United States General Accounting Office

GAO

Report to the Acting Secretary of the Navy

July 1993

NAVY MAINTENANCE

Improved Labor Estimates Can Reduce Shipyard Costs

GAO/NSIAD-93-199

GAO

United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-253340

July 22, 1993

Admiral Frank B. Kelso II
Acting Secretary of the Navy

Dear Admiral Kelso:

This report addresses the Navy's methods for managing and controlling labor costs at naval shipyards. We found that labor estimates for ship repairs frequently were overstated, resulting in increased repair prices and inaccurate labor efficiency data.

The report contains recommendations to you. As you know, 31 U.S.C. 720 requires the head of a federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs no later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Chairmen and Ranking Minority Members, House and Senate Committees on Appropriations and on Armed Services; the Chairmen, Senate Committee on Governmental Affairs and House Committee on Government Operations; the Director, Office of Management and Budget; and the Secretary of Defense.

Please contact me on (202) 512-5140 if you have any questions. The major contributors to this report are listed in appendix II.

Sincerely yours,

Mark E. Gebicke

Mark E. Gebicke
Director,
Military Operations and Capabilities Issues

Executive Summary

Purpose

The Navy's public shipyards support peacetime fleet maintenance needs and provide a base for responding to wartime requirements. Although the eventual size of the public shipyard industrial base is uncertain because of fleet downsizing, each shipyard should operate as efficiently as possible. Because labor cost control is fundamental to efficient operations, GAO evaluated the Navy's methods for managing and controlling shipyard labor costs.

Background

The Navy's eight public shipyards employed about 59,000 civilians and incurred costs of about $4.1 billion in fiscal year 1992. About $1.7 billion, or 41 percent of these costs, paid for direct labor—employee labor hours used to complete specific ship repairs.

To help control direct labor costs, shipyard planners estimate the number of labor hours scheduled ship repairs should require. Labor efficiency is measured by comparing the labor estimates to the actual labor hours used by production personnel to complete the repairs. Managers can use this information to help keep projects on budget and to identify problem areas requiring attention.

Labor estimates also are one of the key factors used to determine the prices charged to shipyard customers for ship repairs. Customer prices are based on estimated, rather than actual, costs because Department of Defense policy requires industrial fund activities to establish prices prior to the start of each fiscal year. The intent of this policy is to protect customers from unforeseen inflationary increases and other cost uncertainties and to ensure that customers will not have to reduce their programs to pay for higher-than-expected prices. As Defense Business Operations Fund activities, shipyards use a businesslike buyer-seller approach to contract with their customers, normally other Navy commands, for work to be performed. Shipyard customers use annual appropriations to pay for the goods and services the shipyards provide.

Results in Brief

Navy reviews conducted between 1989 and 1991, and subsequent GAO tests, found that labor estimates for ship repairs frequently were overstated. In addition to increasing repair prices, overstated labor estimates caused erroneous labor efficiency data to be reported. Without accurate labor efficiency data, managers lost the ability to measure labor performance and identify areas needing attention. The problem occurred because shipyard planners did not always follow estimating policies,

internal controls were not in place to ensure compliance with policies, and labor standards were not always current to help planners prepare accurate estimates.

The shipyards also devoted considerable effort to implementing labor-saving improvements, such as more efficient production methods and equipment. However, the benefits from these improvements were not always incorporated into labor estimates for repairs because planners were not told of new processes and equipment. As a result, labor savings resulting from improvements often were not reflected in reduced benchmarks for efficiency measurement or in lower repair prices.

Principal Findings

Navy Reviews Found Overstated Labor Estimates

The Navy began a program in the late 1980s to review the accuracy and credibility of labor estimates for selected ship repairs. The program focused on labor estimates as a means of achieving savings because labor estimates were used to help control labor costs and establish customer repair prices.

Navy reviews of six ships showed that shipyard planners frequently overestimated the labor hours planned repairs should take. The excess labor in the estimates ranged from 3 percent to 23 percent and averaged 11 percent for the six ships. The estimated savings from eliminating the excess labor ranged from about $2 million to $15 million a ship and totaled over $40 million for the six ships.

To illustrate, a review team at one shipyard found that a planner's estimate on a missile system for the USS South Carolina was overstated by 3,179 labor hours. At another shipyard, a review team found the planner had estimated 1,864 more labor hours than necessary to install temporary piping systems on the USS California. Eliminating the excess labor from these estimates reduced the repair prices for the work by $132,000 and $83,000, respectively.

Excessive Labor Estimates Continue to Be a Problem

GAO reviewed the accuracy and credibility of labor estimates on 31 repair jobs at 3 shipyards. For the 27 estimates with sufficient data for an independent assessment, GAO found that the estimates were accurate in

6 cases and excessive in 21 cases. For example, a planner at one shipyard estimated 62 percent more labor hours than the labor standard allowed for preparing wood blocks used in dry docking. At another shipyard, a planner estimated 29 percent more labor hours than allowed by the applicable standard to repair a wind speed and direction indicator. In both cases, contrary to estimating policy, the planners had allowed more time than the standards allowed based on individual judgment.

In addition to increasing repair prices, excessive labor estimates hinder efficiency measurement and staffing forecasts. When labor estimates for performing repairs are excessive, labor efficiency measures become inaccurate and unreliable, making efficiency analyses and comparisons meaningless. Further, because shipyard staffing forecasts are largely based on labor estimates for future work, excessive estimates can result in overstated staffing forecasts.

Primary causes for excessive labor estimates included (1) planners did not always comply with Navy policies for preparing accurate and credible labor estimates; (2) shipyards did not have adequate internal controls, such as independent audits, to ensure compliance with these policies; and (3) shipyards did not maintain up-to-date labor standards to assist planners in labor estimating. Recent Navy initiatives to improve ship repair management, such as a new training program for shipyard planners, address some of these areas. However, these initiatives have not been fully implemented and additional steps are needed to ensure accurate and credible labor estimates at all shipyards.

Many Labor Estimates Do Not Reflect Benefits From Improvements

The shipyards have devoted considerable effort to identifying and implementing labor-saving improvements as a means of increasing efficiency. In addition to using industrial engineers to develop improved production methods and processes, shipyards have attempted to reduce costs through investment of $622 million in modern plant equipment between fiscal years 1988 and 1992.

However, the benefits from such improvements were not always incorporated into labor estimates for ship repairs. Because labor standards were not updated to reflect changes and there was no other formal method to inform planners of new processes and equipment, planners often continued to base labor estimates on processes and equipment no longer used. Thus, labor savings resulting from improvements often were not reflected in reduced benchmarks for

efficiency measurement or in lower repair prices. For example, a planner at one shipyard was not aware of an improvement that automated a dry dock monitoring system that saved 1,666 labor hours. The planner's labor estimate for the work was based on the old process and the repair price for the work was overstated by $79,000.

Recommendations

GAO recommends that the Secretary of the Navy direct the Commander, Naval Sea Systems Command, to

- establish milestones for implementing the new training program to ensure that all planners are well-trained in estimating policies and procedures;
- ensure that each shipyard conducts periodic, independent audits of labor estimates to assess accuracy and compliance with estimating policies;
- establish a labor standards improvement initiative to ensure that frequently performed repair tasks are covered by current, independently developed labor standards; and
- establish a procedure ensuring that shipyard planners are informed of all new production processes, methods, and equipment that improve worker efficiency.

Agency Comments

The Department of Defense agreed with GAO's findings and recommendations and stated that the Navy was implementing several corrective actions to improve the accuracy and reliability of labor estimates. (See app.I.) These actions include (1) implementing the new planner training program at all shipyards, (2) requiring that labor estimates be independently audited for accuracy and adherence to standards, (3) ensuring that key labor standards are kept current, and (4) communicating labor-saving improvements to planners. These corrective actions are targeted for implementation by January 1994.

