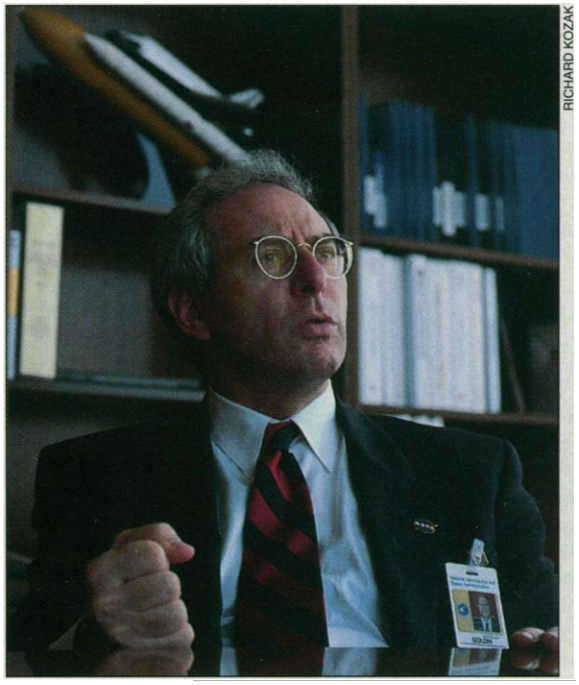
Making Less Do More at NASA

The space agency's new boss, Daniel Goldin, is trying to change the culture of the place, promoting efficiency, risk-taking, and smaller, cheaper missions

After 6 months at the helm of the National Aeronautics and Space Administration (NASA), Dan Goldin insists he can do something that amounts to a bureaucratic miracle: get more bang for fewer bucks in an agency still recovering from a string of embarrassing failures in the 1980s. Although he doesn't expect NASA's funding to grow in the next few years, he does expect the agency to complete all the big space projects on its agenda—on time and within budget. Not only that, but he wants to start a couple of major new science missions, perhaps launch a small probe to Pluto in 1996, and begin work on a voyage to Mars. Looking at this picture, some observers think that Goldin will need a miracle.

Goldin himself doesn't think so, as he made clear in a recent interview with *Science*. He is counting on one secret weapon: increased efficiency. Using management techniques imported from the aerospace firm TRW, where Goldin led the space and technology group, he is trying to revitalize the agency's culture and "deliver on what we said we'd do." He rattled off a list of NASA's unfulfilled promises: "We have to deliver on building the station....We have to deliver on microgravity research. We also have to deliver AXAF, Cassini, and EOS [an orbiting x-ray telescope, a probe to Saturn, and a complex series of satellites to monitor Earth's environment]—three of the most important scientific missions we have ever embarked on." Meanwhile, Goldin adds, NASA may begin work to establish an astronomy center on the moon, land people on Mars, and routinely send small science probes into Earth orbit and beyond.



RICHARD KOZAK

Miracle maker? Goldin insists NASA will complete its big missions in spite of the budget squeeze.

Goldin quickly makes it clear that he's bent not just on reform but on a crusade: "We have a moral commitment to the future of this country" to develop cutting-edge technology, he says. "That's why I came to this place....We've done it [before], and we're going to do it again. But we're not going to do it by being mentally congested."

This is heady talk for an agency whose leaders have always spoken—as one White House aide says—in a "gray engineering monotone." But skeptics like John Pike, space policy expert at the Federation of American Scientists, have been watching NASA's budget shrink this year and conclude that changes in management style won't be enough to carry out Goldin's ambitious agenda. Just last week, for example, Congress approved a budget for NASA in 1993 that provides close to what the Administration requested for the space station—$2.1 billion—but held funding for most other projects at about this year's level or less. "My own gut hunch," says Pike, "is that less is less."

Pike isn't the only one wondering whether Goldin can do more with less. In interviews with a score of leaders in the space community—scientists, government officials, and business people—*Science* found a lot of support for Goldin's efforts. But there was also considerable wariness: People are waiting to see whether he can build on a few initial successes to bring new efficiency in really big, expensive programs like the space station.

Goldin appears to have no doubts that he can pull it off, although he concedes it will be a slow process to "change the culture" at NASA from a gun-shy bureaucracy to a risk-taking cadre of innovators. He says he's seen it happen before at TRW, and it takes "about 5 years." "Some people don't have the patience for it," says Goldin. "If you plant seeds and watch day by day, you're not going to see results." One question that must wait until after the presidential election for an answer is: Will Goldin himself have time to reap the harvest? Although he's a registered Democrat who has shown no political favoritism in office, as a Bush appointee, it isn't certain he will be asked to stay if the Democrats win in November.

