After Challenger: Painful Choices

In the wake of the shuttle disaster there are no easy choices: a new orbiter, the space station, space science, advanced launch vehicle development—something has to give

FOUR months after the catastrophic flight of the space shuttle Challenger on 28 January, official Washington is still trying to come to grips with the full implications of that disaster. The most visible phase of the process now seems to be drawing to a close: in early June an independent commission headed by former Secretary of State William Rogers is scheduled to report to President Reagan on its investigation into the accident; meanwhile, reports from the White House suggest that Reagan will soon give the National Aeronautics and Space Administration (NASA) the go-ahead to build a $2.8-billion replacement shuttle.

However, these developments are only a beginning. In the aftermath of the Challenger disaster it has become clear that the space program as a whole was fundamentally flawed—not just in the well-publicized management problems at NASA, but conceptually. What is not clear is how the program should be rebuilt. Indeed, people are only just beginning to face that question. The decision-making process promises to be a long and contentious one, made all the more so by the increasingly tight constraints on the federal budget, and by the fact that some very painful choices have to be made.

In retrospect the case against NASA has become all too familiar. First, in a hopeless effort to make the shuttle as cheap, reliable, and routine as an airline, NASA tried to increase the shuttle's flight rate far too rapidly—and thereby lost sight of safety. Second, the agency became mired in shuttle operations, becoming a kind of high-tech trucking company instead of the premier research and development agency it was originally intended to be. And third, NASA treated space as its turf and tried to fight off all rivals. In particular, agency officials tried to smother the fledgling commercial launch vehicle industry. Thus, in trying to make the shuttle be all things to all people, they left the nation dependent on an extremely brittle launch system that had no backup.

While this bill of indictment is accurate, however, it is not enough just to say, "Don't do that anymore." From discussions with top NASA officials it is apparent that the agency's behavior over the past 5 years has been a coldly rational response to two overriding realities.

The first is that the shuttle is vastly more complex and expensive to operate than anyone ever anticipated. When the idea of a reusable launch system was originally proposed in the early 1970's, NASA administrator James C. Fletcher, who has recently been reappointed to the post, estimated that its operating cost would be perhaps a few hundred dollars for every pound of payload lofted into orbit. That estimate was wildly optimistic, and Fletcher and his colleagues knew it. "I wish we hadn't done it," recalls one former high agency official, "but we were getting *so* many votes. . . ."

We face a tyranny of small decisions on the future direction of the space program.

However, no one was prepared for the actual costs: $2500 to $5000 per pound, depending on how the accounting is done. By the time the shuttle finally made its first flight in 1981, it had become painfully obvious that the requirements of "cheap" and "routine" were at odds with "manned" and "reusable." Among other things, a manned vehicle requires complex life support systems, painstaking check-out procedures, and Byzantine mission abort modes with stand-by crews scattered all over the world at emergency landing sites.

The second reality is that NASA has had to accommodate this hugely expensive launch system on a budget that has remained virtually constant in real terms since about 1976. Of course, the agency is hardly unique in having tight budgets. Nonetheless, the combination of the two factors led to a bureaucratic imperative: if NASA ever wanted to do anything else—space science, space station, whatever—it had to bring down the costs of operating the shuttle. And that goal, in turn, meant flying as often as possible: every paying customer helped offset the fixed cost of maintaining the shuttle launch system, estimated at roughly $1 billion per year. Thus, when James M. Beggs became NASA administrator in 1981, he made it one of his top priorities to lure commercial satellites away from the European launcher Ariane and to push the flight rate as fast as possible toward the agency's target of 24 flights per year.

In the months since 28 January, of course, it has become tragically clear that in the rush to meet that goal, too many people in the agency lost sight of safety, quality control, and sometimes even common sense. NASA obviously has a great deal of house-cleaning and soul-searching to do, not to mention a great deal of engineering redesign of the shuttle itself. That process is already under way internally; moreover, the Rogers commission can be expected to offer some explicit suggestions.

Meanwhile, however, it has become equally clear from a strategic point of view that the all-eggs-in-one-basket policy is no longer tenable. Indeed, it was clear the day Challenger fell into the ocean. As any number of congressmen, Administration officials, and space scientists have proclaimed, the nation needs "assured access to space." Very quickly after the accident, officials therefore embraced expendable rockets, driven by the specter of an ever-growing backlog of payloads while NASA struggles to bring the shuttle back to flight status.