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Abbreviations

DOD	Department of Defense
GAO	General Accounting Office
NAVSEA	Naval Sea Systems Command

Introduction

The Navy's eight public shipyards provide depot-level logistics support to the fleet, including the repair, overhaul, and modernization of Navy ships. Operating under the Naval Sea Systems Command (NAVSEA), these large industrial activities are chartered to produce quality products in a timely and cost-effective manner. In fiscal year 1992, the shipyards employed about 59,000 civilians and incurred costs of about $4.1 billion.

Throughout its history, the Navy has operated public shipyards to help support peacetime maintenance needs and to respond to wartime requirements. Because of fleet downsizing and a shift to less maintenance intensive ship designs, ship repair requirements are projected to decline significantly over the next several years. As a result, the Navy has scheduled one shipyard to close in fiscal year 1996 and two additional shipyards have been recommended for closure as part of the 1993 base closure and realignment process.

Shipyard Financial Operations

Naval shipyards are industrial fund activities included in the Defense Business Operations Fund. As such, shipyards use a businesslike buyer-seller approach to contract with their customers, normally NAVSEA or fleet commands, for work to be performed. Shipyards use working capital funds to finance the cost of goods and services, and customers use annual appropriations to reimburse the shipyards for work completed.

When a customer requests work from a shipyard, the shipyard helps define the work required and provides the customer an estimated price for the work. Because each shipyard's financial goal is to break even, prices are established to cover all costs without incurring a profit or loss. In general, prices are based on the sum of (1) a shipyard's estimated labor days required to accomplish the work multiplied by the shipyard's established daily labor charge and (2) a shipyard's estimated material cost to accomplish the work.

Customer prices are based on estimated, rather than actual, costs because Department of Defense (DOD) policy requires industrial fund activities to establish prices prior to the start of each fiscal year. The intent of this policy is to protect customers from unforeseen inflationary increases and other cost uncertainties and to ensure that customers will not have to reduce their programs to pay for higher-than-expected prices.

For several reasons, the actual cost of work completed by a shipyard may differ from the price paid by the customer, thus, creating a profit or loss.

For example, if the shipyard's labor estimate for a repair is greater than the labor actually required, the customer pays more for the repair than necessary. Shipyard profits and losses are combined with profits and losses from other Defense Business Operations Fund activities. Ultimately, profits can be returned to customers through direct refunds or reduced daily labor charges, and losses can be recouped through direct appropriations from the Congress or higher daily labor charges to customers. In fiscal year 1992, the shipyards' total costs exceeded total revenues, resulting in an operating loss of $218 million.

Increased Shipyard Efficiency Is the Key to Labor Savings

Regardless of the eventual size of the public shipyard industrial base, each shipyard should strive to be as efficient as possible. A February 1992 DOD report on industrial facilities stated that naval shipyard efficiency is one of the most critical factors in determining ship maintenance budgets. The report also stated that the controlling factor with respect to increasing efficiency and reducing costs is the extent to which labor can be made more productive.

Labor costs comprise a major portion of the shipyards' total costs. In fiscal year 1992, the total operating costs of $4.1 billion included $2.7 billion in direct and overhead labor costs. Direct labor costs (the costs of employee labor hours used to complete specific ship repairs) were $1.7 billion, or about 41 percent of the total operating costs.

To help control direct labor costs, shipyard planners estimate the number of labor hours each scheduled ship repair should take. Labor efficiency is then measured by comparing each repair estimate to the actual labor hours used by production personnel to complete each repair. Managers can use this information to help keep projects on budget and to identify problem areas requiring attention. Labor estimates are also used as the basis for determining repair prices and forecasting future staffing requirements.

Because of these uses of labor estimates, it is imperative that the estimates be as accurate as possible. Accurate labor estimates enable the shipyards to better manage labor resources and obtain labor efficiency improvements to accomplish the same work at less cost. When this goal is achieved, the total funds required to perform the work declines and real savings result.

To illustrate, if a shipyard were to reduce its labor estimates because of a new, less labor-intensive technique without reducing its actual costs to complete the work, then (1) the shipyard's actual costs would remain the same, (2) customer prices would go down, (3) shipyard revenue would go down and the shipyard would incur a greater financial loss (assuming the shipyard was operating at a loss), and (4) total appropriated funds would remain the same with the customer requiring less funds but the shipyard requiring more to cover its increased financial loss. The shipyard would obtain the extra funds either directly from the Congress or by increasing its daily labor charges to customers in future years.

On the other hand, if shipyard management were to use lower labor estimates as a tool to get the production shops to complete the work with fewer labor hours, then repair prices and shipyard labor costs would decrease and there would be a reduction in the appropriated funds used to complete the work. Specifically, if a shipyard were to reduce its labor estimates and its actual costs, then (1) the shipyard's actual costs would decrease; (2) customer prices would go down; (3) shipyard revenue would go down, but the shipyard's financial loss would be the same because costs also would have decreased; and (4) total appropriated funds would decrease with the customer requiring less funds and the shipyard requiring the same funds.

Objectives, Scope, and Methodology

Because control of labor costs is fundamental to efficient operations, we evaluated the Navy's methods for managing and controlling direct labor costs in the naval shipyards. Specifically, our objectives were to determine whether (1) labor estimates for ship repairs were reliable and served as an effective tool to help managers control labor costs and (2) the benefits from labor-saving process improvements and new equipment were reflected in labor estimates.

We interviewed DOD and Navy officials and examined documents and pertinent data at the DOD Productivity Program Office, Washington, D.C.; NAVSEA, Washington, D.C.; and the Commander-In- Chief, Atlantic Fleet Headquarters, Norfolk, Virginia.

We also performed detailed audit work at the Norfolk Naval Shipyard, Portsmouth, Virginia; the Puget Sound Naval Shipyard, Bremerton, Washington; and the Charleston Naval Shipyard, Charleston, South Carolina. The Norfolk and Puget Sound shipyards were selected because they were the largest naval shipyards on each coast. The Charleston

shipyard was selected because it was the test site for several NAVSEA initiatives designed to improve ship repair management.

To determine whether shipyard labor estimates were reliable and served as an effective tool to help managers control labor costs, we reviewed, analyzed, and followed up on Navy studies conducted between 1989 and 1991 regarding shipyard labor estimates on selected ship overhauls. We also conducted tests at the three shipyards to assess the validity of labor estimates and extent of planner adherence to estimating policies and procedures. These tests included a detailed analysis of the labor estimates for 31 repair jobs. The jobs were from 11 ships repaired during 1992 or 1993 at the shipyards visited. For each of these judgmentally selected jobs, we interviewed the responsible planner and reviewed supporting documentation to assess the credibility of the estimate. In addition, we examined NAVSEA initiatives designed to improve planner training and ship repair management.

To determine whether the benefits from labor-saving process improvements and new equipment were reflected in reduced labor estimates and repair prices, we analyzed shipyard resources expended on process improvements and new equipment, reviewed selected labor standards to determine whether they were updated to reflect changes caused by new processes or equipment, and interviewed planners and key managers at each shipyard visited to determine how planners became aware of improvements affecting labor efficiency.

We performed our review between August 1992 and May 1993 in accordance with generally accepted government auditing standards.

Excessive Labor Estimates Have Increased Ship Repair Costs

Although Navy policy emphasizes the importance of accurate, well-supported labor estimates for ship repairs, recent Navy reviews found that shipyard planners had estimated more labor time than justified to accomplish repairs on several ship overhauls. The reviews found that labor estimates were overstated from 3 to 23 percent and resulted in repair prices being overstated from $2 million to $15 million on each ship. Some actions were taken to correct the problems identified by these reviews, but our subsequent tests indicated that shipyard planners continue to overestimate labor requirements.

In addition to increasing repair prices, inaccurate labor estimates cause erroneous labor efficiency data to be reported in the shipyards' management information system. This, in turn, hinders management's ability to measure labor performance and take timely corrective action when needed. Further, because labor estimates are used to help forecast shipyard staffing requirements, inaccurate labor estimates may result in work load and work force imbalances and additional labor inefficiencies.

