"Faster, Better, Cheaper"? Agencies and Scientists

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A time-honored engineering cliché states that you can make something better, you can make it go faster, or you can make it cheaper. In the early 1990s, in response to criticism of the growing costs of science missions, NASA avowed: "faster, better, *and* cheaper." It was a challenge to politicians, to industry, and to scientists, but above all to the agency itself. NASA's motto has come under considerable criticism after the recent catastrophic losses of the Mars Polar Lander and the Mars Climate Orbiter, two stepping stones for the exploration of Mars. Were traditional engineers too conservative, or has NASA, and especially Dan Goldin, been too daring?*

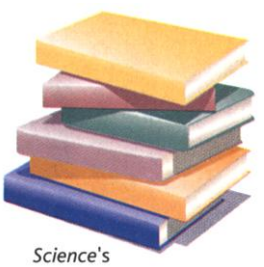
Contrary to popular belief, there is as yet no proof that "faster, better, cheaper" is the culprit—too few missions have flown under this regime to allow for conclusions. In fact, all space science missions are subject to a high rate of attrition. For example, out of four x-ray astronomy missions flown in less than 1 year, two were completely lost (Astro-E, from Japan, and Abrixas, from Germany). Going back a few years, several more losses can be listed: the European Space Agency's (ESA's) CLUSTER (revived as CLUSTER II, now in orbit); the Scientific Application Satellite–B from Argentina; Phobos I and Mars'96 (interplanetary probes from Russia); and the High Energy Transient Experiment (reborn as HETE II, now in orbit) and Wide Field Infrared Explorer (WIRE), both from NASA's workhorse, the Explorer series. There are also cases of crippled missions being recovered through ingenuity (and increased costs). In 1990, shortly after the launch of NASA's Galileo mission to Jupiter, its main antenna failed irretrievably to deploy. Engineers saved the science (and the public image) of Galileo by funneling data through a much smaller, secondary antenna, and the image quality was still impressive. Other examples include ESA's Hipparcos, NASA's Hubble Space Telescope, and Japan's NOZOMI.

"[H]as NASA... been too daring?"

Clearly, there is a difference between science missions (always unique technology-pushing prototypes) and commercial missions such as telecommunication or meteorology satellites, where the need for a sound profit on investment dictates lower risks. Thus, commercial missions ride, as they should, on science-driven technology development work. If a science mission that is technically successful and generates a significant advancement of knowledge (i.e., is also scientifically successful) is defined as "accomplished," then only about one in two science missions are accomplished. Is this good or bad? Should we stop doing science missions because we are putting the taxpayers' money at an unacceptable risk while exploring the unknown? Certainly not; space scientists should go on undeterred. But lessons have been learned. From the postmortem after the losses of the two Mars probes, it has been possible to identify the mission team's lack of experience and a failure of internal communication as major causes of not spotting problems before it was too late. A proposal would be for scientists to become more involved in reviewing a mission's global logic, telecom sequence, software quality, and so on. They should take on more extensive responsibilities, from system-level tests to orbital operations planning and implementation.

Another, more general, lesson concerns the role of the various space agencies. With the exception of NASA, they all need increased focusing of intent. In Europe, where space science activities rely on the synergy between ESA and the national agencies, it has been natural to allocate the bigger missions to ESA and retain the more agile ones for individual agencies. This requires coordination,† especially because science carries greater strategic freedom. To an increasing extent, national (European Union for ESA) policymakers dictate each agency's commercial role. However, they trust the agencies and their communities to propose and implement winning science strategies: Yet another reason for each scientist to ask not what your agency can do for you, but what you can do for your agency.

As NASA engages in an in-depth restructuring of its planetary program and is determined to go back to Mars in collaboration with some European counterparts, scientists the world over should seize this important, possibly unique, occasion. They should volunteer their support and assert the need for their increased involvement in validating and operating space missions.



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