



Do NASA's Wind Tunnel and Propulsion Test Facilities Serve National Needs?

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The nation has invested billions of dollars in wind tunnel and propulsion test facilities—investments that have created a testing infrastructure that has helped secure the country's national security and prosperity through advances in commercial and military aeronautics and space systems.

Many of these facilities exist within the National Aeronautics and Space Administration (NASA). Over the past two decades, NASA has reduced the number of these facilities by one-third, has identified additional facilities to be closed, and is experiencing patterns of declining use in some facilities that suggest they too may face closure.

Given these trends, the RAND Corporation was asked to clarify the nation's aeronautic testing needs and the continuing place that NASA's facilities have in serving these needs. The research answered five basic questions: (1) What are the nation's current and future needs for aeronautic prediction capabilities? (2) What roles do NASA's facilities play in serving these needs? (3) How well aligned is its portfolio of facilities with national needs? (4) How "healthy" is its portfolio? and (5) How should it manage that portfolio?

Despite Aeronautic Maturity, Test Facilities Are Still Critical

Some argue we do not need the testing capabilities that have been built up over the years. This view is based on the beliefs that the aeronautics industry has matured and that whatever test capabilities we need can be met through other means, such as sophisticated simulation technology.

Research confirms industry maturity, but that maturity relies on our workforce and test facility infrastructure. No vehicle classes have gone away, and for each class, we will continue to need to predict airflow behavior across a range of design considerations.

And while simulation technology, like computational fluid dynamics (CFD), has made inroads

Abstract

NASA's wind tunnel and propulsion test facilities continue to be important to U.S. competitiveness across the military, commercial, and space sectors. But management issues are creating real risks. This research shows that NASA needs to develop an aeronautics test technology vision and plan, analyze the viability of a national test facility plan, identify and maintain its minimum set of facilities, and identify shared financial support to keep its underutilized but essential facilities from entering financial collapse.

in reducing some empirical test simulation needs, it is not yet reliable for predicting the characteristics of the complex separated flows that dominate most critical design points for an aircraft. Moreover, while CFD technology may become a comprehensive solution in the future, we will not realize that potential for decades. Attaining that potential will, ironically, require many precise facility experiments; thus, we cannot replace test facilities altogether without maintaining existing high-quality testing facilities during CFD development.

Nearly All NASA Facilities Serve Strategic National Needs

We examined how well NASA's portfolio of 31 test facilities aligns against national strategic needs in each of six categories: subsonic, transonic, supersonic, hypersonic, hypersonic propulsion integration, and direct-connect propulsion.

Nearly all existing NASA facilities serve at least one strategic need category (i.e., are primary facilities serving at least one need) important to the nation's continuing ability to pursue aeronautic vehicles. We found very little overlap and very few gaps in coverage.

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NASA's Portfolio Is in Mixed Health

In looking at the health of NASA's test facilities, we see two key dimensions: how technically competitive the facilities are and how well utilized they are. By these measures, NASA's portfolio is generally in good condition. The table shows that more than three-quarters of its facilities are competitive and effective with state-of-the-art requirements and that more than two-thirds are well utilized. Overall, about two-thirds are both technically competitive and well utilized, with this number varying across the six test facility categories. But there is room for improvement, especially in reducing the backlog of maintenance and repair across the portfolio.

Technical Competitiveness and Utilization by Facility Category

Facility Category	Number of Facilities	Percentage TC	Percentage WU	Percentage TC and WU
Subsonic	8	75	50	50
Transonic	5	80	80	60
Supersonic	3	100	33	33
Hypersonic	3	100	100	100
Hypersonic propulsion integration	9	78	66	66
Direct-connect propulsion	3	100	100	100
Overall	31	84	68	65

TC = technically competitive; WU = well utilized.

Using a third dimension of health status—financial health—we found that the full-cost recovery (FCR) accounting practices NASA has imposed have serious implications for the financial health of currently underutilized facilities (about one-third of the facilities in general, with variation across the facility types). Average-cost-based pricing, decentralized budgeting, poor strategic coordination between users and providers of NASA facilities, and poor balancing of short- and long-term priorities inside and outside NASA are creating financial problems that leave elements of the U.S. testing capacity underfunded. With declining usage and FCR accounting, these facilities run the risk of financial collapse.

NASA Should Provide Shared Financial Support for Its Minimum Set of Test Facilities

Of the 31 existing major NASA test facilities, 29 constitute the “minimum set” of facilities important to retain and manage to serve national needs. Thus, the test complex within NASA is both responsive to serving national needs and mostly “right sized” to the range of national aeronautic engineering needs.

But some in the minimum set that should stay “open for business” are financially unhealthy. For the facilities in the most danger, NASA should **identify shared support to keep them from entering financial collapse** because of variable utilization, FCR accounting, and lack of program support for long-term national benefits. Shared support would be relatively small. Even the total operating costs of about \$130 million per year for these important facilities make up less than 1 percent of NASA's overall budget and are even smaller than the \$32–58 billion the nation invests annually in aerospace research, development, test, and evaluation (RDT&E).

Recommendations

For NASA leadership, the most critical issue is to develop a specific and clearly understood **aeronautics test technology vision**, to continue to support developing plans to **very selectively consolidate and broadly modernize** existing test facilities, and to prescribe **common management and accounting** directions for NASA's facilities. This vision cannot be developed apart from other critical national decisions. It must be informed by the long-term aeronautic needs, visions, and capabilities of both the commercial and military sectors supported by NASA's aeronautical RDT&E complexes.

While generally not redundant within NASA, a few of the NASA facilities' capabilities are redundant with those of facilities maintained by the Department of Defense (DoD). Whether these redundancies amount to the “unnecessary duplication” of facilities prohibited by the National Aeronautics and Space Act of 1958 was beyond the study's scope. Further analysis of technical, cost, and availability issues is required to determine if consolidation and right-sizing across NASA and DoD would provide a net government savings. **NASA should work with DoD to analyze the viability of such a national reliance plan** because it could affect the determination of the future minimum set of facilities NASA must continue to support.

NASA should keep pursuing all three approaches—facility, CFD, and flight testing—to meeting national testing needs; establish the minimum set of facilities important to retain and manage to serve national needs; reassess poorly utilized facilities for strategic, long-term needs rather than eliminate them out of hand; identify financial support concepts to keep its current minimum set of facilities healthy for the good of the country; and continue to invest in CFD, eliminate the \$128 million backlog of maintenance and repair at its facilities, and address hypersonic air-breathing research challenges.

Unless NASA, in collaboration with DoD, addresses specific deficiencies, investment needs, budgetary difficulties, and collaborative possibilities, the nation risks losing the competitive aeronautics advantage it has enjoyed for decades. ■

This research brief describes work done by the RAND National Defense Research Institute documented in *Wind Tunnel and Propulsion Test Facilities: An Assessment of NASA's Capabilities to Serve National Needs*, by Philip S. Antón et al., MG-178-NASA/OSD, 2004, 124 pp., \$25, ISBN: 0-8330-3642-4, available at <http://www.rand.org/publications/MG/MG178/>, and in *Wind Tunnel and Propulsion Test Facilities: Supporting Analyses to an Assessment of NASA's Capabilities to Serve National Needs*, by Philip S. Antón et al., TR-134-NASA/OSD, 2004, 162 pp., \$20, ISBN: 0-8330-3590-8, available at <http://www.rand.org/publications/TR/TR134/>. Also available from RAND Distribution Services (phone: 310-451-7002; toll free 877-584-8642; or email: order@rand.org). The RAND Corporation is a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. RAND® is a registered trademark.



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