TESTIMONY BEFORE THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY

SUBCOMMITTEE ON SPACE AND AERONAUTICS

NASA'S AERONAUTICS R&D PROGRAM: STATUS AND ISSUES

Carl J. Meade

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Mr. Chairman, members of the subcommittee, thank you for inviting me to testify today. My colleague, Dr Donald Richardson, and I are co-chairs of the National Research Council's Committee for the Assessment of NASA's Aeronautics Research Program. I appear here today in my capacity as co-chair of that committee. The views I share with you, are those of the committee, not those of my employer, Northrop Grumman Corporation.

The Subcommittee's April 17, 2008 letter to me requesting this testimony posed three questions that are addressed below.

1. What were the major findings and recommendations of your recently completed assessment of NASA's fundamental aeronautics research program?

Our committee assessed the entirety of NASA's Aeronautics Research Program and made several recommendations to NASA to improve its ability to (1) meet the high-priority technology challenges that are identified in the *Decadal Survey of Civil Aeronautics*, which was published by the National Research Council in 2006, (2) address NASA's internal requirements for aeronautics research (e.g., to support robotic and human space exploration), and (3) satisfy non-civil aeronautics research requirements that NASA is addressing in agreement with other federal agencies and departments. The committee also addressed workforce expertise and research facilities relevant to the goals of NASA's Aeronautics research program.

The committee determined that the strategic objectives of the *Decadal Survey* are consistent with the key principles of the *National Aeronautics Research and Development Policy* (NSTC, 2006) and the *National Plan for Aeronautics Research and Development and Related Infrastructure* (NSTC, 2007). Thus, the recommendations below will also help achieve the goals of the *National Policy* and *Plan.*

Attachment 1 contains the full committee report, *NASA Aeronautics Research—An Assessment* (NRC, 2008), available online at <www.nap.edu/catalog.php?record_id=12182>.

RESOURCES VERSUS SCOPE OF RESEARCH

NASA supports a great deal of worthwhile research. However, NASA must determine how to respond to a vast array of worthwhile research possibilities within the constraints of budget, facilities, workforce composition, and federal policies. The *Decadal Survey of Civil Aeronautics* (NRC, 2006), recommended that NASA use the 51 highest-priority Research and Technology (R&T) challenges in the *Decadal Survey* as the foundation for the future of NASA's civil aeronautics research program during the next decade. However, the *Decadal Survey* was designed to identify the highest-priority R&T challenges without considering the cost or

affordability of meeting the challenges.[1] As a result, even though the NASA aeronautics program has the technical ability to address each of the highest-priority R&T challenges from the *Decadal Survey* individually (through in-house research and/or partnerships with external research organizations), NASA's Aeronautics Research Mission Directorate (ARMD) would require a substantial budget increase to address all of the challenges in a thorough and comprehensive manner.

In addition to resource limitations, NASA's aeronautics research program faces many other constraints (in terms of the existing set of NASA centers, limitations on the ability to transfer staff positions among centers, and limitations on the ability to compete with the private sector in terms of financial compensation in some critical fields), and attempting to address too many research objectives will severely limit the ability to develop new core competencies and unique capabilities that may be vital to the future of U.S. aeronautics.

Recommendation. The NASA Aeronautics Research Mission Directorate should ensure that its research program substantively advances the state of the art and makes a significant difference in a time frame of interest to users of the research results by (1) making a concerted effort to identify the potential users of ongoing research and how that research relates to those needs and (2) prioritizing potential research opportunities according to an accepted set of metrics. In addition, absent a substantial increase in funding and/or a substantial reduction in other constraints that NASA faces in conducting aeronautics research (such as facilities, workforce composition, and federal policies), NASA, in consultation with the aeronautics research community and others as appropriate, should redefine the scope and priorities within the aeronautics research program to be consistent with available resources and the priorities identified in (2), above (even if all 51 highest-priority R&T challenges from the *Decadal Survey of Civil Aeronautics* are not addressed simultaneously). This would improve the value of the research that the aeronautics program is able to perform, and it would make resources available to facilitate the development of new core competencies and unique capabilities that may be essential to the nation and to the NASA aeronautics program of the future.

ASSESSMENT RESULTS--MEETING THE R&T CHALLENGES

The basic planning documents for most of NASA's research projects were prepared before the *Decadal Survey* was published in 2006, and the NASA research portfolio, as a whole, does not seem to have changed course in response to the *Decadal Survey*. Thus, the content of the *Decadal Survey of Civil Aeronautics* appears to not have been a significant factor in the selection of the research portfolio being pursued by many of the ARMD's research projects.