The excessive labor estimates provided by shipyard planners were caused by inconsistent application of estimating policies and procedures, an absence of internal controls to ensure estimates were properly developed and well-supported, and a failure to keep labor standards current. Although the Navy is addressing some of these problems through new initiatives, the initiatives have not been fully implemented. In addition, further steps are needed to ensure the accuracy and credibility of labor estimates at all shipyards.

Navy Reviews Found Overstated Labor Estimates

The Navy began a program to review shipyard labor estimates in the late 1980s as part of the Navy Industrial Improvement Program. The objective of the estimate review program was to reduce direct labor costs for ship repairs without delaying schedules or reducing the quality or quantity of work completed. The program evaluated the accuracy and credibility of labor estimates for selected ship repairs because these estimates were used to help control labor costs and establish repair prices.

The Navy hired a contractor to assist shipyard teams in reviewing selected labor estimates for planned repairs on ships scheduled for shipyard maintenance. In general, only nonnuclear, high-cost repair jobs were reviewed and each review was completed before the shipyard started work.

The teams assessed the accuracy and credibility of labor estimates by determining whether shipyard planners followed Navy estimating guidelines. For example, the teams determined whether planners (1) accurately defined and quantified the work requested by the customers and (2) properly used applicable labor standards in developing the estimates. Navy guidelines instruct planners to use labor standards—benchmarks for how long repair tasks should take—as the basis for labor estimates whenever possible. The teams also analyzed some repair jobs to determine whether there were more efficient ways to accomplish the planned repairs.

Discrepancies discovered by the teams were discussed with the planners. If a planner had valid reasons to support the original estimate, no changes were made. On the other hand, if a planner agreed with the discrepancies or could not support the original estimate, the planner generally reduced the estimate.

Results From Labor Estimate Reviews

Between 1989 and 1991, eight ships from five different shipyards were selected for review. Because the Navy did not retain detailed documentation for two of these reviews, we could only analyze the results from six reviews. Each review found that shipyard planners had overestimated the amount of labor needed to accomplish planned repairs. As shown in table 2.1, the excess labor ranged from 3 percent to 23 percent and averaged 11 percent, and the estimated savings from eliminating the excess labor ranged from about $2 million to $15 million and totaled over $40 million.

Table 2.1: Results From Navy Labor Estimate Reviews

Dollars in millions

Shipyard/ship	Repair jobs reviewed	Original labor days estimated	Excess labor in estimate		Estimated savings
			Days	Percent	
Mare Island USS **La Jolla**	37	76,206	8,500	11	$3.2
Puget Sound USS **Carl Vinson**	86	367,000	11,036	3	3.9
Puget Sound USS **California**	101	167,510	23,795	14	8.5[a]
Norfolk USS **Baltimore**	25	57,862	4,408	8	1.6
Norfolk USS **South Carolina**	69	175,500	40,800	23	15.4
Pearl Harbor USS **Olympia**	54	69,106	12,425	18	7.5
Total	**372**	**913,184**	**100,964**	**11**	**$40.1**

[a]Because documentation supporting the Navy's savings estimate was unavailable, we calculated estimated savings using the daily labor charge in effect at the time of the overhaul.

Summaries of the reviews generally attributed the excessive estimates to misapplication of labor standards, improper definition and quantification of work to be performed, or noncompliance with prescribed estimating policies and procedures. In some cases, the review teams concluded that labor estimates were excessive because more efficient methods were available to accomplish the repairs.

Our Analysis of Two Navy Reviews

To better understand the process followed during the labor estimate reviews as well as the causes for the excessive estimates, we analyzed the reviews for the USS South Carolina at the Norfolk shipyard and the USS California at the Puget Sound shipyard.

We selected and reviewed the detailed summaries for 15 of the 69 repair jobs included in the USS South Carolina review. These 15 jobs included 324 specific work steps, each of which had been estimated by a shipyard planner. The review team found that the planners had provided excessive labor estimates for 233, or 72 percent, of these work steps. The labor estimates were considered excessive based on (1) application of labor standards in 30 percent of the cases; (2) review team judgment in

68 percent of the cases; and (3) other factors, such as new production processes, in 2 percent of the cases.

At the Puget Sound shipyard, we selected and reviewed the detailed summaries for 15 of the 101 repair jobs included in the USS California review. These 15 jobs included 104 specific work steps, each of which had been estimated by a shipyard planner. The review team concluded that the planners had provided excessive labor estimates for 67, or 64 percent, of these work steps. The planners' estimates were considered excessive based on (1) application of labor standards in 33 percent of the cases; (2) improper time allowances for contingency work in 64 percent of the cases; and (3) other factors, such as new production processes, in 3 percent of the cases.

We interviewed selected planners at Norfolk and Puget Sound to obtain their opinions of the review team findings. At Norfolk, we interviewed the planners responsible for 10 repair jobs reviewed by the team. The planners fully or partially agreed with the team's findings for 95 percent of the specific work steps and made reductions in their estimates. At Puget Sound, four of the five planners interviewed fully agreed with the team's findings and reduced their estimates. The remaining planner stated that although he reduced his estimate, he did not entirely agree with the team's findings. Some examples of the labor estimates challenged by the review teams at the Norfolk and Puget Sound shipyards follow.

A repair job on the USS South Carolina involved repairs to the ship's fire fighting system. The review team found the planner had based the labor estimate on repairs to seven fire fighting stations. The team concluded that the planner's estimate was excessive because five of the seven stations had been removed from the ship during a previous ship alteration. When we interviewed the planner, he stated that the review team was correct and that he had reduced the labor estimate by 3,100 labor hours, which reduced the repair price by $148,000. He also stated that he had not visited the ship or made a detailed review of ship plans before preparing the original estimate.

Another repair job on the USS South Carolina involved modifications to one of the ship's missile systems. The review team found the planner's estimate for 22 specific repair tasks was excessive based on application of labor standards and recommended a reduction of 3,179 labor hours in the estimate. We interviewed the planner's supervisor who stated that, except for a few instances, he agreed with the team's findings and noted that the

original estimate had been reduced by 2,780 labor hours, which lowered the repair price by $132,000.

A repair job on the USS California involved installing temporary steam and other piping systems to support the ship during one phase of the maintenance period. The review team found that the planner had estimated 3,504 labor hours for the complete manufacture of the temporary systems. However, the team also found that piping systems used on previous overhauls could be modified and reused on subsequent overhauls. Because modification required fewer labor hours than complete system manufacture, the team recommended a reduction of 1,864 labor hours. The planner agreed and reduced the estimate as recommended, which reduced the repair price by $83,000.

Response to Review Findings

In addition to reducing specific labor estimates cited in review team findings, NAVSEA and shipyard officials took some actions to address the factors causing excessive estimates. For example, NAVSEA officials stated that they tasked the Puget Sound shipyard to develop a comprehensive training program to (1) train shipyard planners in the fundamentals of defining, planning, and estimating ship repair work; (2) improve planner skills and adherence to estimating policies; and (3) establish a basis for qualifying planners in their craft. The shipyard completed development of the program in October 1992. NAVSEA officials stated that all shipyards will be required to implement the training program in the future.

In response to the review team findings, Puget Sound shipyard officials stated that they already have provided their planners with additional formal training consisting of several classes on estimate preparation. They also stated that some changes were made in the planners' procedures manual, such as more specific guidance requiring planners to document the basis for their repair estimates.

Fewer actions were taken at the Norfolk shipyard in response to the review team findings. Norfolk shipyard officials stated that they orally reemphasized to planners the need for accurate estimates but did not take any formal steps to improve labor estimates.

Excessive Labor Estimates Continue to Be a Problem

To independently assess the accuracy and credibility of labor estimates, we selected repair jobs and reviewed planner labor estimates at three shipyards. The results of our analysis are shown in table 2.2.

