The Shuttle: Whistling Past the Graveyard?

NASA's main transport vehicle may be entering an early dotage, making it necessary to develop alternative ideas

WHEN THE SHUTTLE RETURNED FROM ITS 36th trip to space on 10 October, program chiefs from the National Aeronautics and Space Administration (NASA) flew out to California to greet the crew, raise a cheer, and give themselves a pat on the back. But why? Surely after 9 years, shuttle launches and landings should be utterly routine.

They're not at all routine, and critics say they never will be. The system has entered an uncertain middle age, exhibiting signs of stress and strain, and some say it is time to consider early retirement. Intended to be a safe, efficient cargo truck, the shuttle has been instead as temperamental as an antique sports car. And critics who pointed out many of its failings after the Challenger accident are once again questioning its value. "[The shuttle] continues to exist as a sort of stunt or technical curiosity," says aerospace historian Alex Roland of Duke University. "The whole notion that you're going to predicate a space station on that thing—building and resupplying [a station]—is just crazy."

That the shuttle has been losing credibility is not news, but the breadth of disappointment produced by last summer's fuel leaks is surprising. The viability of the shuttle as the primary space transport system for the 1990s has been called into question, as *Science* learned from talking to a score of academics, officials, and independent experts about the need to begin the transition to a new vehicle. While NASA's top-ranked officials still describe the shuttle as the best available technology, engineers at a lower level are already at work on several alternatives that might one day replace it—including capsules with parachutes, a steerable vehicle like the shuttle but smaller, and an aerospace plane that could take off from a runway.

These ideas, although they are getting some research support, are not affecting national policy. Despite its ongoing problems, NASA remains totally committed to the shuttle. The agency did not hesitate 4 years ago in committing $1.8 billion to build a replacement for the Challenger. NASA chiefs still gloss over the shuttle's most obvious fault—the inability to meet a schedule—as a temporary nuisance. This year, for example, nine launches were planned, but only six will get off, at most. Yet NASA's deputy administrator J. R. Thompson, Jr., said in an interview with *Science* last week that the flight rate is about to double. He predicts it will soon climb to between 10 and 12 per year and stay this high for a decade.

Forecasts like this, some outsiders argue, don't gibe with reality. They fear that NASA's leaders cannot judge the shuttle objectively because they have hitched the agency's wagon—and in many cases their own careers—to the shuttle star. NASA's top bosses grew up with the shuttle program: Admiral Richard Truly, NASA's chief, was formerly chief of the shuttle program and, before that, a shuttle pilot; William Lenoir, head of space flight, and Robert Crippen, who now runs the shuttle program, were also astronauts; and Thompson directed development of the main engines at the Marshall Space Flight Center before moving to headquarters.

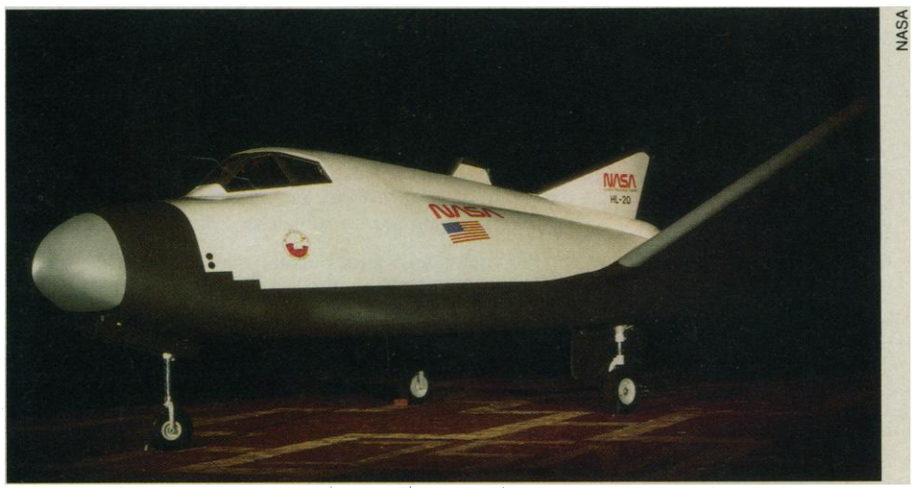
Even the blue ribbon panel created by the White House this year to review the space program is compromised, says one federal space transportation expert. He points out that the panel is chaired by Norman Augustine, chairman of the Martin Marietta Corporation, which "makes millions of dollars every time the shuttle takes off." Augustine, who says the committee will be debating the shuttle's future, concedes that his company has an interest in it, as well as in Titan missiles and other systems. But, he explains, "My policy is when it comes to making a decision [on these items], I won't participate directly in policy-making."

