalized.

The 'cost-effective' Shuttle

When Dr. James Fletcher came in to head NASA in May of 1971, it had become very clear that the space agency would wrangle only one new manned space program out of the Nixon White House. Since there was little point in having a

space station without a transportation system to get astronauts there and back, NASA opted to build the Space Shuttle, or Space Transportation System.

According to space historian John Logsdon, unlike the Apollo initiative, the Shuttle was arrived at through a three-year negotiating and compromise process, rather than from a presidential mandate. He has described this as "pluralistic policymaking." It was also the first space program which was analyzed in terms of cost effectiveness.

Of course, not everyone agreed that the Shuttle was necessary. Senators Walter Mondale, William Proxmire, Clifford Case, and Jacob Javits continued their opposition to any new manned space initiative. The Budget Office was unconvinced that it was a good "investment."

The military did not want the kind of quick and small transport-to-orbit capability that NASA had first envisioned; it wanted a large vehicle that could accomplish military missions that were outside the scope of its available expendable launch vehicles. This greatly increased the size of the orbiter NASA designed, and it has been estimated that this increased the cost of the Shuttle system by about 20%.

The sensible programmatic approach would have been to develop a stable of launch vehicles, including a reusable Shuttle and a heavy-lift expendable vehicle, that could carry military payloads comparable to the lunar-Saturn V. No money was available to pursue the parallel development of these next-generation systems.

President Nixon stated in his budget message on Feb. 2, 1970 that he had "received many exciting alternatives for the future. Consistent with other national priorities, we shall seek to extend our capabilities—both manned and unmanned." Behind the scenes, warfare against the space program was being conducted by George Shultz at the OMB and White House staffer Peter Flannagan, a representative of Wall Street's Dillon Reed.

NASA had proposed to build a fully reusable two-stage Shuttle system, where the first-stage manned booster would separate from the orbiter before reaching orbit, and fly back to Earth to be reused. The Shuttle would continue on up to orbit, using its own engines.

Fletcher recognized that he would have to sell this to the White House, and that the only effective argument would be that the Shuttle would be cheaper per pound of payload launched, than the available expendable rockets. He awarded a $600,000 study contract to Mathematica, Inc. to study the economics of the Shuttle program.

The study showed that with a *fully reusable* Shuttle, costing about $12.8 billion for its development, savings of about $100 million would accrue, compared to the use of expendables. The determining factor in cost was shown to be the number of operational flights. It was thus clear from the beginning, that if the major proof of the viability of the system were to be its "economics," the number of flights would be key.

Fletcher knew that NASA would have to develop this system within a fixed budget, a peak funding level of $2 billion, with a projected development time of six years. There was no way they would be allowed to spend $12 billion. He sent Mathematica back to the drawing board, and the company did an analysis based on the cheaper, one-stage, not fully reusable design. Meanwhile, the OMB had told Fletcher that he would probably end up with about *half* of the $12 billion.

The mission model was a highly optimistic one, showing a two-week turnaround time for the orbiters, and sufficient flights to make it "economical" enough to sell to the Budget Office. NASA ended up with a $5.2 billion total development price, a 1978 flight start, and a 20% limit on cost overruns. According to the anti-science *New York Times*, "NASA left itself no margin for error. This is, of course, the classic engineer's nightmare."

To cut the cost of the Shuttle in half, of course, design compromises had to be made. Instead of being boosted on a reusable first stage, the Shuttle would have two partially reusable boosters, at its side. To increase the payload capability, the fuel tank would be external to the orbiter, and would be used up on each mission. Both of these decisions would have a negative impact on the overall safety of the system.

The debate on final Shuttle design continued until days before Nixon announced the program, on Jan. 5, 1972. He declared that the Shuttle "will revolutionize transportation into near space, by routinizing it. In short, it will go a long way toward delivering the rich benefits of practical space utilization and the valuable spinoffs from space efforts into the daily lives of Americans and all people."

He continued, "1972 is a year of conclusion for America's current series of manned flights to the Moon." He described the Shuttle as being used up to 100 times per vehicle, which would bring operating costs down as low one-tenth those of present launch vehicles.

On March 15 that same year, NASA announced that it had decided to opt for solid-fueled boosters instead of liquid-fueled boosters, because of lower cost and lower technical risk, since this was a proven technology. Solid-fueled boosters had been used for years on expendable rockets, but never before in a manned spacecraft system.

Since the contract for the boosters had to go to the lowest bidder, which turned out to be Morton Thiokol, the location of their production plant in Utah meant that the 149-foot-long boosters had to be shipped in segments, in order to be transported safely.