Table 2.2: Our Analysis of Labor Estimates for Selected Repairs

	Charleston	Norfolk	Puget Sound	Total
Number reviewed	10	11	10	**31**
Number with excessive labor estimates based on standards	5	6	4	**15**
Labor hours estimated by planners	2,199	10,861	10,318	**23,378**
Labor hours allowed by standards	1,642	9,791	9,190	**20,623**
Excess labor hours in estimates	557	1,070	1,128	**2,755**
Excess labor hours as a percentage of standard allowance	34	11	12	**13**
Estimated cost of excess labor hours	$26,000	$55,000	$54,000	**$135,000**

As shown in the table, 15 of the 31 estimates were excessive based on the time allowed by applicable labor standards. Of the remaining 16 estimates, 6 were accurate and 6 were excessive based on other factors such as mathematical errors or allowances for work that may not be required. We could not determine the accuracy of four estimates because sufficient information was not available to make an independent assessment.

Planners agreed with our analysis of the 15 estimates that were excessive based on labor standards. They stated that the standards we used in these cases accurately described the work to be performed. They stated, however, that in their judgment the standards did not allow enough time to perform the repairs. Therefore, although contrary to estimating policy, they had estimated more than the standards allowed. In only 4 of the 15 repair jobs where the estimates exceeded the standards did the planners include required backup sheets in the file to explain how the estimates were developed.

The following examples illustrate the labor estimates that we found to be excessive. At the Charleston shipyard, a planner estimated that the woodworking shop would require 340 labor hours to mill wood blocks for use in dry docking the USS Providence. The recommended standard estimate for this work was 210 hours. Thus, on the basis of his judgment, the planner estimated 130 labors hours, or 62 percent, more than the standard time. As a result, the repair price for this work was overstated by $6,000.

A Norfolk shipyard repair on the USS South Carolina provided for the preservation, cleaning, and inspection of ship condensers. The planner estimated that the preservation portion of this work would require 672 labor hours. The recommended standard estimate for this work was 408 labor hours. Thus, on the basis of his judgment, the planner estimated 264 labor hours, or 65 percent, more than the standard time. This resulted in the repair price being overstated by $13,000.

At the Puget Sound shipyard, a planner estimated that 738 labor hours would be required to remove, repair, and reinstall the wind speed and direction indicating system on the USS Carl Vinson. The standard estimate for this work was 571 labor hours. Thus, on the basis of his judgment, the planner estimated 167 labor hours, or 29 percent, more than the standard time. As a result, the price for the repair was overstated by $8,000.

Inaccurate Estimates Hinder Efficiency Measurement and Staffing Forecasts

In addition to increasing repair prices, excessive labor estimates hinder efficiency measurement and staffing forecasts. Navy managers use a sophisticated management information system to measure direct labor efficiency. The system measures efficiency by comparing the labor hours a repair task should take with the labor hours actually used to complete the repair.

When labor estimates for performing repairs are excessive, labor efficiency measurements reported by the system become inaccurate, unreliable, and skewed to the positive side. As a result, Navy managers cannot use reported efficiency data to assess worker performance accurately or to indicate where corrective actions may be needed. Further, because the extent of overestimating varies, comparisons and analyses of labor efficiency over time or among shipyards are meaningless.

To illustrate the problem, we compared the labor estimate and the actual labor expenditure for a repair job at the Norfolk shipyard. The job involved the overhaul of the wind speed and direction indicating system on the USS South Carolina. The labor standard for this work allowed 192 labor hours for the repair. However, using his judgment, the planner estimated that the repair should take 280 labor hours to complete. On the basis of the standard, the planner's estimate was overstated by 88 labor hours, or 46 percent.

Shop personnel actually expended 275 labor hours on the repair. The management information system divided the expended hours by the

planner's estimate and reported a shop efficiency of 98 percent—a good performance. However, if the system had divided the expended hours by the standard estimate, reported shop efficiency would have been 143 percent—a poor performance.

In fiscal year 1992, each shipyard expended more labor hours than were estimated. Overall, the labor hour expenditures exceeded the estimates by 11 percent and ranged from 3 percent to 21 percent for each shipyard. However, this information is of little value to management because the estimates do not accurately reflect how many labor hours the work should have taken.

The accuracy of labor estimates also affects the accuracy of shipyard staffing forecasts. Shipyards forecast future staffing needs largely based on planner estimates for anticipated future repair work. Thus, excessive labor estimates can result in overstated staffing forecasts that, in turn, can result in work load and work force imbalances and additional labor inefficiencies.

A Charleston shipyard instruction described the relationship between accurate labor estimates and staffing forecasts. The instruction states:

"It is important that each planner understands the effect of estimates on forecast manning and how the actual manning, in turn, affects the shipyard's performance. When estimates are too high, the projected workload is distorted and manning to this projected workload breeds inefficiency which results in high cost and long availabilities. When estimates are too low, projected workload is distorted and manning to this projected workload could cause the shipyard to miss scheduled availabilities. When estimates are competitive and manning is controlled to the projected workload, scheduled availabilities are more attainable and costs controlled to a greater degree."

Several Factors Cause Inaccurate Estimates

Three factors contributed to the inaccurate labor estimates. First, planners did not always comply with Navy policies and procedures for preparing labor estimates. Second, shipyards did not have adequate internal controls, such as independent audits, to ensure compliance with these policies and procedures. Third, shipyards did not maintain up-to-date labor standards to assist planners in labor estimating.

Planners Did Not Always Follow Guidance

Shipyard planners did not always follow Navy policies for preparing accurate and credible labor estimates. NAVSEA instructions require planners

to use applicable labor standards without adjustment to establish "should cost" labor estimates. Yet, we found that planners routinely allowed more time than the standards allowed. During our interviews with 31 planners at the Charleston, Norfolk, and Puget Sound shipyards, 18 stated they used the standard time without adjustment in less than 75 percent of the instances where standards were applicable to the work. Several planners said, even when a standard was current, they would not use the standard estimate if they believed more time was needed to perform the repair.

To avoid incorporation of past shop inefficiencies, NAVSEA instructions prohibit planners from using labor hour expenditures from previous repair jobs as the basis for current estimates. However, 10 of the 31 planners stated they used past expenditures to help develop estimates for current repair jobs. Further, although required by estimating instructions, many planners did not retain backup support in their files showing how labor estimates were developed. Only 9 of the 31 repair estimates reviewed had backup support. Such support adds credibility to the estimate and provides an audit trail for subsequent reviews by supervisors and compliance examiners.

Because the performance of shop personnel is measured in part against the estimated labor hours required to perform a task, NAVSEA officials stated that estimates should be developed independently. In other words, in developing labor estimates, planners should not rely on shop personnel opinions of how many labor hours a repair task should take. Yet, 23 of the 31 planners interviewed stated that they used discussions with shop personnel in developing their labor estimates—7 to a great extent and 16 to some extent.

Controls Not in Place to Ensure Quality Estimates

Another factor contributing to excessive labor estimates was the absence of adequate controls, such as independent spot checks or audits, to ensure compliance with estimating policies and procedures. NAVSEA instructions require each shipyard to conduct audits assessing the quality of planner estimates. However, the shipyards we visited were not performing these audits.

Officials at each shipyard visited stated that such audits had been performed in the past but were discontinued due to lack of personnel and higher priority requirements. We found that the past audits had been performed by personnel within the planning department. Independent audits performed by staff outside of the planning department had not been

accomplished. We noted that each shipyard's internal review staff was responsible for conducting periodic audits to help ensure the accuracy of actual labor time charges. However, the internal review staffs were not responsible for auditing the accuracy of labor estimates.

We reviewed some documentation on the discontinued audits at the Norfolk and Puget Sound shipyards. The Norfolk shipyard's audits, which were last performed in April 1992, did not identify the problems we found with Norfolk's labor estimates. Instead, these audits primarily identified administrative errors such as improper completion of estimating forms. At the Puget Sound shipyard, we reviewed the last 16 audits, which were performed in 1990 and 1991. These audits found problems with the labor estimates in 13 of the 16 repair jobs reviewed. The problems included excessive estimates based on applicable standards and planner use of incorrect standards for the work being estimated.