Critics argue that NASA's obsession with the shuttle is causing the agency to spend more time and money on it than is prudent. The machine is eating NASA alive, they say, and other technologies are being kept in abeyance.

Thompson responds that people who see the shuttle's hydrogen leaks as a fatal weakness are making "a big to-do out of nothing." He is "frankly surprised" by the negative public reaction, because NASA is now following a more cautious approach mandated by the Rogers Commission, the group that investigated the Challenger accident. Says Thompson: It's "dead wrong to say, 'Hey, let's go jump on a new horse,'" just because the shuttle had a bad summer.

And Thompson rejects the criticism that NASA is fixated on the shuttle, saying rather that it is improving the best and most reliable heavy launcher in the world. The European Space Agency's Ariane launcher, he notes, has had five failures in 39 attempts to fly, and the Soviets are now having trouble with the Zenit booster, which is part of their heavy-lift rocket, Energia. A Zenit blew up on the pad on 4 October. Furthermore, Thompson insists, NASA *is* investing in future technology. It has joined with the Defense Department to fund R&D on the National Aerospace Plane, a plane that is designed to take off from an ordinary airstrip and fly into orbit.

But the aerospace plane depends on technology that hasn't even reached the prototype stage, and there is no consensus at present on how rapidly NASA should be preparing to retire the shuttle and move to something new. For enthusiasts like Hans



NASA

Junior generation. *This model spacecraft (the HL-20) would weigh one-tenth as much as the shuttle but is designed to carry two crew members and eight passengers.*

Mark, chancellor of the University of Texas at Austin, who presided over the first 12 shuttle flights as deputy NASA chief in the early 1980s, the shuttle can have a central role in the U.S. space program for quite some time. "You can do everything President Bush wants to do"—building a space station, returning to the moon, and visiting Mars—"with the shuttle and the Titan IV." The Titan is a large workhorse of a rocket used by NASA and the military since the 1960s to carry cargo. Model IV is the latest version. Like Thompson, he sees no need to switch horses, and he thinks the reason for the slow launch rate at present is that "the guys flying it are superconservative." He adds: "I'll bet we flew with leaks like [those detected in the past summer] when we flew back in the 80's."

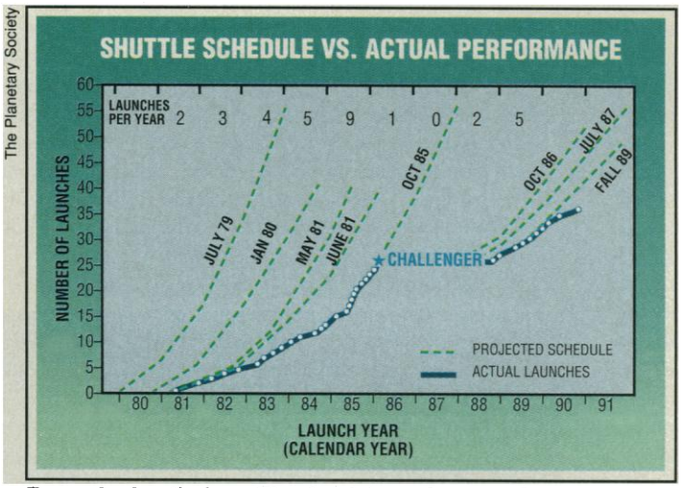
NASA officials like Thompson say the accumulation of experience is making that shuttle safer and more reliable every year. But, if so, the improvements are not reflected in "turnaround time"—the time needed to refurbish each orbiter between flights. In a 1986 report to NASA after the Challenger accident, the National Research Council estimated a "conservative" turnaround time in the 1990s would be 75 workdays. But the time actually scheduled by the Kennedy Space Center for the first three flights in 1991 are 115 days, 118 days, and 96 days. This past year, when the shuttle was down for 5 months, the turnarounds were even longer.