Air Force secretary-designate Edward C. Aldridge, for example, has estimated that his service alone will have a backlog of about 15 payloads if the shuttle is grounded for 18 months, which is NASA's current planning figure, and 21 payloads if the shuttle is down for 2 years, which is entirely possible. Moreover, since NASA will be operating with a three-orbiter fleet and a low flight rate for some time—a new orbiter will take 3 to 4 years to build, even if the go-ahead is given tomorrow—that backlog will continue to grow when the shuttles do start flying again.

Thus, the Air Force has identified the need for 13 heavy-lift Titan 34D-7's, in addition to 10 it had ordered previously, plus 12 medium-lift boosters, possibly Deltas or Atlas-Centaurs. The cost has been estimated at roughly $4 billion. Moreover, Aldridge has strongly backed NASA in its bid for a new orbiter. The Air Force still plans to fly at least four to six shuttle flights per year, and Aldridge does not want to put the Pentagon in the awkward position of bumping civilian payloads from future shuttle flights on the grounds of national security.

NASA, meanwhile, has its own backlog of

commercial communications satellites, as well as major scientific missions such as the Hubble Space Telescope, the Galileo mission to Jupiter, and the Ulysses mission to explore the polar regions of the sun. Thus, in February, in a striking turnabout from NASA's previous stance, then-acting administrator William Graham endorsed the idea of moving as many of the shuttle's payloads as possible onto expendables. On 21 May, that idea was endorsed again by the National Research Council's Space Science Board, which urged NASA to make expendables the primary means of launching scientific satellites. Only the space telescope and possibly Galileo really require the shuttle for launch, they said. Every other currently planned scientific mission could be accommodated on existing Deltas and Titans.

In sum, the political system has tacitly moved toward a policy in which the shuttle will be strictly confined to operations such as satellite maintenance and repair, or to laboratory flights such as those involving Spacelab—operations in which a human presence in space is mandatory. Unmanned satellites, conversely, will be launched by conventional rockets whenever possible.

But therein lies the problem: while this new policy is sensible enough in the abstract, nothing about the accident or its aftermath has changed the reality of tightly constrained budgets and an exorbitantly expensive shuttle system. It is not at all clear how the mixed-fleet strategy can be made to work in practice. Some key issues:

■ **The cost of diversity.** It is an open question just how long this new-found commitment to "diversity" and "access to space" will last in the face of continued budgetary pressure. The fact is that a redundant system is inefficient by its very nature. From a strictly accounting standpoint, without any consideration for the possibility of disaster, it will always have more capacity than it technically needs. As federal budgets continue to be squeezed by the deficit reduction process over the next few years, one can therefore anticipate more and more pressure to cut back on redundant launch systems.

This dynamic has already become apparent in the debate over the replacement orbiter. The forum for that debate has been the Senior Interagency Group on Space (SIG-Space), a White House advisory panel that includes representatives of such interested agencies as NASA, the departments of Defense, Commerce, State, and Transportation, the Office of Management and Budget (OMB), and the Central Intelligence Agency. The group reports to the National Security Council.

One school of thought, led by OMB representatives on SIG-Space, was that building a replacement orbiter would be a mistake. NASA had actually had excess capacity with four orbiters, they pointed out, and the accident certainly did not create any new payloads. The remaining three orbiters could in fact handle the backlog and everything else in the shuttle schedule, especially if all possible payloads were transferred to expendable rockets. The country is already spending some $4 billion on extra expendables for the Air Force—conventional rockets are not all that much cheaper than the shuttle—plus $500 million or more to bring the shuttle system itself back into operation.

Wide World

NASA administrator James C. Fletcher

No new starts in space science?

So why spend another $2.5 billion for a new orbiter when the traffic doesn't justify it?

Both NASA and the Defense Department, however, while conceding that a new orbiter could not be justified strictly in terms of the projected launch demand, made the case on the basis of redundancy: a three-orbiter fleet, they said, would leave no margin for error whatsoever. If another orbiter were lost, or if one were even damaged and put out of commission for a long time, the fleet would be reduced to two, and would be hopelessly unable to fulfill its commitments.

The latter argument appears to have carried the day within SIG-Space. The group's recommendation to proceed with a new orbiter has been forwarded to the Oval Office, and it seems likely that President Reagan will soon give NASA the go-ahead.