Labor Standards Have Not Been Maintained

A third factor contributing to excessive labor estimates is the general absence of up-to-date labor standards to assist shipyard planners in estimating. Although DOD and Navy instructions require shipyards to maintain an effective labor standards program, the shipyards visited largely had neglected the standards program over the past several years. Without up-to-date labor standards to use as benchmarks in determining how long repair tasks should take, planners developed estimates based on personal judgments that normally lacked the independence and consistency of standards.

Shipyard planners told us that although repair processes often change over time, few labor standards are ever updated. To obtain an indication of whether labor standards were current, we determined the age of the standards based on when they were last reviewed or updated. We found that 39 percent of Charleston's 1,101 labor standards, 70 percent of Norfolk's 2,260 labor standards, and 72 percent of Puget Sound's 516 labor standards were more than 10 years old.

During our interviews with shipyard planners, 28 of the 31 planners stated that updated labor standards would be a great or considerable help in developing accurate labor estimates. They also stated that, because many existing standards cover rarely performed repair tasks, it is not necessary to update all standards to greatly improve the usefulness of the standards. For this reason and because of the costs associated with labor standards

development, the planners stated that only those standards covering frequently performed repair tasks should be updated.

We also found that requests from shipyard planners to have specific labor standards updated often were ignored. For example, since 1982 Norfolk shipyard planners have requested the industrial engineering staff to update 61 standards and develop 4 standards for new types of work. None of the standards were updated and the new standards were never developed. Our review of an August 1992 management report showed that Norfolk shipyard planners had cited several of the outdated standards as support for 103,000 estimated labor hours for repair work assigned to production shops.

Similarly, since 1989 Charleston shipyard planners have requested the industrial engineering staff to update 14 commonly used standards. At the time of our visit in March 1993, only one had been updated.

Industrial engineering managers, who have responsibility for maintaining the labor standards, stated that standards development and maintenance was a low priority that received little management emphasis. The Norfolk and Charleston shipyards had no one working full-time on labor standards, and the Puget Sound shipyard had one person working full-time on labor standards. The managers stated that industrial engineering services mostly were devoted to production process improvements and that they lacked sufficient staff to devote more effort to standards. We noted, however, that the Charleston, Norfolk, and Puget Sound shipyards had a total of 200 engineers and engineering technicians available to perform industrial engineering services.

New Navy Initiatives Address Some Problems

NAVSEA has two initiatives underway that address some of the factors contributing to excess labor estimates at shipyards. The first is the new planner training program developed by the Puget Sound shipyard. As discussed earlier, NAVSEA officials stated that all shipyards will be required to implement the training program in the future.

The second initiative, called the Advanced Industrial Management Program, involves a new approach to ship repair planning and management. The Charleston shipyard is prototyping this new approach and NAVSEA officials state that, eventually, the initiative will be implemented at all shipyards. The goal of this initiative is to reduce ship repair costs.

Key elements of the new approach are (1) dedication to a project manager concept with one person responsible for all aspects of a ship's repair, including design, planning, and production execution; (2) more detailed, finite identification and quantification of required repair tasks; (3) review of all labor estimates prior to work commencement to obtain joint project manager, planner, and production personnel agreement on the minimum labor hours required to complete each repair; and (4) use of benchmarks by comparing the current repair estimates with labor hours used or planned for the same repairs on other similar ships.

Another goal of the new approach is to document and retain the detailed plans and labor estimates for each repair task. Thus, if required in the future, these repair tasks would not require replanning even if the repairs were performed at a different shipyard.

At the time of our visit to the Charleston shipyard in March 1993, the initiative was still evolving and was not yet documented in terms of procedural guidance and instructions. Also, because the two ship overhauls subjected to the new initiative were not complete, actual results from the initiative could not be measured. Therefore, while the initiative appears to offer benefits, we were unable to draw any final conclusions on the initiative and its ultimate potential in ensuring more credible estimates and lower repair costs.

Conclusions

Because planners did not always follow estimating policies, internal controls were not in place, and labor standards were not always current, many labor estimates for ship repairs were excessive. Overstated labor estimates increased repair prices and caused inaccurate labor efficiency data to be reported. Without accurate labor efficiency data, managers lost the ability to measure labor performance and take timely corrective action when needed. In addition, because labor estimates also are used to help forecast shipyard staffing requirements, the overstated estimates can contribute to larger work force forecasts than warranted.

New NAVSEA initiatives calling for comprehensive training for planners and new approaches to managing ship overhauls address some of the causes for excessive labor estimates. However, these initiatives need to be fully implemented to achieve their potential benefits. In addition, further improvements are needed to ensure accurate and credible labor estimates at all shipyards. These improvements include better internal controls and updated labor standards for frequently performed repair tasks.

Recommendations

We recommend that the Secretary of the Navy direct the Commander, Naval Sea Systems Command, to

- establish milestones for implementing the new training program to ensure that all planners are well-trained in estimating policies and procedures;
- ensure that each shipyard conducts periodic, independent audits of labor estimates to assess accuracy and compliance with estimating policies; and
- establish a labor standards improvement initiative to ensure that frequently performed repair tasks are covered by current, independently developed labor standards.

Agency Comments

DOD agreed with our findings and recommendations and stated that corrective actions are underway. DOD stated that milestones have been established at all shipyards to implement the new planner training program. Also, the Navy is modifying the Advanced Industrial Management Program to add a requirement that labor estimates be independently audited for accuracy and adherence to standards. Further, the Navy is implementing an initiative to ensure that frequently performed repair tasks are covered by current, independently developed labor standards. DOD stated that all of these corrective actions are targeted for implementation by January 1994.

Shipyard Improvements Need to Be Incorporated Into Planning

The shipyards have devoted considerable effort to identifying and implementing labor-saving process and equipment improvements. However, the Navy did not always ensure that the benefits from such improvements were incorporated into shipyard planning for ship repairs. Because labor standards were not always updated to reflect changes and there was no other formal method to inform planners of new processes and equipment, planners often continued to base labor estimates on processes and equipment no longer used. As a result, labor savings resulting from improvements often were not reflected in reduced benchmarks for efficiency measurement or in lower repair prices.

Shipyards Devote Considerable Resources to Improving Industrial Processes

NAVSEA's 5-year plan for 1990 to 1994 to achieve measurable savings and operational improvements emphasizes the need for each shipyard to identify and eliminate inefficient work practices and processes through the use of industrial engineering resources and investment in state-of-the-art equipment. Each shipyard has a staff of industrial engineers who are responsible for developing and improving production processes, methods, and practices to reduce labor costs and achieve higher quality. For example, the Charleston, Norfolk, and Puget Sound shipyards have 60, 63, and 77 engineers and engineering technicians, respectively, who perform these and other related duties.

Working with production employees, the engineering staffs have successfully identified and implemented cost-saving improvements in many production areas. Some recent examples from the shipyards visited follow.

The Charleston shipyard implemented a new high volume, low pressure painting system for many interior ship spaces. In addition to increasing painting efficiency, the new system reduced masking requirements, paint overspray, pollution, and hazardous waste. Charleston shipyard officials estimated that the new system reduced the interior painting labor hours for one submarine by 35 percent, saving $800,000.

In conjunction with a NAVSEA initiative, the Norfolk shipyard modernized work practices and equipment in its inside machine shop. According to NAVSEA, the inside machine shop represents the core of the shipyard's industrial capability. In addition to the shipyard investing about $15 million in modern, labor-saving equipment for the shop, Norfolk industrial engineers improved the shop's physical layout and the work

flow for about 150 components repaired in the shop. The engineers told us that these changes have resulted in significant labor savings.

The Puget Sound shipyard's industrial engineers identified and implemented a process improvement that will reduce labor hours used to paint interior surfaces and bilges. By reducing subsequent damage to areas already painted, reducing cosmetic touch-up painting, and through other changes, the improvement will reduce the labor used to paint the areas. Puget Sound engineers estimate that the improvement will save $30,000 to $45,000 in labor costs on each repair.

Table 3.1 summarizes the overall investment by each shipyard in new capital equipment for fiscal years 1988 through 1992. Much of this investment provided labor-saving, state-of-the-art equipment to modernize production shops.