NASA is doing a mixed job in responding to the 51 highest-priority R&T challenges in the *Decadal Survey of Civil Aeronautics*. In a few cases, the shortcomings noted by the committee (both major and minor) indicate that NASA research plans are poorly conceived and the resulting research will likely be ineffective. In most cases, however, shortcomings reflect inconsistencies between NASA project plans and the *Decadal Survey*. These inconsistencies are generally the result of NASA choosing to do little or no work in a particular task area and/or selecting research goals that fall short of advancing the state of the art far enough and with

[1]Other decadal surveys that the NRC routinely produces for NASA in the space sciences consider budgetary factors in formulating their findings and recommendations, and it may be worthwhile to follow that model in future decadal surveys for aeronautics research.

enough urgency either to make a substantial difference in meeting individual R&T challenges or the larger goal of achieving the strategic objectives of the *Decadal Survey of Civil Aeronautics*. However, as noted above, NASA does not have the resources necessary to address all 51 R&T challenges simultaneously in a thorough and comprehensive manner, and so (regardless of how the projects plans were developed) it is inevitable that the plans, as a whole, do not fully address all the priorities of the *Decadal Survey*.

WORKFORCE

There are—among NASA, the academic community, and the civilian aerospace industry—enough skilled research personnel to adequately support the current aeronautics research programs at NASA and nationwide, at least for the next decade or so. NASA may experience some localized problems at some centers, but the requisite intellectual capacity exists at the various centers and/or in organizations outside NASA. Thus, NASA should be able to achieve its research goals, for example, by using NASA Research Announcements or other procurement mechanisms; through the use of higher, locally competitive salaries in selected disciplines at some centers; and/or by creating a virtual workforce that integrates staff from multiple centers with the skills necessary to address a particular research task. The content of the NASA aeronautics program, which has a large portfolio of tool development but little or no opportunities for flight tests, may in some cases hamper the ability to recruit new staff as compared with the space exploration program. In addition, there will likely be increased requirements for specialized or new skill sets. Workforce problems and inefficiencies can also arise from fluctuations in national aerospace engineering employment and from uneven funding in particular areas of endeavor.

Recommendation. To ensure that the NASA aeronautics program has and will continue to have an adequate supply of trained employees, the Aeronautics Research Mission Directorate should develop a vision describing the role of its research staff as well as a comprehensive, centralized strategic plan for workforce integration and implementation specific to ARMD. The plan should be based on an ARMD-wide survey of staffing *requirements* by skill level, coupled with an *availability* analysis of NASA civil servants available to support the NASA aeronautics program. The plan should identify specific gaps and the time frame in which they should be addressed. It should also define the role of NASA civil servant researchers vis-à-vis external researchers in terms of the following:

- Defining, achieving, and maintaining an appropriate balance between in-house research and external research (by academia and industry) in each project and task, recognizing that the appropriate balance will not be the same in all areas.
- Defining and addressing issues related to research involving multidisciplinary capabilities and system design (i.e., research at Levels 3 and 4, respectively, as defined by ARMD).
- Ensuring that research projects continue to make progress when NASA works with outside organizations to obtain some of the requisite expertise (when that expertise is not resident in NASA's civil servant workforce).

NASA should use the National Research Council report *Building a Better NASA Workforce* (NRC, 2007) as a starting point in developing a comprehensive ARMD workforce plan.

FACILITIES

NASA has a unique set of aeronautics research facilities that provide key support to NASA, other federal departments and agencies, and industry. With very few exceptions, these facilities meet the relevant needs of existing aeronautics research. NASA also has a dedicated effort for sustaining large, key facilities and for shutting down low-priority facilities. However, some small facilities (particularly in the supersonic regime) are just as important as some larger facilities and may warrant more support than they currently receive. In addition, at the current investment rate, widespread facility degradation will inevitably impact the ability of ARMD projects and other important national aeronautics research and development to achieve their goals.

Recommendation. Absent a substantial increase in facility maintenance and investment funds, NASA should reduce the impact of facility shortcomings by continuing to assess facilities and mothball or decommission facilities of lesser importance so that the most important facilities can be properly sustained.

2. Your report stresses the importance of ensuring that NASA's aeronautics research results are transferred to industry, the FAA, and other organizations that manufacture, own, and operate key elements of the air transportation system. What needs to be done to ensure that the transfer takes place in an efficient and effective manner?

USER CONNECTIONS

NASA civil aeronautics research will provide value to its stakeholders if and only if the results are ultimately transferred to industry, to the Federal Aviation Administration, and to the other organizations that manufacture, own, and operate key elements of the air transportation system. A closer connection between the managers of NASA aeronautics research projects and some potential users of NASA research would ensure that the need to transfer research results to users is properly considered in project planning and execution, and it would facilitate the formation of a coordinated set of research goals and milestones that are timed to meet the future needs of the nation. In addition, for technology intended to enhance the competitiveness of U.S. industry, U.S. leadership would be enhanced by a technology-transfer process that does not necessarily include the immediate, public dissemination of results to potential foreign competitors, so that the U.S. industrial base has a head start in absorbing the fruits of this research.

