Simplifying Procurement and Acquisitions Regulations

Some proposals for streamlining focus on the process by which the agency designs, develops, and operates even its most technically challenging systems. They emphasize increasing the authority and responsibility of program managers, who would report directly to a central oversight authority instead of being bound by each link in a long chain of command. Costs supposedly would be lower because decisions would be made more quickly and fewer resources would be consumed in oversight and assessment. These proposals overlap with the call for NASA to buy more on commercial terms, but even in traditional procurement, streamlining would place the agency in a more hands-off relationship with its contractors.

A particularly prominent proposal for streamlining was offered under the title of the National Space Enterprise Initiative. (The initiative was never implemented, but many of its ideas persist in other offerings.) Auditors like the General Accounting Office have often recommended that NASA improve the workings of its current management system by redoubling its efforts to carry out federal acquisitions regulations and agency management controls. But the National Space Enterprise Initiative moved in the opposite direction, proposing that NASA remove specific programs from the current system to the extent permitted by law.

In its broadest outlines, the proposal would have granted a special status to some percentage of NASA's new projects. That status would place a project outside of the normal NASA management structure by granting extensive discretion and power to the private contractor and the program manager, who would report to the National Space Council (which operates within the White House Office of Science and Technology Policy) rather than to various levels of NASA center and headquarters management. Administrative expenditures would be limited to 10 percent of costs. Documentation of program requirements and specifications would be subject to arbitrary page limits. Program managers would be shielded from outside interference by a four-year appointment; they would be granted considerable flexibility in resolving problems related to costs or schedules including the option of reducing the project's scope.

The evidence presented to support the effectiveness of these measures is not compelling. It is sometimes claimed that classified military projects or programs of the intelligence community organized along the lines suggested by advocates of streamlining perform better than NASA programs. But no comprehensive study has been undertaken that would allow comparison of the universe of classified and unclassified programs.

The Strategic Defense Initiative Organization (SDIO) is another program offered as an example of successful streamlining. In particular, some advocates of streamlining suggest that three SDIO experiments conducted during the 1980s at a cost of $700 million are comparable to a NASA project costing $2 billion. The previous NASA administrator and an independent space analyst reject this parallel, however, pointing out that the SDIO experiment used hardware that was already developed and launch vehicles already under contract to NASA. They also note that the complexity and duration of a moderate-size NASA mission far exceed those of the SDIO flights.[24] More generally, the independent analyst points out that the cost of subsequent SDIO experiments that required the development of new hardware was similar to comparable NASA efforts.

If streamlining is defined as a loosening of the federal acquisitions regulations, it could increase costs. According to the General Accounting Office's "High-Risk Series" review of NASA's contract management, NASA's failure to implement regulations fully and in a standardized way has led to higher, not lower, costs. Not complying fully with procurement requirements has led NASA field centers to approve changes in contracts without adequate technical evaluation and to allow unpriced

24. Letter from Richard H. Truly, NASA Administrator, to Mark J. Albrecht, Executive Secretary of the National Space Council, February 14, 1992; and testimony of John Pike, Director, Space Policy Project, Federation of American Scientists, before the Legislative and National Security Subcommittee, House Committee on Government Operations, October 6, 1993, pp. 10-11.

changes to persist. Those factors have contributed to cost overruns and unsatisfactory performance.[25]

Even if streamlining improves performance, there remain the social objectives of government procurement beyond buying a good or service at the lowest price. Those objectives include regional economic development and preferential contracting with small businesses and minority-owned firms. No compelling reason exists for space, above any other concern of the government, to be exempt from those objectives.

Changing the Role of NASA's Centers

The Augustine Committee's report and the more recent report on redesign of the space station have raised concerns about the role of NASA's field centers in project management.[26] The redesign report concluded that managers at the centers should act as providers of resources and facilitators, not program overseers. Analogies are often drawn between the role of the field centers in the space program and a negative caricature of the armed services, suggested by some defense analysts, as parochial and likely to pursue their own rather than national objectives. The direction of change in DoD has been toward more authority at the program level with centralized and standardized review at the level of the Office of the Secretary of Defense. Streamliners suggest that NASA take similar action.