Table 3.1: Shipyard Capital Equipment Investment for Fiscal Years 1988 Through 1992

Dollars in millions

Shipyard	Investment
Charleston	$85.1
Long Beach	28.4
Mare Island	97.1
Norfolk	105.9
Pearl Harbor	61.7
Philadelphia	51.7
Portsmouth	67.6
Puget Sound	124.7
Total	**$622.2**

Many Labor Estimates Do Not Reflect Improvement Benefits

Although the Navy estimates that considerable savings have resulted from process improvements and equipment investments, the benefits from these changes were not always incorporated into labor estimates and customer prices for ship repairs. For example, in the production improvements discussed previously, the claimed benefits had not been reflected in reduced labor estimates or repair prices, according to shipyard planners.

The shipyards' failure to keep labor standards up-to-date contributed to this problem. We found that few labor standards at the shipyards visited had been updated because of new processes and equipment.

Moreover, even without updated standards to use as a guide, planners did not consider the impact from process improvements and new equipment when preparing labor estimates because they often did not know about the improvements or learned about them long after implementation. Thus, many labor estimates reflected more labor than required because they were based on less efficient shop processes and equipment no longer used.

Planners and industrial engineers at the shipyards visited stated that there was no formal or structured procedure to ensure that planners were informed of shop changes affecting labor efficiency. Planners told us they relied on informal communications and shop visits to become aware of such changes. Some planners stated that they may never learn of labor-saving improvements because they are not systematically notified when improvements have been identified or implemented.

The following examples highlight some of the problems we found. At the Norfolk shipyard, a review team concluded that the planner's labor estimate for dry docking the USS South Carolina should be reduced by 1,666 hours because of a process improvement. By automating a dry dock monitoring system, the time required for a worker to check on the system was significantly reduced. The planner stated that he was not aware of the change and had based his estimate on the old process. As a result, the price for the work was overstated by $79,000. Norfolk officials stated that the shipyard needed to close the loop on process improvements by informing planners of improvements and ensuring that benefits are incorporated into labor estimates.

At the Charleston shipyard, 7 of the 10 planners interviewed stated they may not include benefits from shop improvements in their estimates because they are not routinely notified of changes. One Charleston planner stated he often became aware of a new shop process or new shop equipment long after the improvement had been implemented. For example, he learned that the paint shop had adopted a new method for blasting bilge tanks many months after the change had been adopted. Although the new method saved considerable time, the planner said he had continued to estimate time for such work based on the old method.

During a visit to the electrical shop, another Charleston planner stated he discovered the shop was using a new piece of equipment. The new equipment computerized the process for making equipment identification name plates and saved considerable time over the previous, manual

process. The planner said if he had not seen the new equipment, he would have continued to base his labor estimates on the old, more labor intensive process.

At the Puget Sound shipyard, 8 of the 10 planners interviewed said they became aware of process improvements and new equipment only if they saw changes during shop visits or if they happened to hear someone discussing a change. Two planners said because they never were informed of changes, they never considered shop improvements when making labor estimates. Puget Sound officials agreed with planners that a structured procedure was needed to inform planners of improvements so benefits could be incorporated into labor estimates.

Conclusions

Although the Navy's efforts to improve shipyard industrial operations through process improvements and equipment investment have resulted in labor savings, the shipyards have not always incorporated these benefits into the planning process. Only when labor estimates accurately incorporate these benefits can the savings be reflected through reduced benchmarks for efficiency measurement and lower repair prices.

As discussed in the previous chapter, the shipyards need to update frequently used labor standards to ensure that they reflect new shop processes or equipment. In addition, shipyards need to ensure that industrial engineers, or others, who implement labor-saving improvements communicate these changes to the planners. With this knowledge, planners can include the benefits from improvements in labor estimates even before standards have been updated.

Recommendation

We recommend that the Secretary of the Navy direct the Commander, Naval Sea Systems Command, to establish a procedure ensuring that shipyard planners are informed of all new production processes, methods, and equipment that improve worker efficiency.

Agency Comments

DOD agreed with our findings and recommendation and stated that the Navy will direct each shipyard to ensure that labor-saving improvements are communicated to the planners. The initiative to keep key labor standards current also will help ensure that planners consider process improvements in their labor estimates. Implementation of these corrective actions is targeted for January 1994.

Comments From the Department of Defense

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, DC 20301-8000

PRODUCTION AND LOGISTICS

July 7, 1993

(L/MD)

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and
International Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "NAVY MAINTENANCE: Improved Labor Estimates Can Reduce Shipyard Costs," Dated May, 21, 1993 (GAO Code 394486), OSD Case 9419. The DoD concurs with the report.

The DoD agrees with the importance of ensuring that accurate labor cost estimates are developed to support ship repair and maintenance. As recognized by the GAO, Navy initiatives are underway that will improve planner training and ensure the shipyard work is properly and accurately identified, based on approved standards. In addition, the Navy will be taking action to ensure that information on new production processes and work improvements is provided to shipyard personnel. Each of the Navy actions should be completed by January 1994.

The detailed DoD comments on the draft report findings and recommendations are provided in the enclosure. The DoD appreciates the opportunity to comment on the draft report.

Sincerely,

David J. Berteau
Principal Deputy

Enclosure

**GAO DRAFT REPORT - DATED MAY 21, 1993
(GAO CODE 394486) OSD CASE 9419**

"NAVY MAINTENANCE: IMPROVED LABOR ESTIMATES CAN REDUCE SHIPYARD COSTS"

DEPARTMENT OF DEFENSE COMMENTS

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FINDINGS

• **FINDING A: Overview of Navy Public Shipyard Operations.** The GAO observed that the Navy utilizes eight public shipyards to provide depot-level logistics support to the fleet, including the repair, overhaul, and modernization of Navy ships. The GAO reported that, in FY 1992, the eight shipyards incurred costs of about $4.1 billion, including about $1.7 billion paid for direct labor costs. The GAO noted that, because of fleet downsizing and a shift to less maintenance intensive ship designs, ship repair requirements are projected to decline significantly over the next several years.

The GAO also observed that the shipyards are industrial fund activities, which are included in the Defense Business Operations Fund. The GAO explained that, as such, they use a businesslike buyer-seller approach to contract with their customers. The GAO further explained that, when a customer requests work from a shipyard, the shipyard helps define the work required and provides the customer an estimated price--designed to cover all costs without incurring a profit or loss. The GAO noted that customer prices are based on estimated, rather than actual costs, because DoD policy requires industrial fund activities to establish prices prior to the start of each fiscal year. The GAO further noted that the intent of the policy is (1) to protect customers from unforeseen inflationary increases and cost uncertainties and (2) to ensure customers do not have to reduce their programs to pay for higher prices.

The GAO found that, for several reasons, the actual cost of the shipyard work may differ from the price paid by the customer--thus, creating a profit or loss. The GAO noted, for example, that if the shipyard labor estimate is greater than the labor actually required, the customer pays more than necessary. The GAO reported that, in FY 1992, the total costs of the shipyards exceeded total revenues, resulting in an operating loss of $218 million. The GAO observed that, because of the various uses of labor estimates, it is

Enclosure

Now on pp. 2, 8-10.

imperative that the estimates be as accurate as possible to manage labor resources better and obtain labor efficiency improvements. The GAO concluded that, overall, increased shipyard efficiency is the key to labor savings. (pp. 2-3, pp. 11-15/GAO Draft Report)

DOD RESPONSE: Concur. The accuracy of labor cost estimates is important, but it is not the only cost driver of an availability. The March 23, 1993 GAO report entitled FINANCIAL MANAGEMENT: Navy Industrial Fund Has Not Recovered Losses," (OSD Case 9287), cited three additional accounting practices that contributed to significant revenue shortfall:

- changes in the volume and composition of workload;
- guidance followed by the shipyards resulted in charging prices lower than those required to recover estimated costs; and
- workload carried over from one fiscal year to the next was billed at the generally lower prices in effect when the work was ordered.