But whether or not he gets to stay, Goldin is already putting his stamp on NASA. In the interview with *Science*, he talked about what he's doing and what he plans to do as he attacks the monster job of transforming the culture of perfectionism and cost overruns into the culture of efficiency and success.

Boot camp for bureaucrats

The principal changes Goldin has brought so far are in NASA's management style, in the trimming of science missions, and in tough new guidelines for staffers and contractors.

All of those new measures are aimed at enabling the agency to break out of what Goldin calls NASA's "vicious cycle." Because NASA flies relatively few missions, program officers overload each one with instruments. This makes each spacecraft expensive. Because they're expensive, they must be carefully tested before flight. This takes time and costs more money, raising the ante. In the end, so much is riding on each flight that NASA can't afford to have them fail—leading to more caution, delay, and expense. "We've got to cut the Gordian knot," says Goldin, by making spacecraft smaller, lighter, and cheaper, so that people can afford to make mistakes again.

But breaking the cycle requires a bold, new mindset from all the people in the agency, Goldin says, and in order to achieve that, he employs a style quite different from the low-keyed, inward-focused manner of his predecessor. He is on good terms with Congress, the press, and agency critics such as Pike and John Logsdon, director of George Washington University's Center for Space Policy Studies. He's gregarious and political, although with subordinates he reportedly "chews the carpet" at times, blasting them when they don't live up to expectations.

Beyond the personal differences, Goldin has brought a new vocabulary, one derived from efforts to improve competitiveness in the private sector. Much of the newspeak comes from Total Quality Management (TQM), a hip new business discipline that aims to create a moral

contract between the employees and employer, establishing responsibility for "products" and setting a standard of excellence. Though the term is usually applied in manufacturing, NASA is now trying it out on the bureaucracy. It is not at all clear that the technique can be transferred from the private to the public sector, or that it will work as intended. "It'll be interesting to see the result," says Robert Hager, a Boeing Aerospace vice president who wholeheartedly approves of the effort.

Goldin speaks frequently of NASA's "vision" and the need to "empower" staffers to do their best. A heavy dose of this philosophy came out in a memo from Goldin to NASA staffers on 5 June. He announced that he had "chartered a Vision Team to develop an initial draft vision statement" for the agency. He tapped Michael Griffin—the associate administrator for exploration, a White House favorite and former Strategic Defense Initiative official —to lead the group. The assignment: define NASA's purpose in a crisp sentence by 26 June. The draft, hammered out by the 31-member committee in long sessions this summer, states: "As explorers, pioneers, and innovators, we will boldly expand the frontiers of air and space for the benefit of all." A list of missions and values is attached. The package will be "shared" with the public at six "town meetings" around the country this fall. According to the press office, all NASA employees will be expected to sign the result—"like an oath of allegiance," mutters one dubious NASA boss.

Goldin also has begun testing out a training seminar on NASA employees called "Continuous Process Improvement," or "CPI Boot Camp." In it, attendees learn the nitty-gritty of TQM philosophy and solder parts of a product together. "We proved conclusively that if you change a culture you can produce [high-quality] products without inspection," says Goldin. He's calling in other management gurus as well, including W. Edwards Deming, founder of the TQM movement, for some direct inspiration.

What has all this self-analysis achieved? Mainly confusion, if you believe a critical NASA division chief who asks to remain anony-mous. He says Goldin has the staff "so tied up in boot camps and wrapped around the axle with this TQM nonsense that no one's doing any work." Nor does this critic care for seminars: "NASA has always been an organization of thoroughbreds; you don't motivate people like that by taking them to a management meeting" and teaching them to manufacture an electronic part.

Goldin says he recognizes some people don't like his cultural revolution. They are afraid of change, he says: "Are we going to allow this nonsense and insecurity about change to stop us from doing what we've been chartered with?" Goldin asks. He says he won't, though he concedes "there are some barricades in the street."

There is, however, at least one very concrete reason why some staffers might feel uneasy. Goldin has indicated that he may cut the number of headquarters employees in half. Rumors of an impending purge have circulated for months, and some people are making plans to bail out, many of them senior staffers who extended their careers at NASA to help with the Challenger crisis and then to take advantage of a big government pay raise. One Lockheed executive jokes, "I've put a check mark in my NASA phone book beside everyone who I've heard is leaving, and so far, I think there's one secretary on the fifth floor who isn't." But Goldin himself has made few major personnel changes, aside from bringing in a crew for his own office and naming Jeremiah W. Pearson III, a former Marine general, to oversee the shuttle and space station. Major staff changes are not expected until November.

