



AERONAUTICS INNOVATION: NASA'S CHALLENGES AND OPPORTUNITIES (2006)

NASA is the premier government office working on aeronautical research in the United States. Its Aeronautics Research Mission Directorate (ARMD) supports research and development (R&D) in advanced airframe, engine, emissions, air safety, and air traffic control technologies. Using research and testing in the laboratory and in flight, NASA scientists and engineers develop tools and technologies to improve vehicle and air system safety and performance. Predating the creation of NASA in 1958, such missions have survived many changes in the industry and are still

considered essential to the government. However, there is now concern that the research is not being used effectively to improve the air transportation system despite ARMD's accomplishments in areas such as advanced materials, propulsion, aerodynamics, aviation safety and emissions, controls systems, and human factors.

This is not surprising since the program faces a number of management challenges. Most importantly, NASA aeronautics is overshadowed in resources, managerial attention, and political support by the agency's principal mission of space exploration and discovery. Next, NASA has no institutional responsibility, resources, or ability to directly implement technologies developed by the aeronautics program. Application of the technologies depends on a variety of government and private-sector clients or customers—airframe and aircraft engine industries, military services, and regulatory and operational arms of the Federal Aviation Administration (FAA). Also, customers have diverse goals and needs, ranging from supplying quasi-public goods (air transportation safety) to supporting commercial activities. Finally, NASA supports a very broad range of R&D activities—from basic research to demonstration of specific technologies.

NASA aeronautics officials requested that the National Academies' Board on Science, Technology, and Economic Policy recommend tools, techniques, and practices to facilitate and accelerate NASA's aeronautics R&D activities, focusing on users outside the agency deploying these technologies. The following recommendations in the areas of public policy and program prioritization, management for transition, personnel management, and financial management outline a plan for accomplishing this goal.

PUBLIC POLICY AND PROGRAM PRIORITIZATION

There is a growing discrepancy between ARMD's goals and the resources available stemming from a lack of national consensus about the federal government's role in civilian aviation and NASA's role in aviation technology development. On one hand, industry, academic, and other stakeholders support an expansive public R&D program with NASA playing a lead role. On the other hand, policy leaders over the past eight years have reduced the aeronautics budget. The following steps need to be taken to ensure that ARMD has a clear strategy for meeting its highest priorities:

- Congress and the executive branch should discuss national goals in civil aviation and the role of the public sector.
- NASA should develop a national aeronautics policy that is strategically aligned with available resources.
- There should be ongoing consultation with customers and users.
- NASA should optimize its ability to use projects productively.
- ARMD's research portfolio should:
 - reflect stakeholder needs;
 - be closely aligned with core competencies of NASA research centers and those of external performers that the agency supports;
 - be balanced between near-term needs and longer term investments required to achieve transformational national capabilities.
 - be diversified in terms of the stage of technology being developed.

TABLE 1-2 Projected NASA Aeronautics Research Centers' Civil Service and Contractor Personnel, FY 2005-2010

Civil Service Employees	FY05 05 Budget	FY05 06 Budget	FY06 06 Budget	FY07 06 Budget	FY08 06 Budget	FY09 06 Budget	FY10 06 Budget
Aero DFRC	395	424	408	293	295	285	264
Aero GRC	861	790	647	429	404	385	362
Aero LRC	1205	1327	1004	764	690	647	604
Total Aero	2461	2541	2059	1486	1389	1317	1230

Contractor Employees	FY05 05 Budget	FY05 06 Budget	FY06 06 Budget	FY07 06 Budget	FY08 06 Budget	FY09 06 Budget	FY10 06 Budget
Aero DFRC	262	299	255	228	243	242	242
Aero GRC	480	295	267	235	233	230	216
Aero LRC	990	990	594	743	563	506	450
Total Aero	1732	1584	1116	1206	1039	978	908

DFRC = Dryden Flight Research Center, GRC = Glenn Research Center, LRC = Langley Research Center.
Source: *Budget Estimates, FY 2006*.

MANAGEMENT FOR TRANSITION

ARMD should implement management tools to aid in the transition of technologies to users.

- ARMD should build relationships with customers and users to engage them early in the process so they can help plan and prioritize R&D activities and stay involved through product implementation.
- ARMD should use decision processes to establish expectations among customers, research managers, and the technical team throughout the development process; to clarify goals, schedules, deliverables, concrete target performance metrics, and review templates; to set decision criteria; and to ensure accountability of all parties involved.
- ARMD should document technology transition to external stakeholders.
- ARMD should solidify its reputation as a trustworthy, reliable partner.
- ARMD should look to the Joint Planning and Development Office (JPDO), the multiagency entity charged with developing a plan for a modernized air traffic control system, as a model for future ARMD technology development projects requiring close external collaboration.
- ARMD should be flexible with regard to project schedules because of the variety of technologies and diversity of stakeholder capabilities.

PERSONNEL MANAGEMENT

In order to support innovation, ARMD should implement more flexible personnel practices, increase incentives for creativity, and actively manage decisions about staffing.

- ARMD should encourage personnel rotations among its several research centers and external partners to enhance staff training, secure early interest by partners, and facilitate technology transitions.
- ARMD should foster customer contact early in and throughout the careers of technical personnel.
- ARMD should pilot-test a dual-track, pay-for-performance program similar to the one at the Air Force Research Laboratory.
- ARMD should encourage R&D personnel to take time for “free thinking” and organize events for employees to showcase their ideas.
- NASA should expand its Centennial Challenges program to offer high-profile prizes that will generate public interest.

FINANCIAL MANAGEMENT

ARMD should structure financial management in a way that minimizes demands on resources and one-size-fits-all accounting rules. Without adequate resources to improve financial management, new technologies will not be applied successfully.

- NASA should modify full-cost pricing for ARMD test facilities, with charges more closely aligned with marginal costs.
- ARMD should work with the Office of Management and Budget and Congress to establish separate centrally funded budgets for national infrastructure and facilities maintenance.
- ARMD should establish greater budget and milestone flexibility through centrally funded pools and contingency accounts.
- ARMD should explore Working Capital Fund structures for wind tunnels and aeronautics R&D services.
- ARMD should negotiate with congressional sponsors of directed funding and recipients to align mandated activities better with established programs. If this is not possible, direct funding should be separated in budget accounting and in management.

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For More Information

Copies of *Aeronautics Innovation: NASA's Challenges and Opportunities* are available from the National Academy Press (NAP); (800) 624-6242 or (202) 334-3313, or visit the NAP website at www.nap.edu. For more information on the project, contact staff at (202) 334-2200 or visit the PGA website at www.nationalacademies.org/pga.