This created the requirement that the boosters had to be stacked together at the Kennedy Space Center. Questions about the joints between these segments have been raised during the investigation of the Challenger explosion.

Within *weeks* of Nixon's announcement, the NASA budget was cut by nearly *half a billion dollars*. The projected

The real economics of the NASA space program

The economic results of space exploration, like any great project, can never be comprehended or judged simply in terms of the project's immediate, or even long-term economic payback, since also reaped are both the technological spin-offs hitting many other, even all other projects and industries, and the technological optimism that lays the basis for conquering new frontiers. Whole generations of mankind have been transformed by the accomplishment embodied in Brunelleschi's dome on the cathdral in Renaissance Florence, or by the great internal improvements programs inaugurated in the 19th-century United States, particularly under Abraham Lincoln.

The scientists and engineers graduated and trained for the Apollo lunar landing, like those who came through the training of Admiral Rickover's nuclear navy, have fanned throughout society to make breakthroughs that have given us the artificial heart, new energy sources, and so forth.

Even had President Kennedy's Apollo program failed to achieve its goals, and a landing on the Moon and return to Earth had never been accomplished, the technical manpower and the technological developments accrued from having taken up that challenge would have made it more than worthwhile.

From the ability to operate in orbit above the Earth, mankind gained the capability to survey his planet continuously from space. If the remote-sensing capabilities developed in the Apollo program were actually applied on a large scale, world agriculturalists could intervene to prevent large-scale destruction of food from floods, drought, pestilence, and disease.

From orbit, it is possible to bring even the remotest village into contact with the rest of the world, through the use of communications satellites and small Earth-based antennas. Planning new development projects, where the careful mapping of rivers, geological formations, and other natural features is key, can only be done efficiently from space.

Technologies such as advanced solar cells, which had to be developed for space application, have brought rural communities in India their first bit of electricity—to run a refrigerator, a radio, and a reading light.

Nearly every piece of equipment in today's intensive care units in hospitals were developed when doctors had to be able to monitor the health of astronauts thousands of miles from Earth. It is very likely that tomorrow's breakthroughs in genetic engineering or cancer will be significantly influenced by the problems NASA will have to solve in sending the first human beings millions of miles away, to Mars.

Experiments being performed aboard the Space Shuttle now are producing ultra-pure biological materials that hold out the hope of curing, not simply treating, chronic diseases such as hemophaelia and diabetes.

It is not really possible to turn into dollars what the space program has bought for the world community over its 25-year history. Those who would try to force the space program to justify itself in return-on-investment statistics are either fools, or are out to cripple mankind's most valuable undertaking.

Shuttle launch date slipped from 1978 to 1979, and the process of underfunding the next NASA manned space program was off and running. If President Nixon's Space Shuttle was off to a bad start, President Reagan's space station is faring no better.

NASA has estimated it will cost at least $700 million just to replace the equipment lost in the explosion (excluding a replacement orbiter), pay for the investigation and salvage operations, do the modifications the Rogers Commission might recommend, and store the payloads that were ready for launch until the Shuttle starts flying again. A replacement orbiter will cost about $2 billion, and take more than three years to complete and test. The Congressional Budget Office released a report earlier this month saying that all of this is certainly too much money. They state that money could be taken from the space station program, which won't be built on time without a full orbiter fleet anyway, and from the development of new science experiment payloads, which won't be able to fly, either.

Will the lesson be learned?

This country has a fundamental decision to make. Cuts in operating costs, maintenance, training, and pay through the deregulation of the commercial airlines, produced a year with more fatalities than any other in the history of flight, in 1985.

Space Shuttle accidents are, of course, more spectacular and shocking than airline crashes, but the causes are not that much different. No matter what the investigating bodies may finally determine the cause of the Challenger explosion to be—even if it was sabotage—we have, as a nation, paid for the 15 years of cheating the space program.

By fiscal year 1974, the NASA budget of $2.9 billion

was the lowest it had been since 1963. According to historian Emme, "Later cuts, though less severe, reduced confidence even in the 1979 date, which undoubtedly had some impact on schedule delays in 1978-80. Although President Nixon (and subsequently President Ford) continued to support the Shuttle Program in principle, the budgetary process with its cuts did not allow the orderly development that the Apollo Program had enjoyed."

Speaking before the National Academy of Engineering in November 1975, NASA head Fletcher stated, "The OMB, which controls the government's pursestrings, rarely plans beyond one or two years at a time. NASA's Space Shuttle program is an excellent example of the effects of year-to-year budget cycles. The program has never been funded in its entirety, but has been piecemealed together out of the agency's overall yearly budget. Yet, if NASA did not proceed with the development of the Shuttle, the nation would be without a major new space program for the 1980s."