Streamlining is unlikely to contribute immediately to resolving the fit of NASA's program into lower annual budgets. In NASA's most prominent attempt to generate savings by streamlining--the space station program--savings are to come from less contractor oversight and a reorganization of the responsibilities of the centers. According to the analysis of the space station redesign, those savings are necessary just to bring the cost of the current program down to the levels that were included in NASA's 1993 budget plan. Reductions below those amounts to the $2.1 billion limit proposed by the Administration could require stretching out the program relative to the January 1993 baseline.

Intragovernmental Coordination and International Cooperation

Another major avenue of reform for NASA that some analysts have suggested would lead to a dramatic increase in its intragovernmental cooperation with the Department of Defense and its cooperation with the space agencies of other nations. Common threads run through both forms of cooperation. New approaches are possible, say these analysts, because the Cold War is over, and those approaches should differ from past arrangements: NASA should enter into ventures in which its dependence on its partners' performance and participation is essential to the success of the venture. Only by fully embracing such joint ventures can the agency expect to make gains in a tight budgetary environment.

Intragovernmental Cooperation

Before leaving office, the Bush Administration issued a study that argued for NASA's involvement in more cooperative ventures with the Department of Defense and foreign nations.[27] The central idea in the report was that the U.S. space program had evolved to meet a unique set of circumstances driven by the conflict between the Soviet Union and the United States. Military efforts were closed and secretive to meet national security needs. In contrast, the civilian effort was open and expansive to meet scientific and foreign policy objectives. Accordingly, each sector developed separate research capabilities, launch vehicles, infrastructure, and op-

25. General Accounting Office, *NASA Contract Management*, pp. 15-21.

26. National Aeronautics and Space Administration, *Report of the Advisory Committee on the Future of the U.S. Space Program*, p. 40; and National Aeronautics and Space Administration, *Final Report to the President, Advisory Committee on the Redesign of the Space Station* (June 1993), pp. 16-19.

27. Vice President's Space Policy Task Force, *A Post Cold War Assessment of U.S. Space Policy* (December 1992).

erational mechanisms. Now that the Cold War has ended, the argument goes, the opportunity exists to eliminate duplication between the civilian and military space programs and reduce the cost of both.

The potential for more intragovernmental cooperation between NASA and other government agencies is largely an issue of NASA and DoD cooperation. One suggestion, to share weather and land-remote sensing satellite systems and data, is not new but may be more feasible now that security concerns have lessened. Another idea is to combine funds from NASA and DoD for new investments in space transportation. NASA and the national security community are the principal government users of space launch services. The nation should invest in only one new core capability to meet its future needs; thus, a basis for cooperation is evident.

As with many other changes in the way NASA does business, the cost of NASA's program may ultimately be reduced by cooperation with other government agencies, but results in the short term are unlikely. In the Earth science area, the long lead times built into military and civilian programs alike push potential savings into 1999 and beyond, even if prompt action is taken. Concerning the capability for space launches, neither NASA nor DoD has large new investments now in its budget plans. Although a coordinated effort might lower the cost to NASA of developing new space transportation systems, any major spending for new systems would require an increase in NASA's budget.

International Cooperation

NASA has long been involved in international space ventures. But the opportunity that now exists for cooperating with Russia would require a fundamental change in NASA's approach to international cooperation and could have significant implications for the long-run cost of achieving the agency's goals in piloted spaceflight.

The space station is the focus of current discussions about changing NASA's approach to international cooperation and many of the other suggestions to change the way NASA does business.[28] After six months of work, NASA has settled on a redesigned station called Alpha, which adds major Russian participation to the long-standing international partnership of the United States, Japan, Canada, and the member nations of the European Space Agency. Russia will contribute launch services and hardware--either selling or leasing equipment to the United States; it will also have an ongoing operational role, carried out by the Russian Space Agency.

The essential difference between this venture into international cooperation and previous NASA efforts is the agency's heightened dependence on foreign partners to fulfill goals of the mission successfully. NASA has limited its past ventures with foreigners to "value-added" activities that increased the output of a specific venture but that were not absolutely necessary to achieve the basic objectives of the mission. (An example is Europe's development of the spacelab module that increased the scientific capabilities of the space shuttle.) The broad outlines of the international partnership NASA describes would create a strong interdependence between the U.S. and Russian space programs, which introduces a substantial and obvious political risk into the U.S. space program. Counterbalancing this risk are the benefits of the facility's being fully operational earlier than it would otherwise and a claim of cost savings.