Recommendation. The NASA Aeronautics Research Mission Directorate should bridge the gap between research and application—and thereby increase the likelihood that this research will be of value to the intended users—as follows:

- Foster closer connections between NASA principal investigators and the potential external and internal users of their research, which include U.S. industry, the Federal Aviation Administration, the Department of Defense, academia, and the NASA space program.
- Improve research planning to ensure that the results are likely to be available in time to meet the future needs of the nation.

- Consistently articulate during the course of project planning and execution how research results are tied to capability improvements and how results will be transferred to users.
- For technology intended to enhance the competitiveness of U.S. industry, establish a more direct link between NASA and U.S. industry to provide for technology transfer in a way that does not necessarily include the immediate, public dissemination of results to potential foreign competitors.

As part of the effort to implement this recommendation, NASA should ensure that the Next Generation Air Transportation System (NGATS/NextGen) Air Traffic Management (ATM)-Airportal Project and the NGATS ATM-Airspace Project meet the research and development (R&D) needs defined by the NextGen Joint Planning and Development Office (JPDO) for NASA. [2]

3. Do you have any recommendations for the Committee to consider as we prepare to draft a NASA reauthorization bill?

NASA has a critical part to play in preserving the role of the United States as a leader in aeronautics. NASA research facilities and expertise support research by other federal agencies and industry, and the results of research conducted and/or sponsored by NASA are embodied in key elements of the air transportation system, military aviation, and the U.S. space program. NASA aeronautics research will carry on this tradition as long as its research is properly prioritized and research tasks are executed with enough depth and vigor to produce meaningful results in a timely fashion. Accordingly, the effectiveness of NASA's aeronautics research would be enhanced by Congressional direction to implement the high-priority research challenges in the *Decadal Survey of Civil Aeronautics*. Congress may also choose to relax the constraints that limit the ability of NASA to implement a more robust aeronautics research program. As noted above, constraints of particular interest include the budget, facilities, workforce composition, and related federal policies.

[2]The Next Generation Air Transportation System is now most commonly abbreviated as NextGen, but the titles of NASA's related research projects still feature the old acronym, NGATS.

Biographical Information
Carl J. Meade

Mr. Meade is currently the Director of Space Systems at Northrop Grumman Corporation's Integrated Systems sector in El Segundo, California. He and his team are responsible for the capture and execution of various government projects relating to crewed space flight and non-payload military space vehicles. He was previously employed at Lockheed Martin Aeronautics Company (aka "Skunk Works") in Palmdale, California where he was responsible for the development of a portfolio of advanced aerospace vehicles. He also held numerous positions on the X-33 program—first as Flight Assurance Manager, then as Operations Manager, and finally as the Program Director. Immediately prior to his arrival at Lockheed Martin, Carl was an Air Force officer on astronaut duty with NASA.

Carl began his aerospace career as a Hughes Fellow at the California Institute of Technology. After completing his graduate degree, Carl continued employment at Hughes Aircraft Company as an electronics design engineer. He was then called to active military duty and flew tactical fighter aircraft in the US Air Force. He was selected for test pilot training in 1980 and graduated first in his class at the USAF Test Pilot School at Edwards AFB.

While assigned to the Air Force Flight Test Center, Carl tested various fighter aircraft and instructed at the USAF Test Pilot School. Selected as an astronaut in June 1985, Carl was assigned to the NASA Johnson Space Center in Houston where he held a variety of technical and leadership assignments. He flew as an Astronaut on Space Shuttle missions STS-38, STS-50 and STS-64. During an untethered space walk on STS-64, he performed the first flight-test of a rescue jet-pack and was consequently awarded the Air Force Distinguished Flying Cross.

Carl has authored several publications and is a member of the *Society of Experimental Test Pilots* and the *Association of Space Explorers*. He has served as a member of the National Research Council's committee evaluating the National Aerospace Initiative and also on committee assessing NASA's Aeronautics Research Mission Directorate. He holds an undergraduate degree in Electrical Engineering from the University of Texas at Austin, and a graduate degree in the same field from the California Institute of Technology. During most weekends, you can find Carl teamed with his wife, Celyna, and sons David , Jacob and Michael in a futile attempt to convert their patch of Mojave Desert into a tropical oasis. Between tours of duty in the yard, Carl finds that the experimental aircraft currently under construction in his shop provides ample opportunity to consume all remaining free time.