That commitment to the interest of the nation, despite the most unworkable constraints and demands on the space agency, was reflected recently by former Apollo astronaut Harrison Schmitt. In a commentary written two days after the Challenger loss, Schmitt stated, "In sharp contrast to Apollo, the early years in the design and development of the Space Shuttle were played out in a far more constrained fiscal environment. . . .

"There were many of us 'old Apollo heads' who, on detailed exposure in 1973 to the near-final concepts for the Space Shuttle, felt that the new program was underfunded by a factor of three or four." The Space Shuttle orbiter "was itself an extraordinary technical challenge. It would require more than just state-of-the-art engineering to take a spacecraft as big as a DC-9 into orbit, make good use of it in the harsh environment of space, fly it on return through hypersonic ranges never before experienced by aircraft, land it on a standard airport runway, and then recycle it for reuse within a few weeks.

"Those of us who were skeptical about NASA's ability to succeed in this endeavor were wrong. We underestimated, as so many have, the unexcelled motivation and heart of the NASA family. Space and space flight generate a belief in hundreds of thousands of Americans that working on the exploration of this new ocean is the most important endeavor of their lives."

NASA persevered, trying to build a leading-edge Shuttle system, without enough money. NASA also realized that the Shuttle would be the only manned space capability that the United States would have for nearly two decades. The agency built into the Shuttle the ability to spend 7 to 10 days in space, so scientific experiments in the European-built Spacelab could be done on orbit, since there would be no space station. The Shuttle was no longer simply a "truck" to haul cargo to Earth orbit or to a space station; it became a major space facility on its own.

Budget constraints and safety

Were there any red-flag warning signals that the Space Shuttle system was being stretched to its limit, before the loss of the Challenger? Absolutely.

The Aerospace Safety Advisory Panel, which is independent of NASA, recently released its annual report for 1985. It contains a frontal attack on the stated Space Shuttle policy of the Reagan administration, which for the past three years has been to make the system "operational and cost effective."

The panel objects that neither of those goals is coherent with maintaining safety as the primary responsibility of the space agency, and warns NASA that budget constraints will continue to compromise the safety of the system.

One part of the report gave NASA the opportunity to respond to statements made in the report from the year before. The panel had recommended that the NASA management "would be well advised to avoid advertising the Shuttle as being 'operational' in the airlines sense when it clearly isn't. . . . Shuttle operations for the next five to ten years are not likely to achieve the 'routine' characteristics associated with commercial airline operations. Given this reality, the continuing use of the term 'operational' simply compounds the unique management challenge of guiding the STS through this period of 'development evaluation.'"

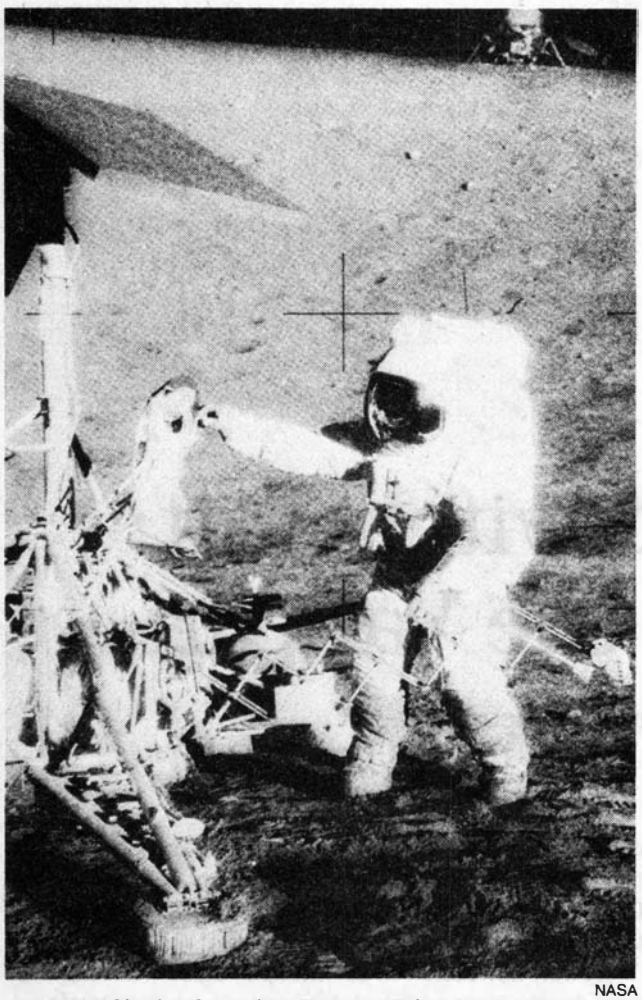
All that NASA could do to respond was to quote directly from National Security Decision Directive 42, which is the stated policy for the space program by the White House:

