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Sustaining the Ability to Design Nuclear Submarines

For the first time, the U.S. Navy faces a period that could last a number of years in which there will be no design program under way for a new class of nuclear-powered submarines. This gap in demand for the skills of submarine designers and engineers raises concerns that this highly specialized capability could atrophy, burdening the next submarine design effort with extra costs, delays, and risks. The Navy asked RAND to evaluate the cost and schedule impacts of various strategies for managing submarine design resources. Of concern were the design resources at Electric Boat and at Northrop Grumman Newport News (the two submarine design and production shipyards), the key vendors that provide components for submarines, and the various Navy organizations that participate in submarine design.

At the Shipyards

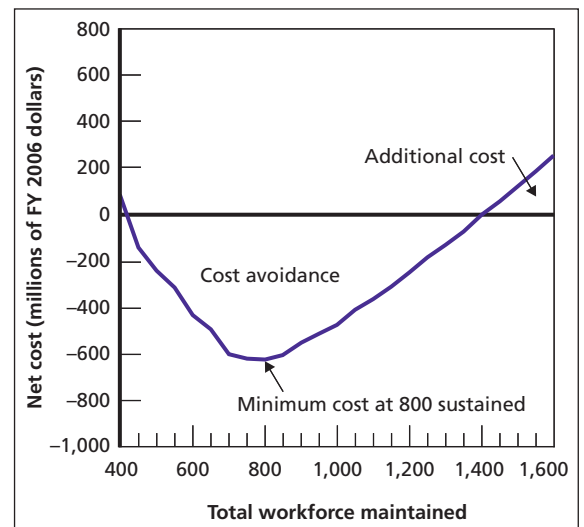
The RAND team evaluated two workforce management strategies: Sustain some number of workers in excess of those needed to meet the residual design demand during the current gap, or let the workforce erode and then rebuild it when required for the next class of submarines. The team found sustaining workers to be less expensive than letting the workforce erode. The optimum number of workers to sustain depends on various assumptions. As a baseline, the team assumed a design duration (15 years) and a workload reflecting recent experience, along with a start date for designing the next class (2014) that is consistent with Navy ship replacement plans. Under these assumptions, Electric Boat would accomplish the next design least expensively if, during the gap, it sustained a minimum of about 800 designers and engineers, and Northrop Grumman Newport News if it sustained about 1,050. These numbers, which include the workforce required to meet the residual demand, vary up or down by a few hundred if workload and start date are varied over reasonably likely ranges.

Abstract

For the first time, there is no nuclear submarine design program under way, which raises the possibility that design capability could be lost. This study recommends that the Navy consider:

- Stretching out the design of the next submarine class and starting it early, or, if that seems too risky,
- Sustaining design resources at the shipyards, their vendors, and in the Navy itself that exceed those supported by the demand, so that the next class may be designed on time, within budget, and without elevated risk.

Base Case: At Electric Boat, Net Cost, Relative to Taking No Action, Is Lowest if 800 Workers Are Sustained



The workload could also be stretched out. For example, a 15-year effort could be stretched to 20 years and, importantly, started early (in 2009), thus preempting much of the workforce drawdown. In that event, no extra workforce need be sustained to minimize cost, and the cost

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could be lower than that achievable with a 15-year design. There are some drawbacks to stretching out the design (e.g., a greater possibility of design obsolescence by the time the first of class is launched); these drawbacks must be considered in any decision regarding this option. However, the alternative—sustaining workers in excess of demand—also has an important drawback: the need to find the designers and engineers something to do that will allow them to maintain their skills. Several options are available; for instance, further evolving the design of the *Virginia* class (spiral development) or creating new designs that may not be built. Even in combination, however, these may not be sufficient for skill retention equivalent to that achievable by work on a new submarine class.

At the Vendors

The potential problems arising from a design gap extend beyond the shipyards. Numerous submarine components are provided by vendors that must design their products. The RAND team conducted a survey that asked firms about the various issues involved (e.g., demographics of the labor force, percentage of workload devoted to design, and competition in the market). The team found that, while in any one dimension most firms appeared unlikely to encounter problems in contributing to submarine design after a gap, some appeared to be potentially at risk in more than one respect.

At Navy Organizations

The Navy's roles in submarine design include ensuring that various aspects of design meet safety and performance standards and designing certain components. The team reviewed workforce structure and trends in pertinent Navy organizations in light of their roles and came to the following conclusion: Sufficient design expertise was unlikely to be available to support hull, mechanical, and electrical submarine design

functions at the Naval Surface Warfare Center's Carderock Division without sustaining designers and engineers beyond those required for residual work. The latter would require between \$30 million and 35 million per year during the design gap. Both for the Navy and for some vendors, avoiding the greater part of the design gap (e.g., by stretching out the design of the next class and starting it early) would obviate the need for concern over skill loss.

Recommendations

From the preceding analysis, the team reached the following recommendation:

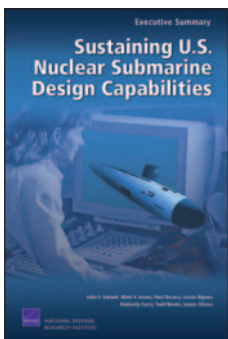
- Seriously consider starting the design of the next submarine class by 2009, to run 20 years.

If that alternative survives further evaluation, the issue of a gap in submarine design is resolved. If that alternative is judged too risky, the team recommends the following:

- Thoroughly evaluate the degree to which such options as spiral development of the *Virginia* class will be able to substitute for new submarine design in allowing design professionals to retain their skills.

If options to sustain design personnel in excess of demand are judged to offer clear advantages over letting the workforce erode, the following actions should be taken:

- Request sufficient funding to sustain shipyard design workforces large enough to permit substantial savings in time and money later.
- Conduct a comprehensive analysis of vendors at high risk to determine the interventions required to preserve critical skills.
- Invest \$30 million to 35 million annually in the Carderock submarine design workforce in excess of reimbursable demand to sustain skills at risk of loss. ■



This research brief describes work done for the RAND National Defense Research Institute documented in *Sustaining U.S. Nuclear Submarine Design Capabilities*, by John F. Schank, Mark V. Arena, Paul DeLuca, Jessie Riposo, Kimberly Curry, Todd Weeks, and James Chiesa, MG-608-NAVY (available at <http://www.rand.org/pubs/monographs/MG608/>), 2007, 234 pp., \$40.00, ISBN: 978-0-8330-4160-9; and *Sustaining U.S. Nuclear Submarine Design Capabilities, Executive Summary*, MG-608/1-NAVY (available at <http://www.rand.org/pubs/monographs/MG608.1/>) 2007, 48 pp., \$20.00, ISBN: 978-0-8330-4161-6. 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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