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U.S. Navy Shipyards

An Evaluation of Workload- and Workforce-Management Practices

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Summary

The nearly 300 ships of the U.S. Navy are among the most complex weapon systems operated by the Department of Defense (DoD). The most demanding maintenance performed on these ships is depot-level maintenance, which is performed at shipyards that specialize in the complex repair and upgrade of ship systems, equipment, and infrastructure.

Depot-level maintenance work of Navy ships is split between public and private shipyards. The Navy spends about \$4 billion annually on depot maintenance for its ships. This includes about \$3 billion for work performed at four public shipyards: Norfolk and Portsmouth on the Atlantic, and Puget Sound and Pearl Harbor on the Pacific. These public shipyards employ over 25,000 civilians and will accomplish about 4 million man-days of work in 2008. They are the focus of this book.

Several laws and public policies constrain how the Navy can accomplish depot-level maintenance. Some of these laws and policies dictate that at least half of all Navy maintenance work be performed at a public depot (this is known as the *50/50 rule*), that the shipyards maintain some core maintenance capabilities for all of the existing ship weapon systems, and that depot maintenance be performed in a ship's homeport when possible.

The size of this business, the complexities of managing it, and the need to accomplish work as efficiently as possible led the Commander, NAVSEA, to research the most cost-effective strategy for matching workforce supply and demand, alternative workload allocations that

could improve cost-effectiveness, and what the Navy can learn from other organizations with similar workload and workforce-management challenges.

Matching Shipyard Work Supply and Demand

By some measures, the Navy does a reasonable job of matching workforce supply to workload demand. We compared the Navy's workforce plan to an optimized plan for meeting forecast workload demand and found virtually no difference between the two. In other words, the Navy's workforce staffing plan is a cost-effective strategy for meeting planned workload.

Nevertheless, the Navy's recent *planned* workload demands have not accurately predicted *actual* workload demands. Rather, workload forecasts have consistently underestimated actual demands, particularly in longer-term forecasts that are necessary for developing some of the skills required in shipyard maintenance. Understanding the causes of this underestimation is an important area of future research. Although the causes of this underestimation may not be well understood, the shipyards can and do use a variety of means to compensate for underestimated demand. These are

- **Overtime.** A modest level of overtime can in some cases help shipyard productivity. It can also allow the shipyards to meet schedule objectives. In recent years, however, public shipyards have been using overtime to an extent that diminishes productivity.
- **Temporary labor.** Temporary labor can theoretically help ease peak demands, but it requires the availability of a temporary and otherwise idle labor force. The availability of such a force varies from shipyard to shipyard. On average, temporary labor is not quite as productive as permanent labor.
- **Seasonal labor.** Seasonal labor can be put on a no-pay status for up to six months per year. These workers can then be hired back into the shipyard when work arrives. This allows shipyard managers to increase and decrease the workforce to meet fluctuations

in workload. However, rehiring seasonal employees is contingent upon their availability. On average, the cost of seasonal labor is the same as permanent labor, but productivity is slightly reduced.

- **Labor borrowed from other shipyards.** Shipyards can and do borrow from and loan labor to each other. Such labor, however, is not quite as productive in other shipyards as it is at home. Even if it were, traveling expenses place a high cost premium on its use.

None of the alternatives the Navy might consider to ease workload demands that consistently exceed planned demands is as productive as resident, permanent labor working standard hours (known as *straight time*). An increase in the resident, permanent labor force could help the Navy be more productive and hedge against the costs of workload growth. Table S.1 shows the costs associated with different workforce and workload scenarios. Under current plans (shown in the first row of the table), the Navy will have an average annual available force of 13,800 workers per day and an average demand for 15,485 man-days per day between 2007 and 2013. The shortfall would be met by overtime that averages 13 percent of straight time but peaks at 19 percent. This scenario would cost the Navy \$2.8 billion per year.

The second row of the table shows the overtime and cost implications of a workforce that is not increased to manage a workload that exceeds the estimate by 6 percent. (Note that this 6-percent growth rate is higher than the rate seen in recent years.) In this case, the Navy

Table S.1
Costs of Executing Planned and Increased Workloads

Workforce Increase Above Plan?	Workload Increase Above Plan?	Average Available Force (men per day)	Average Workload (man-days)	Average Overtime	Peak Overtime	Average Annual Cost (FY 2007 \$ billions)
No	No	13,800	15,485	13%	19%	\$2.8
No	Yes	13,800	16,433	20%	28%	\$3.2
Yes	Yes	14,500	16,433	11%	18%	\$3.0
Yes	No	14,500	15,485	9%	17%	\$2.8

has 13,800 workers to accomplish 16,433 man-days of work. Here, the Navy would use overtime that averages 20 percent of straight time and peaks at 28 percent. This second scenario would have an average annual cost of \$3.2 billion.

The third and fourth rows show how increasing the available workforce would hedge against the costs associated with no increase in the workforce. The third row shows increases in both the workforce and the workload. Should the Navy increase its workforce by 5 percent (to 14,500 workers), then workload growth would cost only \$3.0 billion. This is because overtime would average only 11 percent and peak at no more than 18 percent. In this case, the additional 700 permanent workers reduce the average annual overtime from 20 percent to 11 percent.

