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NASA's Strategic Direction and the Need for a National Consensus

Committee on NASA's Strategic Direction · Division on Engineering & Physical Sciences · December 2012

The National Aeronautics and Space Administration (NASA) is widely admired for astonishing accomplishments since its formation in 1958. Looking ahead over a comparable period of time, what can the nation and the world expect of NASA? What will be the agency's goals and objectives, and what will be the strategy for achieving them? More fundamentally, how will the goals, objectives, and strategy be established and by whom? How will they be modified to reflect changes in science, technology, national priorities, and available resources?

In late 2011, the United States Congress directed the NASA Office of Inspector General to commission a "comprehensive independent assessment of NASA's strategic direction and agency management." Subsequently, NASA requested that the National Research Council (NRC) conduct this independent assessment. In the spring of 2012, the NRC Committee on NASA's Strategic Direction was formed and began work on its task. The committee determined that, only with a national consensus on the agency's future strategic direction—along the lines described in the full NRC report—can NASA continue to deliver the wonder, the knowledge, the national security and economic benefits, and the technology that have been typified by its earlier history.

Introduction and Background

NASA is at a transitional point in its history and is facing a set of circumstances that it has not faced in combination before. The agency's budget, although level-funded in constant year dollars, is under considerable stress servicing increasingly expensive missions and a large, aging infrastructure established at the height of the Apollo program. In addition, there currently there is no strong, compelling national vision for the human spaceflight program, which is arguably the centerpiece of NASA's spectrum of mission areas.

Although gaps in U.S. human spaceflight capability have existed in the past, several other factors, in combination, make this a unique period for NASA. These include a lack of consensus on the next steps in the development of human spaceflight, increasing financial pressures, an aging infrastructure, and the emergence of additional space-capable nations—some friendly, some potentially unfriendly. In addition, U.S. leadership in space science is being threatened by insufficient budgets to carry out the missions identified in the strategic plans (decadal surveys) of the science communities, rising cost of missions, decreasing science budgets, and the collapse of partnerships with the European Space Agency (ESA). All of this is occurring at a time when others (most notably ESA and China) are mounting increasingly ambitious space programs. Finally, NASA's aeronautics budget has been reduced to the point where it is increasingly difficult for the agency to contribute to a field that U.S. industry and the national security establishment have long dominated.

These problems are not primarily of NASA's doing, but the agency could craft a better response to the uncertainty—for example, by developing a strategic plan that includes clear priorities and a transparent budget allocation process. A better response would improve NASA's ability to navigate future obstacles and uncertainties. An effective agency response is vital, because at a time when the strategic importance of space is rising and the capabilities of other spacefaring nations are increasing, U.S. leadership is faltering.

Budgets and Balance

NASA cannot execute a robust, balanced aeronautics and space program within the current budget constraints. For example, major components needed for future human exploration, including important life sciences experiments on the ISS, are not currently in the budget. In addition, high priority science missions, including robotic planetary exploration missions that are precursors to human exploration, identified in the most recent NRC decadal survey are unfunded, and aeronautics research and development now accounts for only about 3 percent of the total NASA budget.

In addition, individual NASA centers are finding it necessary to selectively reduce their infrastructure or find alternative ways to support it through, for example, external collaborations. External partnerships can be highly beneficial, especially in the current fiscally constrained environment, and may enable NASA to execute a robust and balanced aeronautics and space program without additional funds. However, coordination and integration of such activities for the overall benefit of NASA are both essential for success.

Because of legislative and regulatory limitations, NASA officials lack flexibility in terms of managing the agency's personnel and facilities—a factor contributing to the mismatch between budget and mission. With the current available-budget-driven approach, intermediate milestones and completion dates for some programs have been delayed. This in turn results in a lack of tangible near-term performance outcomes from cost-inefficient programs that by nature must accommodate increases in fixed and indirect costs. Delays also have a deleterious effect on mission performance. By stretching out programs, the opportunities for NASA to develop and incorporate new technology into program architectures, as defined years before, are limited.

