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DOCUMENTED BRIEFING

An Update of the Nation's Long-Term Strategic Needs for NASA's Aeronautics Test Facilities

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Prepared for the National Aeronautics and Space Administration and
the Office of Science and Technology Policy

INFRASTRUCTURE, SAFETY, AND ENVIRONMENT and
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Summary

Introduction

The National Aeronautics and Space Administration (NASA) asked RAND to partially update its prior study of NASA's major wind tunnel (WT) and propulsion test (PT) facilities (Antón et al., 2004a, 2004b) to see whether any changes have occurred in the strategic need for these capabilities and to expand the original assessment to include major simulators.

The objectives of this study are to update our prior list of NASA WT/PT facilities and to create a new list of NASA simulation facilities that are strategically important in serving national needs of NASA, the Department of Defense, and U.S. industry. *Strategically important* facilities are those that offer significant and cost-effective technical capabilities important for the long-term research, development, testing, evaluation, or sustainment of the range of the kinds of aeronautic vehicles that the country develops and uses. Here, *strategic* implies a consideration of needs independent of the ups and downs of immediate or budgeted program funding and focuses instead on the classes of vehicles that the country pursues.

We measured and derived national strategic need and importance from an engineering perspective, asking design engineers and users to explain their long-term strategic testing needs as determined by the types of aeronautic vehicles on which they work generally. Their consideration would include not only currently budgeted vehicle projects but future vehicle classes that might be produced to serve national interests. If the nation made an overt, long-term strategic decision to no longer produce a certain vehicle class, then we would be able to eliminate the test facilities needed only for production and sustainment of that class of vehicles. For example, the United Kingdom (UK) Ministry of Defence (MOD) decided about a decade ago to no longer develop complete fixed-wing aircraft and to instead acquire them from other countries; the UK then no longer needed the WTs needed to produce such vehicles.

This discussion with design experts explored not only the technical capabilities they need and use but other factors that affect their decisions to use specific facilities, including cost, availability, and workforce quality. These additional factors provided insights into how to determine the importance of a strategic need and how NASA's capabilities serve that need relative to any competing test capabilities elsewhere. Strategically important needs were those that serve existing NASA programs and their long-term plans, Department of Defense (DoD) needs critical to meeting the DoD's mission, or other DoD and industry needs. Our analysis judged the needs either by their strength in a single sector or by their breadth across multiple sectors.

Our analytic method does *not* rely on an explicit, detailed, and exhaustive long-term national strategy plan for aeronautics test capabilities. This is because such a plan still does not exist and because this study is intended to help inform the creation of such a plan. Also,

aeronautics test facilities and operations are only partially funded by specific line items in the NASA budget. Thus, the study's determination of facility needs and our resulting conclusions and recommendations are not based on the federal budget process as a direct indicator of policy dictates of facility needs. As with a national plan, this study is intended to help inform that process rather than be driven by it.

To identify any changes in national WT/PT needs since our last study, we resurveyed the same DoD service and industry respondents using the same questions to understand their long-term strategic needs (see Antón et al., 2004b, pp. 120–129). To identify specific differences, respondents were sent their own prior survey responses and were asked to identify any changes since 2003.

We also employed the recent DoD study of "critical" facilities conducted by the Defense Test Resource Management Center (DTRMC) (see AT&L, 2007), including a detailed look at the unpublished information collected for that study on facilities that may be strategically important or beneficial but not deemed critical.

In addition, we solicited information on strategic needs from the current NASA research programs (aeronautics and space) and reviewed their program plans.

To assess simulator needs and capabilities, we reviewed the simulator types and their general use and asked NASA, DoD, and industry users to describe their strategic uses for these capabilities.

Finally, although the study focused on national needs and NASA's aeronautics test infrastructure, national needs are not dictated or met solely by NASA's test infrastructure; DoD, U.S. industry, and foreign capabilities also serve many national needs. However, our study was not chartered or resourced to examine data sets for these alternative facilities to fully understand consolidation opportunities between NASA and non-NASA WT infrastructures. Nonetheless, our findings revealed no evidence to change our prior recommendation that such a broader study is important and warranted.

Observations Based on an Updated Assessment of WT/PT Facilities and a New Assessement of Simulators

Update of Assessment of WT/PT Facilities

Overall, our updated assessment finds that NASA's aeronautics test facility capabilities remain strategically important for serving the national strategic needs of the aeronautics research, defense, commercial, and space communities.