Perhaps most importantly, insurance against workload growth would cost the Navy virtually nothing. As the fourth row of the table shows, should the shipyard workforce grow above current forecasts but workload demand not materialize, executing the workload with higher workforce levels would still cost the Navy only \$2.8 billion. This is because with more workers, the shipyards could use less overtime to accomplish their current workload.

These results, of course, depend on several assumptions about workload growth, use of overtime, and the productivity of different types of labor. For the highest percentage workload growth evaluated, 16 percent, the cost penalty for not increasing the workforce could be up to \$1.5 billion annually. In this case, the cost of increasing the workforce if there is no work growth, \$200 million per year, is significantly less than the cost of not increasing the workforce if there is work growth. For the highest percentage workload growth evaluated, should the workload growth be minimal, increasing the workforce to meet the highest expected workload growth will result in cost savings of approximately \$100 million per year. Variations in overtime and productivity assumptions do not change these general findings.

Alternative Workload Allocations

Our analyses of how to accomplish shipyard workload most cost-effectively assume a static workload demand (i.e., workload that is fixed based on a certain plan). Theoretically, the Navy could choose to allocate workload differently than it currently does between public and private shipyards or among the four public shipyards.

Shifting workload from the public sector to the private sector may not be realistic for two reasons. First, such a shift may violate federal law requiring that no more than 50 percent of depot maintenance work be performed by the private sector. Second, most of the public shipyard work involves nuclear vessels; qualifying a third private shipyard (beyond the two currently doing such work) to work on such systems would be expensive and politically challenging.

Shifting nonnuclear surface-ship work from the private sector to the public sector would not result in cost savings for the Navy if “green” (i.e., unskilled) labor would have to be hired to accomplish this additional work. If there was readily available skilled labor to perform the work, however, the minimum cost savings estimated could be offset by costs that we were unable to quantify. Potential costs, such as those associated with increases to indirect expenses at private shipyards, contract modifications and associated penalties or fees, reduction in the competition that is assumed to reduce costs and improve quality, productivity adjustments between public- and private-sector shipyards, and investments needed to accomplish surface-combatant work in the public shipyards, could not be estimated but could result in increased cost.

Shifting work among the public shipyards might realize some efficiencies, but a full evaluation of this option would require data that are not currently available. Such a shift would also have to consider the capabilities of each shipyard, how well shifts could accommodate certain policies (such as homeport rules), and, of course, the cost-effectiveness of changes.

Workload-Management Practices in Other Organizations

To identify practices used elsewhere that may be adapted to the public shipyards, we identified four organizations whose workforce-management issues are similar to those of the public shipyards. These organizations are the UK dockyards that support the Royal Navy, European commercial shipbuilders, U.S. Air Force and U.S. Army depots, and the space-shuttle program of the National Aeronautics and Space Administration (NASA). None encounters both the complexity and breadth of work that the U.S. Navy faces in shipyard maintenance, but some individual characteristics of their work approximate those of the Navy.

Common practices that these organizations use to manage workload, some of which are already used by the Navy to some extent and others which would be more difficult to adapt, include

- **Identifying core capabilities and competencies and subcontracting out the others.** Some public shipyards use contractors extensively, but others do not have such local support readily available. Any U.S. Navy subcontracting efforts must stay within core-capability and 50/50 rules.
- **Avoiding excess overtime.** As noted above, the U.S. Navy already relies on what might be considered excessive overtime, and should consider hiring more shipyard workers to boost productivity and reduce costs.
- **Using temporary labor to meet infrequent demands.** As noted above, some U.S. Navy shipyards may not have a sufficient local pool from which to draw such labor.
- **Promoting a multiskilled workforce.** Adopting such a practice would require union approval and could be limited by the need for some workers to develop highly specialized skills in some areas.
- **Smoothing workload demands.** The U.S. Navy's initiatives in this area include a Fleet Availability Scheduling Team charged with keeping shipyard work more level over time and across shipyards.

- **Accepting other work.** The U.S. Navy shipyards have undertaken some outside work, such as work on U.S. Army vehicles.
- **Tracking performance.** Many methods to track performance were pioneered in U.S. Navy shipyards.

Altogether, the U.S. Navy appears to have implemented many of the above strategies when it was relatively easy to do so. Other strategies, such as reducing overtime or using more contracted labor, would take more work to implement.

Conclusions and Recommendations

Our analysis shows that the Navy workforce plan will efficiently execute the Navy's planned workload. We discovered that the Navy uses practices common in other organizations to manage workload variability and uncertainty. Further measures, such as greater levels of subcontracting, could require significant effort to implement.

Nevertheless, given what may be an underestimated future workload, additional measures to decrease overtime levels and hedge against workload growth are worth considering. We found that increasing the number of permanent journeyman by hiring apprentices is a cost-effective strategy. At the least, such measures are necessary to curtail the currently high levels of overtime that the shipyards use to accomplish additional unplanned work. Using more workers and less overtime would cost about the same amount that the Navy currently spends to execute its workload and would provide a hedge against the costs associated with workload inflation or surge requirements.

Beyond increasing the permanent journeyman staff of the shipyards, the Navy could shift more work to the private sector through subcontracts. Although the costs of such a strategy were not evaluated during our study, we did discover that other organizations extensively employ subcontractors to avoid excessive overtime. Such measures may require Congressional action and hence might not be considered feasible in the immediate future.