The shuttle's efficiency and safety are being questioned anew because it is slated to meet a tough schedule in the 1990s, supporting the construction and servicing of the space station. This would require between six and eight flights per year, every year, for a decade. But what if another accident occurs? The accepted odds of this event, as calculated by aerospace consulting firm L Systems Inc. of Los Angeles, are between one and three per 100 flights, or roughly one accident per decade if NASA follows its current schedule.

Even Thompson agrees there will probably be a mishap, but thinks it will not involve a total loss of the shuttle. He's willing to concede there may be an "abort on launch," with safe return of the crew and a repair period like last summer's. After a "quick look" and a fix, Thompson says, NASA "would press right on."

Most experts are less confident. For example, former astronaut John Fabian, now a consultant at ANSER Inc., a military consulting and engineering firm in Alexandria, Virginia, spoke at a recent meeting of the Planetary Society about the group's concern about using the shuttle to build a big space station. He said data collected by the Society (see chart) show "there should be serious doubts" about relying on the shuttle. "Most would agree that interruptions due to accidents or major systems failures are not unlikely, yet there appears to be no planned alternative to the shuttle for space station assembly."

Meanwhile, as NASA's top leaders insist that there's no need to create an alternative to the shuttle, a few lower-level staffers and independent agents are trying to do exactly that, in a variety of ways:



Record of optimism. *The shuttle's performance has consistently fallen short of expectations, as reflected in flight schedules.*

■ **The most conservative choice** would be to continue improving the shuttle incrementally, the way airplane makers modify the design of commercial aircraft. Engineers at the Johnson Space Center in Houston are spending about $1 to $2 million per year designing a "shuttle-derived" vehicle, to be deployed when the present orbiters give out.

■ **A more radical approach** would be to split the shuttle's functions in two and assign them to new vehicles. One would be a small, safe, simple craft—a personnel launch system (PLS)—to carry people to and from space, and the other would be a large, cheap cargo system. Several approaches to a PLS, described as a "complement to the shuttle," are being studied. With an annual budget of about $1 million, a group of engineers at the Langley Research Center has produced an eye-catching model of one type of PLS—in this case, one that resembles a scaled-down shuttle without engines. It also lacks wings, and would use its wide, flat body shape to provide the aerodynamic lift necessary for a safe landing. According to William Piland, chief of Langley's space systems division, it would carry a crew of eight, have a cross-range enabling it to land anywhere within 700 miles on either side of its orbit path, and could be developed in 8 to 10 years. The catch is that it would require development of a new rocket—or an improved Titan IV—that has been "man-rated" to increase safety and provide a means of escape in an aborted launch.

Yet more ideas for a PLS are being hatched by engineers at Johnson, who are spending about $1 million a year on PLS designs, including one that resembles an old Apollo capsule and another bullet-shaped vehicle—both of which would rely on parachutes to make a soft landing.

■ **Hermes, a mini-shuttle** now in the preliminary stages of design at the European Space Agency, could be ready for operation by the end of the decade if ESA's members agree to pay for development—a decision scheduled to be made in early 1991. Several U.S. experts have suggested that NASA should join the Europeans on the Hermes project, but Thompson says that he prefers a "clean interface" and wouldn't want to be deeply involved in another country's launch system.

■ **The most ambitious scheme** calls for creating a radically new machine capable of flying in the atmosphere and in space—known as the National Aerospace Plane (NASP). Although widely regarded as the most remote candidate, NASP has been touted by former presidential adviser George Keyworth II as a way to "make space launch routine." It "offers hope for precisely the kind of workaday access to space that shuttle proponents once envisioned," Keyworth and his colleague Bruce Abell wrote recently. This is the view of real enthusiasts; other analysts are more guarded. Jack Kerrebrock, a senior professor of aeronautical engineering at the Massachusetts Institute of Technology and chairman of a 1989 National Research Council review on NASP, says, "We do need a replacement for the shuttle," but he considers NASP an unlikely candidate. That program, he says, must continue as "a research project" for some time before it will yield any applications.

So while many people are dissatisfied with the shuttle, they don't agree on when it should be phased out, or what might be used to replace it. In the absence of an economic or policy push to bring on new technology, the current mid-life crisis seems likely to endure.

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