28. In March 1993, the President directed NASA to undertake a 90-day study to redesign the space station. Subsequently, an internal NASA redesign team and an external group of experts, the Advisory Committee on the Redesign of the Space Station (the Vest Committee, after its chairman Charles M. Vest, president of the Massachusetts Institute of Technology), were convened. The Vest Committee in particular foresaw gains in efficiency and savings; indeed, it asserted that the internal NASA team's estimate of annual program savings of $300 million constituted "minimum gains." The committee saw NASA realizing savings of $700 million to $1 billion annually once the improvements from the space station program worked their way through the entire system. By September 1993, the redesign culminated with the decision to include Russia in the international partnership. See National Aeronautics and Space Administration, "Space Station Redesign Team: Final Report to the Advisory Committee on the Redesign of the Space Station" (June 1993); and National Aeronautics and Space Administration, *Final Report to the President.*

That claim is controversial, however. Experience indicates that cooperative ventures usually cost more than national efforts.[29] Moreover, the estimated cost of the Alpha station is not fully developed as yet. A major review of the current design is scheduled for March 1994, and contracts to go forward with the design will not be finalized until later in the summer. NASA's preliminary estimates showed that Russian participation would lower the cost of Alpha by almost $4 billion.[30] Those savings proved tenuous, however, and the most recent estimates indicate only $2 billion in savings. A six-month slip in the schedule for the first launch of U.S. hardware could portend a further decrease in that figure.[31]

Even if one takes NASA's claims of savings at face value, there is still cause for concern because the savings are not achieved until after 1998. NASA projects that spending for the space station will be at least $2.1 billion annually through that year regardless of which option is pursued. Long-time observers of NASA are understandably skeptical; these claims sound similar to ones made for high flight rates and low operating costs for the shuttle system--claims that have proved to be false.

Skepticism seems warranted as well about whether the agency can support its estimates of the cost and content of the space station design. The agency is under extraordinary pressure to reduce costs. In the past, such pressure has led to underestimations of project costs. Although significant elements of the Alpha design are based on the very mature Freedom design (which preceded Alpha), new engineering and cost estimating issues arise with each new paper design and with the introduction of Russia as a partner. NASA readily admits that problems have arisen from such uncertainties in the past; they could well threaten the cost, content, and schedule of the redesigned space station in the future.

Opportunities also exist for international cooperation in areas other than the space station. (For example, the level of cooperation in Earth observation could be increased.) Like the savings generated by international partnerships for the space station, however, savings in other areas of NASA's budget are unlikely to be realized until the beginning of the next century.[32]

Total Quality Management

Beyond NASA's specific problems is a pervasive sense of institutional crisis. NASA's administrator has alluded to this on many occasions and has embarked on an effort to redefine NASA as an institution. The "quicker, cheaper, better" approach to spaceflight projects, the space station redesign, the planned reduction in NASA's federal work force, and the agency's proposed management and procurement reforms are all parts of this effort. Adopting and carrying out the managerial philosophy of total quality management (TQM) is both a symbol of the agency's commitment to reform and a unifying thread among the changes its senior management seeks. That thread also connects NASA with the broader movement to reinvent government.

TQM is a managerial philosophy whose objective is achieving customer satisfaction through continuous improvement of production processes.[33]

29. As Norman Augustine, chairman of the Advisory Committee on the Future of the U.S. Space Program, recently testified, "International programs are *far* more complicated to manage, governments and their priorities change . . . and anticipated cost savings are seldom realized." See his testimony before the Subcommittee on Science, Technology, and Space, Senate Committee on Commerce, Science, and Transportation, November 16, 1993, pp. 7-8.

30. National Aeronautics and Space Administration, "Space Station FY 1995 Budget to OMB" (October 12, 1993), p. 43.

31. Testimony of Daniel Goldin, NASA Administrator, before the Subcommittee on Space, House Committee on Science, Space, and Technology, February 23, 1994.

32. Office of Technology Assessment, *The Future of Remote Sensing from Space: Civilian Systems and Applications* (July 1993), pp. 89-91.

