

# THE CIVILIAN SCIENCE AND ENGINEERING WORKFORCE IN DEFENSE LABORATORIES

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## The Problem

The Department of Defense (DoD) relies upon the skilled scientists and engineers in its laboratories to develop advanced technologies. Sustaining the quality and availability of civilian scientists and engineers in today's global economy is a challenge for DoD.

DoD meets its needs for advanced military technologies through its access to skilled scientists and engineers (S&E). Many of these specialists are employed by DoD laboratories operated by the Army, Navy, and Air Force. The civilian S&Es employed by DoD labs, comprising a workforce of 35,400 workers (in 2008, a benchmark year in which data were available to the research team), play a critical role in national security by working at the forefront of science/engineering and technology breakthroughs. For example, Thomas Edison guided the first Naval Consulting Board, which pioneered the fields of high-frequency radio and underwater sound propagation. The history of modern computing can be traced to the need for increased speed and accuracy in firing projectiles, which led the Army's Ballistics Research Laboratory to support the development of ENIAC, the first operational, general-purpose computer. Also, DoD S&Es capabilities in the core disciplines of aeronautical science, vehicle control technologies, and structures for atmospheric and trans-atmospheric vehicles, have made the Air Force laboratories leaders in the development of military aerospace vehicles.

Over the past several decades, the number of civilian S&Es has declined, both in real numbers and relative to an increase in scientific and engineering contractors. Concerned by the implications of this changing workforce, IDA was asked to assess recent trends and the current status of the civilian S&E workforce. The overarching question is whether DoD will have access to the pool of talent needed to ensure that it will keep pace with technology developments across the globe.

The objective was to provide an assessment of the recent trends/current status of the S&E workforce as input for policy and funding decisions relative to S&E workforce development and to present suggestions regarding policies and practices that will ensure future workforce viability. The principal tasks were to:

- Determine the size and composition of current civilian S&E workforce in DoD science and technology (S&T) laboratories
- Identify recent trends in the S&E workforce and projected trends to 2020

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- Estimate the anticipated future composition of the U.S. and DoD S&E workforces
- Assess current DoD workforce programs, policies, and practices relative to future S&E needs.

A customized database developed by IDA, which contains workforce information provided by the Defense Manpower Data Center (DMDC), was created to conduct the workforce analysis. Trends in DoD lab civilian S&E workforce between 1988 and 2008 were analyzed in five-year increments. The IDA team augmented data analysis with selected DoD lab director interviews, in part to understand the role of “Lab Demo” in shaping DoD S&T workforce personnel policies.<sup>1</sup>

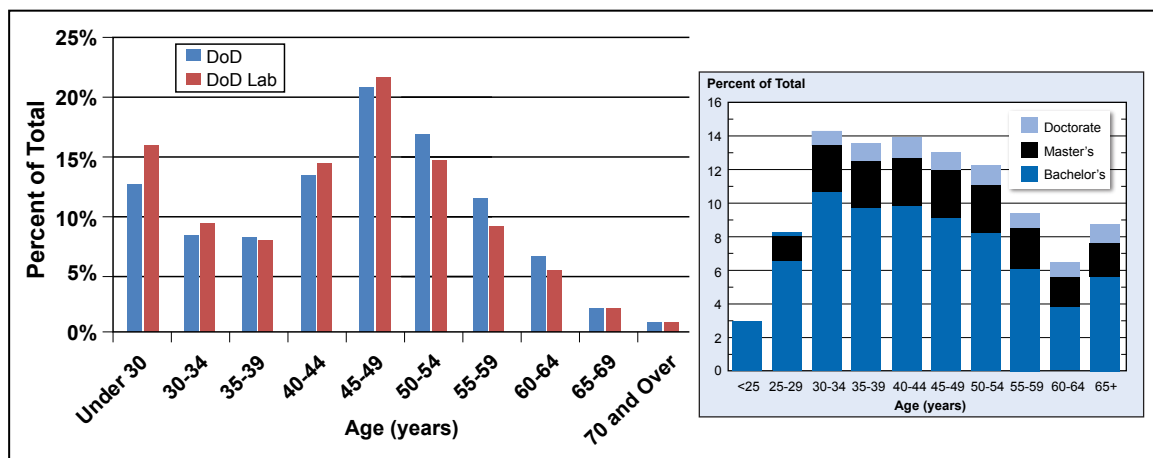
## Workforce Quality

In 2008, the civilian S&E workforce at DoD labs largely resembled the U.S. S&E workforce with some important differences. As shown in the workforce