Approaches to Reducing the Budget-Portfolio Mismatch

There is a significant mismatch between the programs to which NASA is committed and the budgets that have been provided or anticipated. The approach to and pace of a number of NA-SA's programs, projects, and activities will not be sustainable if the NASA budget remains flat, as currently projected. This mismatch needs to be addressed if NASA is to efficiently and effectively develop enduring strategic directions of any sort. To reduce the mismatch between the overall size of its budget and NASA's current portfolio of missions, facilities, and personnel, the White House, Congress, and NASA as appropriate could use any or all of the following four, non-mutually exclusive options. The committee does not recommend any one option or combination of options but presents these to illustrate the scope of decisions and tradeoffs that could be made. Regardless of the approach or approaches selected, eliminating the mismatch will be difficult.

Option 1. Institute an aggressive restructuring program to reduce infrastructure and personnel costs and to improve efficiency.

Option 2. Engage in, and commit for the long term, to more cost-sharing partnerships with other U.S. government agencies, private sector industries, and international partners.

Option 3. Increase the size of the NASA budget.

Option 4. Considerably reduce the size and scope of elements of NASA's current program portfolio to better fit the current and anticipated budget profile. This would require reducing or eliminating one or more of NASA's current portfolio elements—human exploration, Earth and space science, aeronautics, and space technology—in favor of the remaining elements.

Observations and Recommendations

The report identifies significant impacts of current budget constraints on the individual programs at NASA and describes the kinds of options that would have to be considered to address the mismatch between the scope of NASA's programs and budget. However, the committee has not attempted to judge the appropriateness of the budget distribution among these programs internal to the agency.

Moreover, it would have been difficult to do so because of the absence of stated priorities that would provide a framework for making that assessment. In addition, the committee notes it was not asked to set those kinds of agency-wide priorities. The foregoing observations, and the detailed discussions in the full NRC report, lead the committee to offer the following conclusions and related recommendations:

Conclusion: There is no national consensus on strategic goals and objectives for NASA. Absent such a consensus, NASA cannot reasonably be expected to develop enduring strategic priorities for the purpose of resource allocation and planning. *Recommendation*: The administration should take the lead in forging a new consensus on NASA's future that is stated in terms of a set of clearly defined strategic goals and objectives. This process should apply both within the administration and between the administration and Congress and should be reached only after meaningful technical consultations with potential international partners. The strategic goals and objectives should be ambitious, yet technically rational, and should focus on the long term.

Recommendation: Following the establishment of the new consensus on the agency's future, NASA should establish a new strategic plan that provides a framework for decisions on how the agency will pursue its strategic goals and objectives; allows for flexible and realistic implementation; clearly establishes agencywide priorities to guide the allocation of resources within the agency budget; and presents a comprehensive picture that integrates the various fields of aeronautics and space activities.

Recommendation: NASA's new strategic plan, future budget proposals prepared by the administration, and future NASA authorization and appropriation acts passed by Congress should include actions that will eliminate the current mismatch between NASA's budget and its portfolio of programs, facilities, and staff. This should be implemented while establishing and maintaining a sustainable distribution of resources among human spaceflight, Earth and space science, and aeronautics through some combination of the kinds of options identified in the full NRC report. The strategic plan should also address the rationale for resource allocation among the strategic goals in the plan.

Although the committee carefully analyzed NASA's current strategic plan, as well as previous plans, it ultimately concluded that the strategic planning process is affected more by what happens outside the agency than any process inside of it. The lack of a national consensus on what NASA should do constrains NASA's ability to plan and to operate.

Reforming NASA's Institutional Structure

The committee recognizes that it lacks the capability and time to conduct the detailed supporting analysis and to make specific recommendations for changes in the current NASA infrastructure. However, the committee offers a suggested path forward for NASA to follow, in close collaboration with the President and Congress.