33. The TQM literature is vast. A large part of it is definitional and historical or oriented toward applications. Relatively little research has attempted to apply formal analysis to determine how TQM works. The Winter 1991/1992 edition of *GAO Journal* has two articles and an interview with TQM pioneer Joseph M. Juran that define terms, evaluate TQM in the private sector, and discuss the application of the philosophy within GAO specifically and within the federal government generally. See John E. Watson and Thomas W. Hopp, "The Private Sector's Experience with Total Quality Management," pp. 34-38; Mary R. Hamilton, Allan Mendelowitz, and Richard L. Fogel, "TQM at GAO," pp. 39-47; and "Some Thoughts at the Outset," an interview with Joseph Juran, pp. 48-54, all in *GAO Journal* (Winter 1991/1992).

Customer satisfaction and the positive performance indicators that go with it--profitable firms and well-paid workers--are achieved by committed managers and empowered employees seeking to continuously improve their products by applying empirical data and analysis to production processes.

First adopted by private manufacturing firms in Japan, TQM spread to private manufacturers in the United States in the late 1970s, achieved wide acceptance in the 1980s, and by late in the decade was being adopted by large parts of the federal government. In addition to those specific applications, the federal government adopted TQM as a general policy to improve private productivity and created the Baldridge Awards in 1987.[34] Modeled on the Deming Prize, which since 1951 has been awarded to firms in Japan that achieve success in quality management, the Baldridge Prize gave TQM a high profile in the United States.[35] Although the TQM philosophy originated in manufacturing, it has spread to the service sector, where it has gradually won adherents. That consideration is pertinent to NASA's internal attempt to implement TQM, because in some respects the agency functions more like a private-sector service firm than like a manufacturer.

TQM is perhaps best understood when contrasted with a caricature of "traditional" quality control in manufacturing: workers mindlessly executing the plans of middle management that incorporate quality into the production process only through end-of-the-line inspection and correction of defects. In contrast, TQM emphasizes the active participation of workers in determining how output will be produced and offers a set of tools to analyze processes, identify problems, and develop improvements.

Private-sector acceptance of TQM exceeds the available objective evidence of its effectiveness. Nevertheless, the claims of success that practitioners offer are impressive. In an open letter published in the *Harvard Business Review*, the chief executive officers of American Express, IBM, Proctor and Gamble, Ford, Motorola, and Xerox proclaim that TQM works: "Results from TQM at our companies range from halving product-development cycle time to a 75 percent improvement in 'things gone wrong' in shipping products to a $1.5 billion saving in scrap and rework over a five-year period."[36] Evidence of a positive relation between TQM and performance indicators in employee-related areas, operations, customer satisfaction, and financial results was also presented by GAO in applying for the Baldridge Award in 1988 and 1989.[37]

Several large sample surveys of firms that have adopted TQM show that not all of them have been successful in attempting to implement the approach. One survey of more than 500 companies in the United States, Canada, Germany, and Japan casts doubt on the universal success of TQM and, according to *The Wall Street Journal*, suggests that "many businesses may waste millions of dollars a year on quality improvement strategies that don't improve their performance and may even hamper it."[38] Another survey of 500 U.S. manufacturing and service firms found that only 36 percent of all firms (43 percent of manufacturing concerns and 28 percent of service firms) thought that TQM had had a significant impact on their competitive position. Two-thirds of the firms surveyed, however, anticipated future gains in their competitive strength.[39] This anticipation of future benefits emphasizes the long time frame over which advocates of TQM seek improvement. Japanese firms using the approach have decades of experience; the most successful U.S. practitioners (for example, Motorola) have used TQM for a little more than 10 years.[40]

34. David A. Garvin, "How the Baldridge Award Really Works," *Harvard Business Review* (November/December 1991), pp. 80-93.

35. Mary Walton, *The Deming Management Method* (New York: Putnam, 1986), p. 15, describes the Deming Prize and W. Edward Deming's role in the quality management movement.

36. "An Open Letter: TQM on the Campus," *Harvard Business Review* (November/December 1991), pp. 94-95.

37. General Accounting Office, *Management Practices: U.S. Companies Improve Performance Through Quality Efforts* (May 1990).

38. Gilbert Fuchberg, "Total Quality Is Termed Only Partial Success," *The Wall Street Journal*, October 10, 1992, p. B1.

39. Arthur D. Little, *Executive Caravan Survey Summary* (undated), transmitted to the Congressional Budget Office on August 30, 1993.