Applying the heat

In the "vision" directive last June, Goldin announced that "NASA's Senior Management Team agreed the time was ripe to begin a cultural revolution and develop a new NASA." To this end, he created a dozen analytical groups, called red teams (outsiders) and blue teams (insiders), which combed through all the agency's programs looking for ways to improve quality and cut costs. "All employees," said the memo, "should feel empowered to examine their work areas to do things better, faster, and cheaper—without compromising safety."

The red/blue process has gone through one cycle, leading to recommendations for the 1994 budget, and a second arduous phase is just beginning. The goal is to reduce the anticipated cost of programs by 30%. Already, Goldin claims, the reviewers have identified cuts that will reduce expenses in the next 5 years by 17%. "But," Goldin says, "that's not enough. I want more."

Among the projects being shrunk are some major science programs, such as the Earth Observing System, whose 8-year cost estimate declined from $11 billion to $8 billion over the summer. Scientists at the Jet Propulsion Laboratory who worked on the project say they understand why it must shrink, though they also say the quality of science will suffer. And Cassini, the probe to Saturn, has been cut back, as well. AXAF, the x-ray telescope, has been cut from one large platform into two less expensive craft. The surprising fact is that scientists are taking it in good spirit. Says Louis Friedman, executive director of the Planetary Society and an outspoken advocate of robotic missions: "Frankly, I think [Goldin] is right, Cassini is more expensive than any other planetary mission except Viking....It warranted some cutback."

At the same time, Goldin has warned contractors that "we will hold you accountable for what you sign up to deliver." He recently quoted from a General Accounting Office study showing an average cost growth of 75% in a sample of NASA programs. This is unacceptable, he says, and "that ain't gonna happen" on his watch. He hammers away on the importance of accurate bids, and to drive the point home, in August he rejected proposals for the EOS data system from TRW and Hughes Aerospace because their cost estimates were too low. Meanwhile, he is changing NASA's procurement rules so that companies will be asked to meet simple performance standards rather than follow detailed manufacturing instructions—a change the companies welcome. He has created an independent cost-estimating team to boost NASA's credibility.

So far, however, Goldin has not made

NASA

Space Station Freedom Budget

($ Millions)

Year	NASA Requested	Appropriated	%NASA Budget
1985	150	155	2.1
1986	230	200	2.6
1987	410	420	3.9
1988	767	393	4.4
1989	967	900	8.4
1990	2050	1750	14.2
1991	2451	1900	13.7
1992	2029	2029	14.1
1993	2250	2100	14.6

much headway in bringing the agency's biggest project, the space station, under his control. A bungled attempt to reshape the station made headlines in *Space News* during the summer, when Goldin ran into a wall of political resistance. It began on 12 August when Griffin said he had been asked to lead a reanalysis of the station. Planners were told to keep the basic schedule but undertake a design overhaul to make it more efficient. Within 6 days, according to *Space News*, the redesign effort was scrapped. The team under Griffin was instructed to forget about redesigning the station, but to look at ways of improving management or possibly building a new heavy lift vehicle to carry the structure into space on fewer flights. Aerospace companies, station supporters in Congress, and even White House aides apparently intervened to get the redesign stopped. Congress was getting ready to vote on the 1993 appropriation for NASA, so this was not the best time to begin redesigning the station.

Goldin told *Science* that his review team is considering ways to improve management of the station and the merits of an unmanned heavy launch system using shuttle technology. His idea is to remove the orbiter, place its engines at the rear of the big external tank that carries liquid fuel, and extend the tank's front end 90 feet to create a huge cargo area. Goldin thinks that, if Congress voted the funds, NASA could build a heavy lifter in 5 years and use it to ferry a pre-assembled station to orbit "with many fewer launches." While it might work better than the present plan, it's not clear that this approach would be any cheaper. But Goldin says, "We're going to take a good, hard look" at it.

Pike sees this incident as "emblematic" of Goldin's exaggerated faith in the power of management. There may be no clever way to spend less money and build the station NASA has promised. If you create a new launcher to carry the station, Pike argues, you must redesign the station to take advantage of the vehicle—and that adds to the cost. Big space projects, Pike says, "have some intrinsic and intractable problems...that you can't escape just by smart management."

While skeptics in the space community are concerned that Goldin may be unrealistic about potential cost savings, most are eager to see his approach tested. Many would agree with Friedman of the Planetary Society, who says: "I think Goldin's doing things that are very new, and I find them refreshing....He's confronting reality....The old philosophy of 'just get your budget as high as possible and don't worry about paying [for programs] until later' is changing." But will Goldin's reforms achieve the miracle NASA needs? Friedman is not yet about to make a prediction: "Only time will tell."