In addition, the Navy conducted several analyses of FY 1992 operations to avoid a repeat of the FY 1992 fiscal results. The Navy is executing an aggressive and comprehensive cost reduction program in the Naval shipyards.

• FINDING B: Navy Reviews Found Overstated Labor Estimates. The GAO reported that, in the late 1980s, the Navy began a program to review shipyard labor estimates as part of the Navy Industrial Improvement Program. The GAO found that, between 1989 and 1991, eight ships from five different shipyards were selected for review. The GAO analyzed the results from six of the reviews and found that, in each case, the shipyard planners had overestimated the amount of labor needed to accomplish the planned repairs. The GAO noted that the excesses ranged from 3 to 23 percent, and averaged 11 percent. The GAO also noted that estimated savings from eliminating the excess labor ranged from about $2 million to $15 million per ship, and totaled over $40 million for the six ships.

To better understand the labor estimate process and the causes for the excessive estimates, the GAO analyzed the reviews for two of the ships. The GAO discussed several examples of the review team findings, including (1) the over-estimation of 3,179 labor hours on a missile system for the U.S.S. SOUTH CAROLINA, and (2) the estimation

Now on pp. 2-3, 12-16.

of 1,864 more labor hours than necessary to install temporary piping systems on the U.S.S. CALIFORNIA. The GAO noted that eliminating the excess labor from those estimates reduced the repair prices for the work by $132,000 and $83,000, respectively.

The GAO found that, in addition to reducing specific labor estimates cited in the review team findings, Navy officials also took some actions to address the factors causing the excessive estimates. The GAO cited examples of increased training and changes in procedures at Puget Sound. The GAO noted that fewer actions were taken at Norfolk--while the need for accurate estimates was reemphasized orally to planners, formal steps to improve estimates were not taken. (pp. 3-5, pp. 18-26/GAO Draft Report)

DOD RESPONSE: Concur. Corrective actions are in process--see Finding F. Excessive work scope occurs when the planner identifies more work to be done than necessary to satisfy the customer's requirement. For example, if a shipyard has performed a job multiple times, such as a repetitive pump or valve repair, it was not uncommon to find that the planner would increase the scope of work on each subsequent job to include the repairs required for the worst case previous performance, instead of estimating for the average condition. Excessive work scope was the single largest contributor to the excessive estimates identified during the Navy reviews conducted in the late 1980s.

• FINDING C: Excessive Labor Estimates Continue To Be A Problem. The GAO reported that, to assess the accuracy and credibility of labor estimates on an independent basis, it reviewed the estimates for 31 repair jobs at three shipyards. The GAO concluded that, based on the time allowed by applicable labor standards, 15 of the 31 estimates were excessive. Of the remaining 16 estimates, the GAO found six were accurate and six others were excessive based on other factors--such as mathematical errors or allowances for work not required. The GAO found that insufficient information was available to make an assessment for the other four estimates.

The GAO discussed several examples. The GAO found that a planner at one shipyard estimated 62 percent more labor hours than the labor standard allowed for preparing wood blocks used in dry docking. At another shipyard, the GAO found a planner estimated 29 percent more labor hours than allowed by the applicable standard to repair a wind direction and speed indicator. The GAO found that, in both cases, the planners had allowed more time than the standards allowed based

Now on pp. 3-4, 16-18.

on individual judgment--contrary to estimating policy. The GAO concluded that excessive labor estimates continue to be a problem at Navy shipyards. (pp. 5-6, pp. 26-28/GAO Draft Report)

DOD RESPONSE: Concur. Corrective actions are in process--see Finding F. Excessive estimates can occur when planners either fail to use standards or improperly use standards. Lack of use is a more common occurrence than misuse of standards. The reason most frequently given by planners for lack of use is that the applicable standard is outdated and therefore does not reflect current practice. Investigation of standards by the Naval Sea Systems Command confirmed that many are not current and require revision; however, it was not uncommon to find that standards cited as outdated were usable as written.

- **FINDING D: Inaccurate Estimates Hinder Efficiency Measurement and Staffing Forecasts.** The GAO observed that, in addition to increasing repair prices, excessive labor estimates hinder efficiency measurement and staffing forecasts. The GAO explained that, when labor estimates for performing repairs are excessive, labor efficiency measurements reported by the system become inaccurate, unreliable, and skewed to the positive side. The GAO concluded that, as a result, Navy managers cannot use reported efficiency data (1) to assess worker performance accurately or (2) to indicate where corrective actions may be needed. The GAO also concluded that, because the extent of overestimating varies, comparisons and analyses of labor efficiency over time or among shipyards are meaningless. (The GAO discussed several examples illustrating the problems.)

The GAO further concluded that the accuracy of labor estimates also affects the accuracy of shipyard staffing forecasts. The GAO explained that shipyards forecast future staff needs largely based on planner estimates for anticipated future repair work. The GAO pointed out that excessive labor estimates can result in overstated forecasts--which, in turn, can result in workload and force imbalances and additional labor inefficiencies. (p. 6, pp. 28-31/GAO Draft Report)

Now on pp. 4, 18-19.

DOD RESPONSE: Concur.

- **FINDING E: Several Factors Cause Inaccurate Estimates.** The GAO identified three factors that cause inaccurate estimates. First, the GAO found that planners did not always follow Navy policies and

procedures for preparing labor estimates. The GAO reported, for example, that although Navy instructions require planners to use applicable labor standards without adjustment to establish labor estimates, planners routinely allowed more time than the standards allowed. The GAO also cited instances where planners used past expenditures to help develop estimates for current repair jobs and did not retain backup support for how the labor estimates were developed. In addition, the GAO found planners frequently used discussions with shop personnel to develop labor estimates.

Second, the GAO found that shipyards did not have adequate internal controls, such as independent audits, to ensure compliance with policies and procedures. The GAO pointed out that Navy instructions require each shipyard to conduct audits assessing the quality of planner estimates. At the shipyards it visited, however, the GAO found those audits were not being performed. The GAO reported that according to shipyard personnel, while such audits had been performed in the past, they were discontinued due to lack of personnel and higher priority requirements. The GAO noted that past audits had been performed by personnel within the planning department, but independent audits had not been accomplished. The GAO also noted that the shipyard internal review staffs were responsible for conducting periodic audits to help ensure the accuracy of actual labor time charges, but not for the accuracy of labor estimates.

Third, the GAO found shipyards did not maintain up-to-date labor standards to assist planners in labor estimating. The GAO observed that DoD instructions require shipyards to maintain an effective labor standards program. The GAO found, however, that the shipyards it visited had largely neglected the standards program over the past several years. The GAO learned that, instead, the planners developed estimates based on personal judgments. The GAO also found that few labor standards are ever updated and requests from shipyard planners to have specific labor standards updated often were ignored. The GAO reported that, according to the managers responsible for maintaining the labor standards, standards development and maintenance was a low priority that received little management emphasis. The GAO concluded that improvements are needed to ensure accurate and credible labor estimates at all shipyards--including better internal controls and updated labor standards for frequently performed repair tasks. (p.6, pp. 31-36, p. 39/GAO Draft Report)

Now on pp. 4, 19-23.

DOD RESPONSE: Concur. (See the DoD responses to Finding F and Recommendations 2 and 3).

• **FINDING F: New Navy Initiatives Address Some Problems.** The GAO reported the Naval Sea Systems Command had two initiatives underway that address some of the factors contributing to excess labor estimates at shipyards. First, the GAO cited the new planner training program developed by the Puget Sound shipyard. The GAO explained that, in October 1992, Puget Sound completed development of the training program--a program designed to (1) train planners in the fundamentals of defining, planning, and estimating ship repair work, (2) improve planner skills and adherence to estimating policies, and (3) establish a basis for qualifying planners in their craft. The GAO noted that, according to Command officials, all shipyards will be required to implement the training program in the future.