Recommendation: NASA should work with other U.S. government agencies with responsibilities in aeronautics and space to more effectively and efficiently coordinate the nation's aeronautics and space activities. *Conclusion*: Legislative and regulatory limitations on NASA's freedom to manage its workforce and infrastructure constrain the flexibility that a large organization needs to grow or shrink specific scientific, engineering, and technical areas in response to evolving goals and budget realities.

Conclusion: The NASA field centers do not appear to be managed as an integrated resource to support the agency and its strategic goals and objectives.

Recommendation with respect to the NASA centers:

- The administration and Congress should adopt regulatory and legislative reforms that would enable NASA to improve the flexibility of the management of its centers.
- NASA should transform its network of field centers into an integrated system that supports its strategic plan and communications and advances its strategic goals and objectives.

International Partnership and U.S. Leadership

Recommendation: The United States should explore opportunities to lead a more international approach to future large space efforts, both in the human space program and in the science program.

Today it is common to declare that all future human spaceflight or large-scale Earth and space science projects will be international. Many U.S. leaders also assume that the United States will take the lead in such projects. However, American leadership in international space cooperation requires several conditions.

First, the United States has to have a program in which other countries want to participate, and this is not always the case. Second, the United States has to be willing to give substantial responsibility to its partners. In the past, the approach of the U.S. to international partnership has too often been perceived as being based on a program conceived, planned, and directed by NASA. Third, other nations must be able to see something to gain—in other words, a reason to partner with the United States. Finally, the United States has to demonstrate its reliability and attractiveness as an international partner.

The capabilities and aspirations of other nations with respect to space have changed dramatically since the early days of the space race between the Soviet Union and the United States. One of the most important successes of the International Space Station (ISS) was its international character and the role of the United States as the managing partner in a global enterprise. If the United States does seek to pursue a human mission to Mars, such a mission will undoubtedly require the efforts and financial support of many nations.

Concluding Remarks

In preparing this report, the committee held three meetings at which current and former NASA leaders, representatives of other government agencies, academics, and historians shared their views of the origin and evolution of NASA and its programs, as well as the issues facing the agency today. The committee received input from nearly 800 members of the public through a web-based questionnaire, and small groups of committee members visited each of the nine NASA field centers and the Jet Propulsion Laboratory. Furthermore, the committee reviewed a large number of studies conducted by the NRC and other groups over the decades that made recommendations about the conduct of NASA's programs and the agency's future, as well as NASA's strategic plans back to 1986.

The committee was impressed with the quality of personnel and the level of commitment of the agency's civil service and contractor staffs and with the superb quality of the work performed by the agency in general, which was most notably demonstrated recently by the Curiosity landing on Mars. But it also heard about frustration with the agency's current path and the limitations imposed upon it by the inability of the national leadership to agree upon a long-term direction for the agency. Only with a national consensus on the agency's future strategic direction, along the lines described in this report, can NASA continue to deliver the wonder, the knowledge, the national security and economic benefits, and the technology typified by its earlier history.

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The NASA Strategic Plan and Strategic Direction

As detailed in the full NRC report, the lack of national consensus on NASA's most publically visible mission—along with outyear budget uncertainty—has resulted in a lack of strategic focus necessary for national agencies operating in today's budgetary reality. As a result, NASA's distribution of resources may be out of sync with what it can achieve relative to what it has been asked to do. NASA now faces major challenges in nearly all of its primary endeavors: human spaceflight, Earth and space science, and aeronautics.

Human Spaceflight

The committee has seen little evidence that a current stated goal for NASA's human spaceflight program—namely, to visit an asteroid by 2025—has been widely accepted as a compelling destination by NASA's own workforce, by the nation as a whole, or by the international community. On the international front, there appears to be continued enthusiasm for a mission to the Moon but not for an asteroid mission, although there is both U.S. and international interest in robotic missions to asteroids. This lack of consensus on the asteroid-first mission scenario undermines NASA's ability to establish a comprehensive, consistent strategic direction that can guide program planning and budget allocation. While the committee did not undertake a technical assessment of the feasibility of an asteroid mission, it was informed by several briefers and sources that the current asteroid mission has significant shortcomings.