On the other hand, it is still not known just how the Administration will propose to pay for the new orbiter. Not surprisingly, NASA has resisted having the money taken out of its own budgets. Yet the OMB, mindful of the Gramm-Rudman-Hollings deficit-reduction act, has insisted that any money that NASA gets will have to be taken out of programs elsewhere in the government—although no other agencies have yet stepped forward to volunteer.

One guess is that Reagan will call for the construction of a new orbiter on a slow schedule—"as fast as *practical*" as opposed to "as fast as *possible*." Moreover, even if NASA does get extra money for the new orbiter this year, it will quite likely have to start taking cuts in subsequent years. Indeed, one can expect continued pressure to slow the pace of construction of the new orbiter, and perhaps even to cancel it after a year or two.

Be that as it may, NASA is facing severe budgetary strain even if it never gets a new orbiter. The agency's current pricing policy is predicated on the shuttle's attaining a flight rate of 24 flights per year. Moreover, its budget projections assume a certain schedule of reimbursements from paying customers. If every possible payload is shifted to expendables, NASA could lose from $300 million to $600 million per year, indefinitely. That is the equivalent of one or two planetary missions per year. Meanwhile, NASA may also have to bear the cost of shifting its scientific missions to new expendable launchers. For example, the Jet Propulsion Laboratory recently estimated that launching NASA's currently planned planetary missions on Titans would cost an extra $1 to $1.2 billion.

Thus, in contradiction to Graham's earlier statements, Fletcher has taken every opportunity to insist that the shuttle continue to fly commercial satellites whenever there is room. The White House is debating that issue now.

All of these expenses would come before the $2.8-billion cost of the new orbiter. Thus the question: will NASA have to absorb these costs on a fixed budget?

■ **The role of NASA.** The National Aeronautics and Space Act of 1958 did not set up a aerospace trucking company, but a research and development agency. If NASA has to start cutting into its science and applications programs, however, a trucking agency is what it will become. Indeed, there is a substantial body of opinion within the space community—members of Congress, the OMB, and space scientists, for example—that NASA has gone too far in that direction as it is. Many projects have been put on hold during the shuttle era, and people are anxious to get moving again.

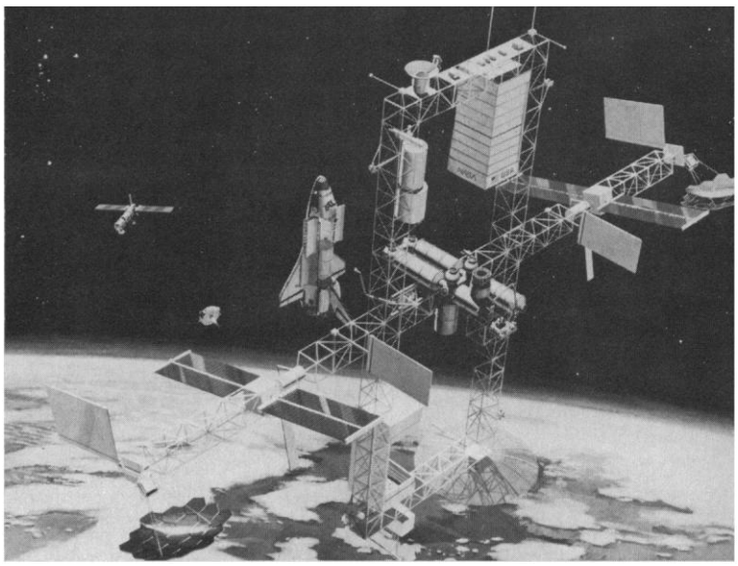
In space science, for example, the astronomers would like to see a whole series of space observatories to complement the Hubble Space Telescope: the Advanced X-ray Astrophysical Facility, the Space Infrared Telescope Facility, the Gamma-Ray Observatory, and the Solar Optical Telescope. The

planetary scientists have devised a 15-year sequence of missions to follow up on such pioneering ventures as Viking and Voyager. The earth scientists are about to release a report calling for a greatly increased program of remote sensing from space. And materials scientists want to expand their opportunities for microgravity research using Spacelab and NASA's proposed space station.

Meanwhile, even before the accident, the aerospace community had begun to look toward the successor to the shuttle, which will be coming to the end of its design lifetime by the year 2000. There is a general consensus among aerospace engineers that a new generation of launch vehicles could cut the cost of lifting a given weight into orbit by a factor of 10, largely by using advanced technology, by designing the vehicles for ease of maintenance and operations, and by optimizing them for particular purposes. A cost decrease of that magnitude would in turn make it much more feasible to contemplate extensive commercial ventures in space and more ambitious manned and unmanned exploration of the moon and the planets.