profiles below, unlike the overall U.S. S&E workforce, the DoD lab S&E workforce age profile is not relatively flat, but instead shows a definite dip in the 35–45 age groups due to the hiring freeze in the 1990s and worker turnover. The DoD lab S&E workforce is also slightly older than the U.S. S&E workforce, but has a similar mix of workers when analyzed by race/ethnicity. However, the number of women S&Es employed by DoD labs has not kept pace with their growth in the U.S. S&E workforce as a whole. Little is known about the quality of the S&E workforce within DoD because pertinent data, such as educational disciplines, educational institutions, and employment history prior to DoD employment, are not recorded in the DMDC database.

## Recommendations

**Additional DMDC data fields.**  
Additional data to support DoD lab S&E workforce quality assessment



**Figure 1. DoD and DoD Lab Civilian S&E Workforce Age Profile in 2008 and U.S. S&E Workforce Profile**

<sup>1</sup> Congress has passed legislation that encouraged DoD to conduct civilian personnel demonstration projects (Lab Demos) in DoD’s science and technology reinvention laboratories (S&T reinvention labs) and for the civilian acquisition workforce DoD-wide. Initially authorized by the Civil Service Reform Act of 1978, personnel demonstration projects allow Federal agencies to waive parts of Title 5, United States Code, to test innovative human resources policies.

should be provided. To achieve this, database fields could be added to the DMDC records about the source of new recruits (e.g., academia, including school and major; industry; government). Information about education and training history is also needed with respect to the names of the educational institutions and types of formal post-degree training certificates that DoD lab civilian S&E staff may have received before joining the DoD workforce.

**Quality metrics.** DoD should compile and document quality of workforce metrics (such as number of patents, number of publications, number of requests for invited external presentations, number of citations) as a part of the annual data call for the DoD In-House S&T Activities Report.

**Lab director survey.** The DMDC database should be supplemented with a formal survey/data call of DoD lab directors to collect additional information on workforce quality.

## Workforce Projections

DoD can expect to find qualified engineers in the coming years because degree production in engineering at all levels has been increasing in the United States. However, the number of U.S. computer science baccalaureates continues to decline after its peak in 2003, and the number of mathematics and physical sciences baccalaureates remains low. Significant uncertainties exist relative to degree production and employment in the sciences and engineering at this time—owing in part to changing economic circumstances and student career preferences. This situation suggests

that DoD might experience problems when seeking qualified workers in those three scientific disciplines and should monitor trends through enhanced modeling work and scenario development.

## Recommendations

**Workforce modeling.** DoD should implement a formal workforce model to inform discussion and strengthen DoD strategic planning. The model should include a disaggregation of information at the occupational level to consider projection-based degree production and hiring and retention patterns for scientists vs. engineers and for individual disciplines.

**Workforce development strategy.** The adequacy of current DoD S&E workforce recruitment and retention strategies can only be understood using various scenarios. IDA developed three possible scenarios and found that each scenario generates a unique set of issues.

## Workforce Management

DoD can expect that a significant portion of more experienced workers (in their fifties) currently employed by DoD S&T labs will begin to retire in the next five years and will have left by 2020. The recent wave of new hires will most likely dominate the DoD civilian S&E workforce by 2020 as mid-career workers, if recent patterns of recruitment and retention continue over the next ten years. The Lab Demo directors reported to the IDA team that Lab Demo provides the kind of flexibility needed to implement personnel decisions responsive to current market conditions—locally and nationally.