We expect utilization to continue to vary from year to year and from facility to facility, causing important management challenges. This reflects the ups and downs of research, development, test, and evaluation (RDT&E) programs and the historical reduction in the frequency (but not elimination) of programs across the range of aeronautic vehicles. This variation in use implies that NASA management will need to take a diligent, long-term, strategic view to preserving strategically important capabilities. As we recommended in our prior study (Antón et al., 2004a), this view will require shared financial support to keep facility prices stable, competitive, and commensurate with individual testing value. NASA should continue to provide this strategic management and shared support (e.g., as it is currently doing through the NASA Aeronautics Test Program [ATP]).

The U.S. need for WT/PT facilities has not changed significantly since our prior study. However, the realities of ongoing low use at certain facilities have logically driven some NASA management actions.

WT/PT Facilities

There were 31 NASA WT/PT facilities during our prior study that met the study criteria, although NASA had already closed an additional 13 other facilities since the early 1990s. Of these 31, twenty-nine facilities were rated as strategically important in our prior study. Twenty-seven remain so, but two should be removed from that list. The two other facilities that were identified as *not* strategically important in our prior study remain so.

The formerly weak strategic support from the user community for the Langley Low-Turbulence Pressure Tunnel (LTPT) has declined even further, and there are no current NASA program needs for it. Boeing (the only prior industrial advocate) suggested that NASA invest in new capabilities at an alternative facility, such as the Langley National Transonic Facility (NTF), to provide two-dimensional testing capability similar to that offered by the LTPT. Since significant investment is required to keep the LTPT operational, it would make sense to mothball it while investigating options and issues for expanding the NTF to cover these needs.

Also, one hypersonic facility in the Langley hypersonic suite continue to have poor support and should be removed from the list of strategically important facilities. However, the remaining facilities in the Langley suite do serve strategically important needs, so the overall suite cannot be closed. Closing one part of this needed suite may not save much money, however.

Within the 27 facilities rated as *strategically important*, two have not been used recently but are being mothballed as hedges against access and technical issues. First, the Ames Subsonic 12-Foot Pressure Wind Tunnel (PWT) has not been used since our prior study and has been mothballed. Thus, NASA actions to mothball this facility makes sense. The Ames 12-Foot is still the only high–Reynolds number subsonic facility in the United States and is being mothballed as a hedge against the event of lack of access to foreign capabilities. Users have been using facilities in the UK and France for technical reasons; some did not want to pay the price to bring the Ames facility out of mothball and thus also went overseas for testing. This has caused a de facto reliance on foreign facilities for a strategically important U.S. test capability need. Even so, except for Boeing, there have been no strategic agreements with these foreign facilities to ensure security and access. Thus far, there has been no negative effect except for data security concerns, but access being denied in the future or security concerns becoming overwhelming could lead to additional problems.

Second, the Glenn Hypersonic Test Facility (HTF) is strategically important as a technical hedge to preserve its unique, nonvitiated heating capability in the event that vitiation turns out to be a real roadblock in hypersonic propulsion research. HTF has been in various states of non-use and mothballing, but the current mothballing is intended to provide additional preservation.

New Assessment of Simulation Facilities

Our assessment reveals that four of the six simulation facilities under study should be kept and managed as strategically important. One of the other two is scheduled to be replaced by a new facility that is nearing operational capability, and the other is a small, relatively inexpensive

visual flight control laboratory that has no current NASA or Federal Aviation Administration (FAA) needs and very few potential users elsewhere.