40. "The Cracks in Quality," *The Economist*, April 18, 1992, pp. 67-68.

NASA was among the first federal agencies to adopt TQM during the late 1980s. According to a 1992 GAO survey, eight NASA installations employing roughly 20,000 people have adopted the approach.[41] Four of the installations placed themselves in the GAO category of "just getting started," three in the category of "implementation," and one in the more advanced category of "achieving results." The GAO survey defined two categories of results from the benefits of TQM: external organizational performance (the implementing agency's perception of how it was doing with its customers) and internal operating conditions. For NASA installations as for a larger survey population of over 2,200 federal facilities, self-reported improvement in both categories was correlated with progress along GAO's five-phase scale. (The three categories noted above are bounded by a first phase, "deciding whether to implement TQM," and a final phase, "institutionalization.")[42] Among the improvements noted was a reduction in costs, although GAO does not report how much or in what categories of effort.

Even if TQM is ultimately successful, its adoption is unlikely to lower the cost of NASA's program or have a significant budgetary impact--at least in the next several years. Experience with TQM in the private sector indicates that it is most effective when consistently practiced over a long period. Experience with TQM in the federal government, including that of NASA, is relatively limited. Like the private sector, the federal units that have adopted and continued using TQM report success--but only after several years of effort. Those findings should create skepticism about claims that immediate cost savings will follow the decision to put TQM in place.

Such caveats, however, should not be taken to mean that TQM does not work or that it will not work for NASA. Surprisingly little empirical analysis exists about the effectiveness of TQM; most evaluations are flawed because they are based on self-reported data by the organizations practicing TQM and are not subject to external verification. Nevertheless, the wide adoption of TQM in the private sector attests to its general, although not universal, success.

Can Reforms Make a Difference?

Calls for improving acquisition and procurement procedures are not unique to NASA's activities. The Department of Defense has also been subject to waves of criticism and reform. The acquisition and procurement environments in which NASA and DoD operate have marked similarities. Both agencies are the sole customer for many of the systems that they acquire. Each requires the development and incorporation of advanced technology into the goods it buys. And the same industrial base supplies both agencies. A significant difference between the two is that most acquisition for DoD includes both a development and a production phase; in contrast, many of NASA's acquisitions end with the development of a single system. Yet even this difference has diminished in recent years. NASA's shuttle program requires relatively large production runs of some items--for example, the solid rocket boosters--and more and more of NASA's projects have long operational lives.

Overview studies of improvements in military acquisition are not a basis for optimism about the ability of reform to improve the costs, schedules, and technical performance of NASA's projects. A RAND study of DoD that was released in 1986 compared DoD's acquisition performance in the 1970s with its performance in the 1960s. The study cited improvements in several measures of performance: cost growth, schedule slippage, and functionality. Moreover, RAND analysts were optimistic that a trend had been established based on early data from the 1980s.[43] A later study by the Institute for Defense Analysis confirmed the RAND finding of improvement in the 1970s compared with the previous decade but expressed concern about the

41. General Accounting Office, *TQM Implementation at NASA* (April 1993), p. 2.

42. General Accounting Office, *Quality Management: Survey of Federal Organizations* (October 1992).

43. Michael Rich and Edmund Dews with C.L. Batten, *Improving the Military Acquisitions Process: Lessons from Rand Research* (Santa Monica, Calif.: RAND Corporation, 1986), p. vii.

1980s. The IDA concluded that there was "little indication that acquisition program outcomes are getting either substantially better or worse. Development schedule growth and cost growth in development, production, and the total program remain persistent problems, even though considerable improvements have been made in the information available to the program managers."[44]

The Congressional Budget Office's review of NASA's ongoing effort to change the way it conducts its business indicates that this effort probably will result in few budgetary savings. Experience shows that the costs of some projects are likely to exceed current estimates and that better management may be necessary just to bring costs to the level of the estimates, let alone reduce them. Furthermore, any reforms that are carried out will have their greatest budgetary effect on new projects rather than on those that are now part of NASA's program. The agency's present focus on piloted spaceflight is likely to limit the effect of cost reduction proposals that aggressively transfer the implementation of NASA's program to the private sector. The public's demand for accountability by the agency may not permit NASA to take the more "hands-off" stance that such a transfer would imply.

44. Tyson and others, *Acquiring Major Systems*, p. IV-12.