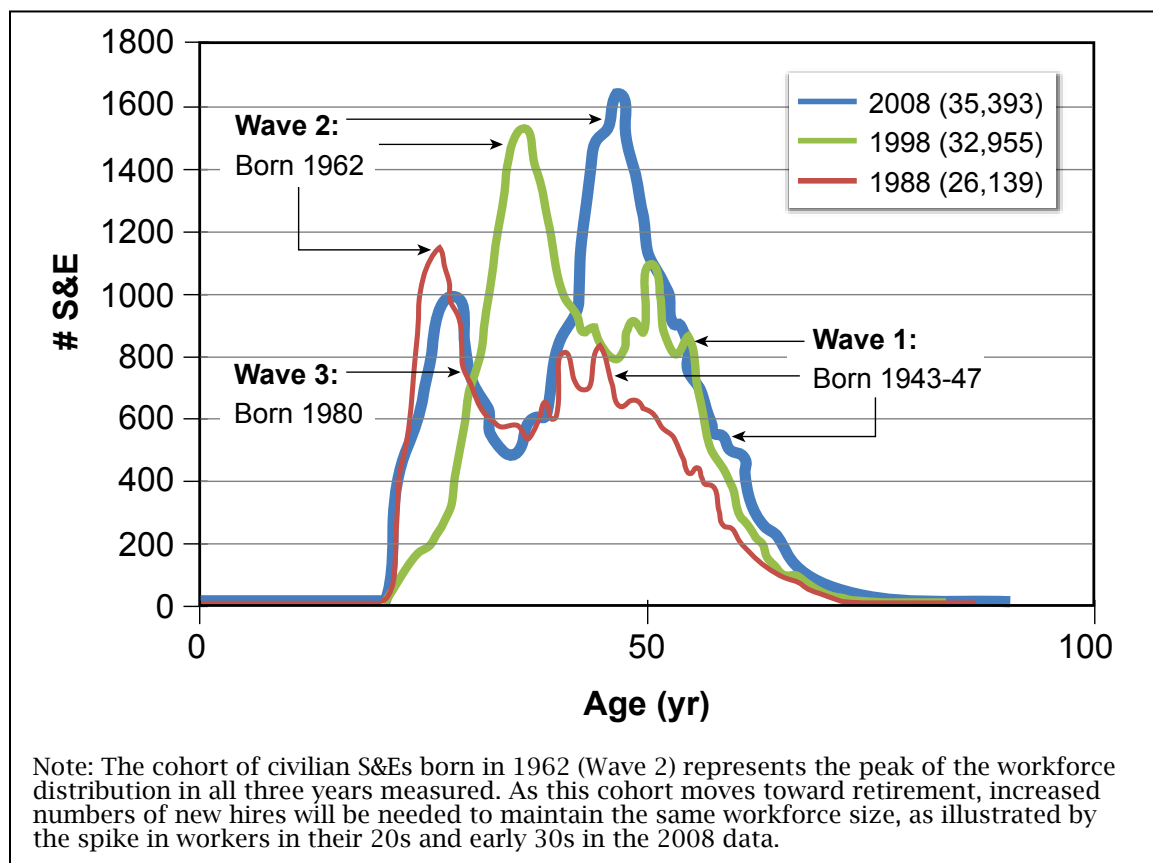
## Recommendation

**Integration of Lab Demo outcomes into ongoing redesign of DoD Personnel Management System.** The 2002 *DoD Science and Technology Reinvention Laboratory Demonstration Program Summative Evaluation* should be updated by validating Lab Demo observations. Best practices and identified needs of all DoD labs should be fed into current and subsequent work on the National Security Personnel System to enable resulting policy direction to develop a permanent personnel management system that works. Since there is urgency to deploy the personnel management authorities necessary to sustain a robust S&E workforce, an

interim solution for DoD labs should be implemented, if the current review of DoD's civilian personnel systems does not lead quickly to a broadly accepted conclusion.

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**Figure 2. Age Profile Trends of Civilian S&Es in DoD Labs in 1988, 1998, and 2008.**