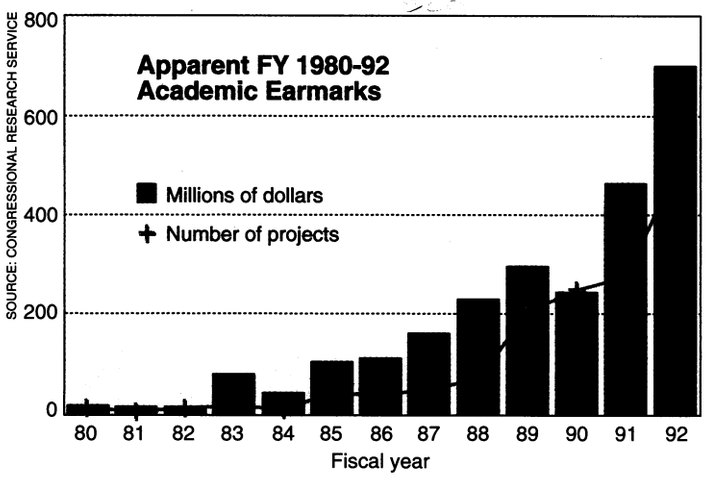
–Eliot Marshall

CONGRESSIONAL EARMARKING

George Brown Cuts Into Academic Pork

Congress acquired a bad habit in the 1980s—steering academic grants to specific schools or institutions favored by powerful politicians. When legislators are taken to task for doing this, the standard response is that they are just helping underprivileged universities get a fair share of federal grants. According to this logic, peer review, the normal system for parceling out R&D funds, is dominated by the elite universities and earmarked funding—or academic pork—is needed to redress the balance. Now comes Representative George Brown (D–CA), chairman of the House Committee on Science, Space, and Technology, a long-time enemy of academic pork, with evidence that explodes this Robin Hood myth. Armed with new statistics, Brown even managed to trim some pork from an appropriations bill earlier this month, and he's vowed to go after earmarked funds in the future.

In a study released last week, Brown's committee examined academic pork in appropriations bills approved over the past 12 years (1980-1992). The result: Earmarked projects go almost as often to rich and successful universities as to the needy. Indeed, the analysis of $2.5 billion worth of special grants revealed no clear rationale in the handouts—other than a tendency to reward states that are well represented on the appropriations committees. The big winners of academic pork, by rank, were Massachusetts, Oregon, Pennsylvania, Louisiana, New York, Florida, Iowa, West Virginia, Alaska, and Mississippi. They received nearly half of the $2.5 billion earmarked for academic projects, according to the study, which was written by James Savage of the University of Virginia and Genevieve Knezo of the Congressional Research Service.



At the trough. Congress has earmarked $2.5 billion for special R&D projects since 1980, half of it in the past 2 years.

Contrary to the view that the earmarked funds go to the needy, Savage found that during the period he analyzed almost one-third (32.2%) went to states that ranked among the top 10 recipients of federal R&D in 1990. And the academic institutions that ranked among the top 50 in terms of federal R&D support got 26.2% of the earmarked money—cashing in on both the peer-reviewed and earmarked funds. Brown calls this "double-dipping."

The report also undermines the notion that earmarked grants are used to help backward institutions catch up with the pack. Savage checked out this possibility by tracking the performance of 37 institutions that received $20 million or more over the past decade, watching to see whether they improved their rank as federal R&D recipients. He saw no clear pattern of improvement. Although nine rose, eight declined and one stayed the same. The data were not adequate to rank the others.

The trend toward earmarking, Brown said in a statement issued last week, is "a disease" that has "spread like a cancer" through the appropriations process in the past decade. But Brown and the senior Republican on the science committee, Robert Walker (R–PA), recently stepped up their efforts to excise the growing tumor, and on 17 September, they won a surprise victory. During a vote on the final version of the energy and water bill, the appropriations committee asked the House to approve a list of earmarked grants worth $94.8 million to 10 projects in eight states. None had been discussed in committee or on the floor. Brown argued that these proposals ought to be scrutinized by scientific peers, or at least by the regular legislative committee, before being funded. The House voted by an unexpectedly big margin (250 to 104) to back Brown and scuttle the pork list. While this decision may put a small dent in the earmarking of academic projects this year, it may not make a significant change. Rick Borchelt, spokesman for the House science committee, says 1993 is still expected to be a "banner year" for pork.

–Eliot Marshall