Conclusions

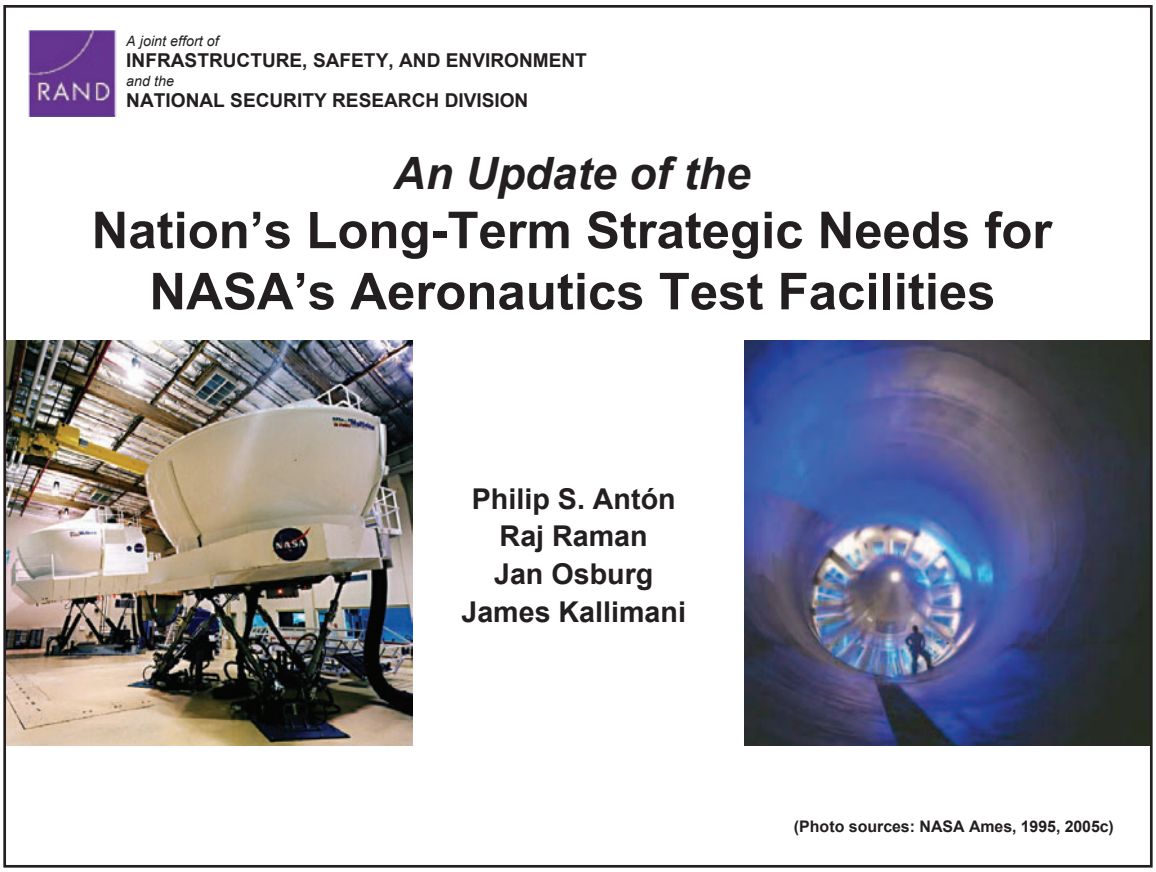
The goals, objectives, and actions of NASA's ATP reflect several strategic needs, and ATP's progress appears to be in agreement with our findings. These include identifying and maintaining a minimum set of strategically important test capabilities and identifying shared financial support to keep underused but essential facilities from financial collapse.

Still, NASA and the nation need to continue developing a vision for aeronautics test technology and a plan in response to the new national aeronautics policy (National Science and Technology Council, 2006). Also, national reliance and consolidation remain the next challenges, including between NASA as well as the DoD and between the government and industry.

Further questions and issues remain that were outside the scope of our study but that should be addressed. These include the following: What additional functions should the Strategic Capabilities Assets Program (SCAP) undertake to resolve management issues with its simulation facilities? How can NASA and the DoD best pursue a shared reliance relationship? What kinds of groundwork can be laid now for *international* reliance and consolidation considerations, and can allied cooperation result in noncompetitive infrastructure supporting a competitive development landscape? That is, can we reliably consolidate and jointly share an international test infrastructure in a cooperative reliance model—despite international political or economic differences or tensions—with companies that develop competitive products? What can NASA and the United States do to maintain national and world leadership in aeronautics and in test technology? What kinds of facilities will NASA need in the future as determined by new aeronautics pursuits, such as morphing wings, alternative fuel engines, new hypersonic vehicle concepts, closer aircraft spacing in more crowded U.S. air space, formation flying, and an expanded use of global positioning system (GPS) for flight control?

The nation has been fortunate in that its historical and ongoing test capability investments have resulted in a very flexible infrastructure that continues to serve its testing needs. However, we need to continue asking whether new aeronautics concepts being researched today will require new test capabilities in the future.

Note: Throughout this DB, we use the term *WT/PT facilities* to mean wind tunnel facilities and propulsion test facilities—the type of NASA facilities we assessed. Since individual facilities within this designation can be wind tunnel facilities, propulsion test facilities, or both, *WT/PT facilities* serves as a generic term to encompass them all. That said, when a specific facility is discussed, for clarity, we refer to it by its proper name and, if necessary, include its function (e.g., the *Ames Subsonic 12-Foot Pressure Wind Tunnel*). Also, the terms *test facilities* and *facilities* can be substituted for *WT/PT and simulator facilities*. Of course, NASA owns and operates test facilities other than WT/PT and simulator facilities, but our conclusions and recommendations do not apply to them.



Note: The photographs on this slide are courtesy of the NASA Ames Research Center. The photograph on the left (SimLabs, 2005c) shows the B747-400 and Advanced Concepts Flight Simulator (ACFS) hexapods in the Ames Crew-Vehicle Systems Research Facility (CVSRF). The photograph on the right shows the inside of the Ames Subsonic 12-Foot Pressure Wind Tunnel—a high–Reynolds number facility—near the turbine blades that drive the air through the tunnel.