> NASA's highest priority is to make the Nation's Space Transportation System operational and cost-effective in providing routine access to space. Fully operational means that the STS is ready and available for routine use in the intended operational environment to achieve the committed operational objective.
>
> This means that . . . adequate logistics support for the systems is in place; that the ground and flight processing capabilities are adequate to support the committed flight schedule of up to 24 flights per year with margins for routine contingencies attendant with a flight surge capability.
>
> Cost effective means that the Shuttle provides space services for specific levels of mission capabilities with an efficiency at least equivalent to the cost of alternate systems.

It has always been the case that the major parameter that determines the cost of launches is the flight rate. Safety is not mentioned in the directive.

As soon as the Shuttle started flying in April 1981, the Heritage Foundation, the KGB's favorite Washington, D.C. "conservative" think-tank, suggested that it may be time to consider abandoning the Shuttle program as too costly, particularly if the number of flights turned out to be "less than needed to generate sufficient revenues."

The report of the Aerospace Safety Advisory Panel states



NASA

Astronaut Charles Conrad, Jr. examines the Surveyor III spacecraft on the surface of the Moon. Apollo 12 arrived Nov. 19, 1969. Surveyor III had soft-landed on the Moon on April 19, 1967.

that the "attainment of NASA's goal of 24 launches per year will challenge the capacities of both the physical and human resources" of the agency. The report points to the following facts:

1) "A number of flight hardware components are still undergoing development for both performance and reliability." That is, this is by no means a fully operational system.

2) Additional "brick and mortar" facilities are required at the Kennedy Space Center "for orbiter processing and component maintenance." Without these facilities, it is not possible for NASA to turn the orbiters around in a decreasing amount of time. The alternative is to try to keep to the launch schedule without doing all the work on the Shuttles that is required.

3) "There are ultimate limitations of human resources to compensate for shortfalls in the physcial resources (even with extraordinary dedication and effort)."

4) "Sufficient logistics support, in both hardware and systems, lies sometime in the future."

5) The fact is "that all of the above are subject to constraints by budgetary allocations."

The panel goes into detail on some of the results of the continual funding limitations. Regarding crew training, mentioned by senior astronaut John Young in his recent memo: "Time available in the present fleet of orbiter flight simulator aircraft is becoming marginal and can be foreseen as being inadequate to meet future training demands." They recommend that "NASA commit the funds in a timely manner to ensure an adequately-sized fleet of training aircraft." This problem only gets worse, as the number of missions and therefore, number of required trained crews, increases with launch frequency.

In 1983, the panel reports, a three-phase program was initiated to substantially improve the Space Shuttle Main Engines. "However," they state, "as a result of severe funding-rate limitations, the program was restructured in 1984 to address only certain improvements to the wear life of various turbopump components."

In the crucial, and much criticized, area of spare parts which are needed to be able to maintain a higher launch rate with safe vehicles, the panel states that the "entire program is being 'restructured' to comply with budget restraints. A significant element of this restru
of planned cannibalization," from other orbiters.

"Today cannibalization is a prime means by which many spares are provided," they remark. "STS orbiter 103 [Atlantis] has been a major 'spare parts bin,' but what crisis will develop in six months when these units are needed for the first flight out of Vandenberg? There has to be a minimum allocation of spare units to permit the planned number of flights."

"Reducing the allocation of spares to fit the budget is going at the problem backwards . . . realistic planning should be accomplished to establish the number of missions that can realistically be flown based on such curtailments. The number of missions should be based on real capability."

Expressing further concerns about flight rate, the panel states that the existing constraints include hardware, spares, needed modifications, and payload manifesting (preparation) difficulties. "The goal of 18 flights per year is not within reach at present," they conclude. "A more realistic goal is between 12 and 15 flights per year."

Despite the President's manifest enthusiasm for the space program, in the final analysis, he has merely continued the policy of sabotaging America's space initiative, by starving it of the funds which were critically necessary to allow it to keep functioning, much less allow it to expand. Whatever the immediate cause of the Challenger disaster finally proves to be, the seeds of disaster were laid by the years of underfunding and the series of policy decisions which sabotaged the Space Shuttle program from its inception.