The GAO further reported that the second initiative, called Baseline Advanced Industrial Management, involves a new approach to ship repair planning and management to reduce ship repair costs. The GAO identified several key elements of the new approach--including (1) dedication to a project manager concept, with one person responsible for all aspects of a ship's repair, (2) more detailed, finite identification and quantification of required repair tasks, (3) a review of all labor estimates prior to work commencement to obtain agreement on minimum labor hours required, and (4) use of benchmarks by comparing current repair estimates with labor hours used or planned for the same or similar ships. The GAO noted another goal of the new approach is to document and retain the detailed plans and estimates for each repair task. The GAO further noted that as of March 1993, the initiative was still evolving at the Charleston shipyard and had not yet been documented in terms of procedural guidance and instructions. In addition, the GAO noted the two ship overhauls subjected to the new initiative were not yet completed. The GAO observed that, while the initiative appears to offer benefits, final conclusions could not be reached on the initiative and its ultimate potential to ensure more credible estimates and lower repair costs.

The GAO concluded that, overall, the new Navy initiatives address some of the causes for excessive labor estimates. The GAO further concluded, however, that the initiatives need to be fully implemented to achieve their potential benefits. The GAO also concluded that further improvements, such as better internal controls and updated labor standards for frequently performed tasks, are needed to ensure accurate and credible labor estimates at all shipyards. (p.6, p. 25, pp. 36-39/GAO Draft Report)

Now on pp. 4, 16, 22-23.

DOD RESPONSE: Concur. The planner training program addresses excessive work scope and the contributing causes in depth. It reinforces the policy of estimating for average conditions and clearly explains the serious negative result of including unknown or unnecessary work scope. The Advanced Industrial Management Program has several process features to protect against excessive work scope. For all ship availabilities there will be a project superintendent team review of all jobs to eliminate any work that is not clearly included in the customer authorized work package. As a second feature, all shipyards will prepare work instructions in a standard format, and they will be corporately retained for use the next time the same job is performed at any Naval shipyard. In essence, the retained work instruction established the standard work scope to be used for all future recurrences of the job. The customer will get the same scope of work regardless of which Naval shipyard performs the work. As a second check, corporate standard work instructions will be independently audited for instances of excessive work scope and misuse of estimating standards.

The planner training program trains planners in the applications of standards and strongly emphasizes the importance of their use. It reinforces the policy that the use of standards is not optional and explains the consequences associated with failure to comply. The Advanced Industrial Management Program addresses the use of standards much the same as previously described for eliminating excessive work scope. The project superintendent team reviews all jobs to ensure correct application of standards. Work instructions that are archived for corporate reuse will be independently audited for proper application of standards. Corporate work instructions will establish the standard work scope and estimate to be used wherever and whenever the work is repeated.

• **FINDING G: Shipyards Devote Considerable Resources To Improving Industrial Processes.** The GAO found that the shipyards devote considerable effort to identifying and implementing labor saving process and equipment improvements. The GAO noted that the Naval Sea Systems Command 5-year plan (for the period FY 1990 to FY 1994) to achieve measurable savings and operational improvements emphasizes the need for each shipyard to identify and eliminate inefficient work practices and processes through the use of industrial engineering resources and investment in state-of-art equipment.

The GAO reported that each shipyard has a staff of industrial engineers responsible for developing and improving production processes,

Now on pp. 4, 25-26.

methods, and practices to reduce labor costs and achieve higher quality. The GAO discussed several examples where the engineering staffs, working with production employees, have successfully identified and implemented cost saving improvements. The GAO reported that, for the period FY 1988 through FY 1992, a total of $622.2 million had been invested by the shipyards in new capital equipment, much of which provided labor saving, state-of-the-art equipment to modernize production shops. (p. 7, pp. 40-42/GAO Draft Report)

DOD RESPONSE: Concur.

- **FINDING H: Many Labor Estimates Do Not Reflect Improvement Benefits.** The GAO found that, although the Navy estimates considerable savings have resulted from process improvements and equipment investments, the benefits from the changes were not always incorporated into labor estimates and customer prices for ship repairs. The GAO reported, for example, that in connection with the production improvements previously discussed (in connection with Finding G), planners said the claimed benefits had not been reflected in reduced labor estimates or repair prices. The GAO concluded that the failure of the shipyards to keep labor hour standards up-to-date contributed to the problem. The GAO also found that, even without updated standards to use as a guide, planners did not consider the impact from process improvements and new equipment when preparing estimates, because they often did not know about the improvements or learned about them long after implementation. The GAO observed that, as a result, many planner estimates reflected more labor than required.

The GAO further reported that planners and industrial engineers at the shipyards said there was no formal or structured procedure to ensure planners were informed of shop changes affecting labor efficiency. The GAO noted that, according to the planners, they relied on informal communications and shop visits to become aware of such changes--while some planners said they may never learn of the improvements. (The GAO discussed several examples illustrating the problem.)

Overall, the GAO concluded that only when labor estimates accurately incorporate improvement benefits can the savings be reflected through reduced benchmarks for efficiency measurement and lower repair prices. The GAO further concluded that the shipyards need to ensure that industrial engineers (or others who implement labor saving improvements) communicate the changes to the planners. The GAO also

Now on pp. 4, 25-28.

concluded that, with the additional knowledge, planners can include the benefits from improvements in labor estimates even before standards have been updated. (p. 7, p. 40, pp. 43-46//GAO Draft Report)

DOD RESPOSE: Concur. The Navy has identified contributing causes to be (1) neglect of updating standards in favor of higher priority work for Industrial Engineering staffs, (2) rapidly changing technology and industrial processes which cause many standards to be short lived, and (3) the high cost associated with maintaining large libraries of standards. Initiatives are underway to improve labor cost estimates and ensure the information is communicated to planners--see the DoD response to Recommendations 3 and 4.

* * * * *

RECOMMENDATIONS

Now on pp. 5, 24.

• RECOMMENDATION 1: The GAO recommended that the Secretary of the Navy direct the Commander, Naval Sea Systems Command, to establish milestones for implementing the new training program to ensure that all planners are well-trained in estimating policies and procedures. (p.8, p. 39/GAO Draft Report)

DOD RESPONSE: Concur. Milestones have been established at all Naval shipyards to implement the new training program to ensure that all planners are well-trained in estimating policies and procedures before January 1994.

Now on pp. 5, 24.

• RECOMMENDATION 2: The GAO recommended that the Secretary of the Navy direct the Commander, Naval Sea Systems Command, to ensure that each shipyard conducts periodic, independent audits of labor estimates to assess accuracy and compliance with estimating policies. (p. 8, p. 39/GAO Draft Report)

DOD RESPONSE: Concur. The audit process has been incorporated as part of the Advanced Industrial Management process and will be complete by January 1994. As a second check, corporate standard work instructions will be independently audited for instances of excessive work scope and misuse of estimating standards.

Now on pp. 5, 24.

• **RECOMMENDATION 3:** The GAO recommended that the Secretary of the Navy direct the Commander, Naval Sea Systems Command, to establish a labor standards improvement initiative to ensure that frequently performed repair tasks are covered by current, independently developed labor standards. (p. 8, p. 39/GAO Draft Report)

DOD RESPONSE: Concur. The Advanced Industrial Management Program is implementing a change in process for labor standards that will establish standards for specific component repairs, alterations, tests, and services. In addition, the Navy will implement an initiative to ensure that frequently performed repair tasks are covered by current, independently developed labor standards. Those procedures will be established by January 1994.

Now on pp. 5, 28.

• **RECOMMENDATION 4:** The GAO recommended that the Secretary of the Navy direct the Commander, Naval Sea Systems Command, to establish a procedure ensuring that shipyard planners are informed of all new production processes methods, and equipment that improve work efficiency. (p. 8, p. 46/GAO Draft Report)

DOD RESPONSE: Concur. The Advanced Industrial Management Program includes a "feedback" sheet with all work instructions to capture work improvement recommendations from the performing activity. In addition, each shipyard will be directed to ensure that process improvements are communicated to the shipyard planners. These improvements will be reviewed and incorporated through revisions in the appropriate standard work instructions. Each of those actions will be completed by January 1994.

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