The White House has already directed NASA to begin research into an aerospace plane—Reagan's "Orient Express"—that will take off and fly into orbit from conventional airports. But the aerospace plane is only one of many possibilities for a next generation system. Within the next few weeks a more extensive review will be presented to the National Security Council in a joint study prepared by NASA and the Air Force. Although the results of that study have not yet been made public, the concepts are likely to include an unmanned, heavy-lift launch vehicle for big payloads, and a separate, smaller shuttle vehicle optimized for carrying passengers and for returning payloads from orbit.

Finally, there is the space station, advertised by NASA as "the logical next step" after the shuttle. The space station program has been controversial, to say the least, and is an obvious place from which to take money for a new orbiter and other post-accident expenses. On the other hand, the station has already taken on symbolic significance as an international partnership. Furthermore, many former critics have begun to give NASA high marks for its efforts to listen to the station's intended users. Many scientists now concede that the station will have real utility as a drydock for satellite repair and maintenance, as a test-bed for advanced technology development, as a hands-on laboratory, and as a staging area for advanced probes being sent to deep space. They have no problem with delaying the station by a few years. But few would really want to see it canceled.



The Space Station. *The "logical next step"—and the obvious place to take money for a new orbiter and other post-accident expenses.*

Much the same opinion seems to prevail in SIG-Space; even in the group's struggles to find money for a new orbiter, there has been little enthusiasm for decimating the space station. Indeed, canceling the space station would likely be seen as a symbolic vote of no confidence in the civilian space program as a whole, and nobody really wants to do that.

■ **Who is going to make the choices?** Even before the accident it was doubtful that NASA could do everything people expected of it on the budget it had. After the accident, it now seems impossible. Thus, if the nation wants a vigorous space program, NASA is going to have to have a substantially larger budget. The members of the Space Science Board, hardly unabashed fans of NASA policy in the past, made the case quite succinctly in their position paper on expendable launchers: "[We] recommend that the resources needed be provided to do this program right or not at all. Trying to skimp on a highly visible, prestigious activity on the frontier of technology inevitably leads to highly visible and damaging failures."

On the other hand, there is not a single agency in the federal government that cannot make a case for more money. So it seems extremely unlikely that NASA is going to get favored treatment, especially after the recent revelations about its less than brilliant management performance in the years leading up to 28 January. As one observer asks, "Do you really want to reward an agency with more money because it's screwed up?"

Thus, one is left with the unpleasant necessity of making choices. However, many observers are wondering just who is going to do it.

At the moment, no one is, at least not explicitly. The leadership of NASA itself has been in limbo since Beggs was indicted last December for alleged fraud during his earlier tenure as a vice president of General Dynamics; Fletcher was only confirmed as his successor on 12 May. The Rogers commission has focused exclusively on the Challenger accident itself. The congressional space subcommittees feel they can do very little without some commitment from the other end of Pennsylvania Avenue. SIG-Space has been preoccupied with the replacement orbiter question. And the White House science adviser's post has gone unfilled since George A. Keyworth II left in January.

In practice the choices may well be made by Fletcher and his colleagues during the normal course of preparing the NASA budget. However, NASA has its back against the wall, and under those circumstances one can hardly expect the agency to do anything other than protect its own bureaucratic interests—meaning specifically its large engineering projects, which are the lifeblood of the agency's research centers.

A not-so-subtle hint of that prospect could be found in the budget projections that NASA recently submitted to the House appropriations subcommittee, chaired by Representative Edward Boland (D–MA). The projections extended to 1994, and assumed a steady budget growth of 1 to 2% per year above inflation. They assumed that a new orbiter would be built, that $500 million would be spent on repairing the shuttle's solid rocket boosters, that the space station and the aerospace plane would be funded—and that no new missions would be started in space science.

Fletcher's stance may have been intended as a bit of genteel blackmail to get NASA's budgets raised overall. Nonetheless, as things are going now, it appears that the future direction of the U.S. space program is being set through short-term decisions made on budgetary and bureaucratic grounds. As one congressional staffer puts it, "We face a tyranny of small decisions." ■ **M. Mitchell Waldrop**