The asteroid mission is ostensibly the first step toward an eventual human mission to Mars, which has been the ultimate goal of the American human spaceflight program. This goal has been studied extensively by NASA and received rhetorical support from numerous U.S. presidents, and it has been echoed by some international space officials; however, it has never received sufficient funding to advance beyond the rhetoric stage. Such a mission would be very expensive and hazardous—the primary reasons that such a goal has not been actively pursued.

There also is no national consensus on what would constitute an appropriate mix of NASA's capability-driven and mission-driven programs. While a capabilities-driven approach may be the most reasonable given budget realities, such an approach still needs to be informed by a clear, consistent, and constant path to the objective.

Earth and Space Sciences

NASA has clearly demonstrated the success of the strategic planning process for Earth and space science that is founded on the NRC's decadal surveys. (A decadal survey on life and microgravity science has also been produced for the Human Exploration and Operations Mission Directorate.) The decadal survey process has matured into a robust method for developing a set of goals and objectives for various programs; these are based on a community consensus on an achievable suite of science programs in pursuit of high-priority, compelling science questions. However, even the best strategic plan is vulnerable to severe changes in the assumptions that underlie its development, whether those changes are applied internally or externally. As an example, the recent set of surveys on astrophysics and planetary science were based on budget projections provided to the relevant decadal committees, and now these projections exceed the current budget as well as current budget projections.

Rising costs associated with increasingly complex missions, declining science budgets, international partnerships that fell apart, and mission cost overruns have strained science budgets to their breaking point. As a result, key decadal priorities in astrophysics, planetary science, and Earth sciences will not be pursued for many years or not at all. The carefully crafted strategic planning process—and its prioritization and consensus-building, which in the past has led the United States to global leadership with such science missions as the Curiosity rover on the surface of Mars and the Hubble Space Telescope—is now in jeop-ardy because it no longer may lead to a tangible program outcome.

Aeronautics and Space Technology

The NASA aeronautics program has made important contributions to national priorities related to the U.S. air transportation system, national defense, and those portions of the space program that include flight through Earth's atmosphere. However, the budget for NASA's aeronautics program shrank significantly in the 2000-2010 decade, and the full historically demonstrated potential of the aeronautics program is not being achieved given the current levels of funding. During the course of its deliberations, the committee did not hear a clear rationale for the overall decline in NASA aeronautics spending during the past 15 years.

Because of the unique nature of most NASA missions, the agency has had a number of very specific technological requirements in areas ranging from expendable and reusable launch vehicles to deep-space propulsion systems and radiation protection for astronauts, among many others. The recently established Space Technology Program has carried out a roadmapping and priority-setting strategic planning process for such technologies, assisted by the NRC; however, the program is yet to be funded at the levels requested by the President's budget.

NASA-Supported Commercial Space Activities

Since the late 1950s, the U.S. government has been involved extensively in setting requirements for, and in designing, testing, developing, and launching, human and robotic spacecraft. NASA's Commercial Orbital Transportation Services (COTS) program, initiated in 2006, is designed to foster development of privately operated space transportation systems for access to the International Space Station (ISS). Now that NASA has adopted an initiative to develop commercial capabilities with private companies that are entering the business of developing, testing, and operating space systems, the government no longer has an exclusive role in the design, development, testing, evaluation, and operations of human spacecraft systems.

NASA's new approach to procuring transportation services is an extension of U.S. government policy that discourages direct government competition with industry in manufacturing systems or providing services that are available in the private marketplace. Of course, this approach is possible only because of previous investments made by NASA and the Department of Defense over many decades in the development of launch vehicles, systems, processes, technologies, and components. Just as many continuing improvements in commercial spacecraft are enabled by NASA's ongoing development of advanced technologies for future civil space missions, the growth of a U.S. commercial space transportation sector would be greatly facilitated by NASA's continued investments in space transportation technology.

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