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Report to the Chairman, Legislation and National Security Subcommittee, Committee on Government Operations, House of Representatives

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# CONTRACT PRICING

# Defense Contractor Cost Estimating Systems



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**United States**
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**National Security and**
**International Affairs Division**

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The Honorable Jack Brooks
Chairman, Legislation and
National Security Subcommittee
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

As requested, we performed a number of reviews to determine whether contractors were developing and proposing accurate and reliable cost estimates for negotiating noncompetitive Department of Defense (DOD) contracts. On April 8, 1987, we testified before your Subcommittee on the need to improve the accuracy and reliability of material cost estimates proposed by defense contractors.[1]

This report describes weaknesses in contractors' procedures and practices used to estimate labor and other direct costs.[2] It also provides information on cost estimating policies and procedures at 247 major contractor locations and information on how costs were estimated on 127 negotiated contracts awarded during the year ending June 1986. The objective, scope, and methodology of our review is described in appendix III.

## Background

A cost estimating system includes the policies, procedures, and practices used by contractors to generate cost estimates and other data included in contract price proposals. When DOD awards contracts without price competition, contracting officers rely to a great extent on contractors' price proposals to establish contract prices. Therefore, estimating systems are fundamental to negotiating fair and reasonable noncompetitive contract prices. In fiscal year 1986, DOD awarded about $82 billion in contracts without price competition.

Cost estimating systems should use available data to produce accurate and reliable estimates. Recognizing the government's vulnerability in negotiating noncompetitive contract prices, the Congress passed the Truth-in-Negotiations Act in 1962, 10 U.S.C. 2306a, as amended. The

[1] GAO's Review of Contractor Cost Estimating Systems (GAO/T- NSIAD-87-25, April 8, 1987).

[2] We defined other direct costs as those which could have been discretely estimated but were estimated on the basis of rates, percentage factors, or cost estimating relationships

act, intended to protect the government against inflated cost estimates, requires contractors to submit cost or pricing data to support noncompetitive price proposals and to certify that the data submitted are accurate, complete, and current.

DOD recognizes the importance of cost estimating and requires the Defense Contract Audit Agency (DCAA) to periodically review contractor estimating practices. We reviewed DOD's surveillance of contractor cost estimating practices, and testified[3] about several problems before your Subcommittee in October 1985. We pointed out that the lack of adequate standards in existing regulations had resulted in disagreements among contractors, contracting officers, and auditors on the characteristics of an acceptable estimating system. We also noted that existing regulations did not identify which procurement officials were responsible for resolving estimating system deficiencies.

In our April 1987 testimony, we reported that weaknesses in contractors' material cost estimating practices caused the prices of 24 contracts that we reviewed to be overstated by about $21 million. Contract prices were overstated primarily because contractors had not evaluated major subcontract prices as required by procurement regulations and did not disclose that prices negotiated with vendors are typically lower than the quotations included in material costs estimates. The lack of clear guidance on estimating practices contributed to contractors using unacceptable methods to estimate material costs. Also, procurement regulations did not require contractors to maintain adequate estimating systems.

Following the hearing, we issued a report[4] which recommended that the Secretary of Defense direct DOD personnel to assemble and refine available standards to clearly define what constitutes an acceptable estimating system. In July 1987, DOD proposed revising the Defense Supplement to the Federal Acquisition Regulation to require certain large contractors to disclose and maintain adequate estimating systems. We support the proposed revision and provided comments on it to DOD in September 1987.

[3]See House Report 99-562, Overpricing of Defense Contracts is Extensive, Expensive, and Avoidable. Thirtieth Report by the House Committee on Government Operations, April 29, 1986.

[4]CONTRACT PRICING: Defense Contractor Cost Estimating Systems (GAO/NSIAD-87-140, June 3, 1987).

## Weaknesses in Contractors' Cost Estimates

Our review of the practices used by selected contractors to estimate labor and other direct costs also disclosed estimating system problems. We reviewed labor and other direct cost estimates totaling $885 million in 35 contract price proposals and found weaknesses in the methods contractors used to develop the estimates. For example, we found some contractors did not have written estimating procedures for developing the estimates, and some had not adequately documented the methods and supporting data which were used to develop the estimates.

Questionnaire responses we compiled from DCAA auditors working at 247 major defense contractor locations revealed similar weaknesses. For example, 31 contractors, or 13 percent, did not have written estimating policies and procedures. Also, about 25 percent of the contractors with written policies and procedures did not have a procedure for one or more major estimating tasks such as documenting the rationale and support for estimates.

In several cases, estimates that we reviewed were developed on the basis of judgment without any analytical support. Some of the judgmental estimates did not consider historical costs even though the contractor had been producing the same or similar items for several years. We also found that contractors did not always have procedures for comparing estimates to the actual cost of performance as a basis for assessing the accuracy and reliability of their estimating practices.

We believe some contract prices were higher than warranted because weaknesses in the estimates were not identified and resolved during contract negotiations. We were not able to determine the effect on contract prices in all cases because some contractor accounting systems did not record actual costs for items estimated in contract price proposals.

Specific examples of the weaknesses we identified are discussed in appendix I. A complete analysis of questionnaire responses is contained in appendix II. The eight contractor locations we visited are listed in appendix IV.

## DOD and Contractor Actions

DOD has initiated actions to improve the accuracy and reliability of contractor estimating systems. As mentioned earlier, DOD proposed revising the Defense Supplement to the Federal Acquisition Regulation to specifically require contractors to establish and maintain adequate estimating

systems. The proposed revision describes the characteristics of an adequate estimating system and contains provisions for disapproving inadequate estimating systems. The revision would require that joint reviews of contractor estimating systems by contract administration and audit personnel be performed at least every 3 years. Administrative contracting officers would be assigned authority and responsibility to disapprove inadequate systems and to determine whether contractors adequately resolve estimating deficiencies.

DOD has also sent several memorandums to contracting activities highlighting problems identified in our audits and emphasizing the need to ensure that contractors comply with existing regulations. In December 1985, DCAA sent a memorandum to its field offices providing guidance, clarification, and emphasis on estimating system reviews. DCAA is also developing a standard audit program for these reviews.

Some contractors have also taken actions to improve cost estimating practices. For example, Raytheon Company and Martin Marietta Corporation have revised their estimating procedures to correct specific weaknesses identified by our review.

## Conclusions

Sound contractor estimating systems are essential to pricing noncompetitive DOD contracts. However, some of these systems are not consistently producing accurate and reliable estimates for negotiating noncompetitive contract prices. In some cases, contract prices were higher than warranted because estimating weaknesses were not identified and considered during contract negotiations.

In response to hearings by your Subcommittee and our earlier recommendations, DOD has taken actions to improve the accuracy and reliability of contractor cost estimates. As a result, we are not making any recommendations at this time.

We discussed the results of our work with DOD and contractor representatives at the locations visited. As requested, we did not obtain official agency comments on a draft of this report. Unless you publicly announce its contents earlier, we plan no further distribution of this

report until 30 days from the date of the report. At that time we will send copies to the Secretary of Defense and other interested parties.

Sincerely yours,

Frank C. Conahan
Assistant Comptroller General

# Contents

## Abbreviations

DCAA Defense Contract Audit Agency
DOD Department of Defense

# Contracting Officers Did Not Receive Accurate and Reliable Estimates for Labor and Other Direct Costs

DOD annually awards billions of dollars in contracts without price competition. In the absence of the competitive marketplace to establish fair and reasonable contract prices, DOD contracting officers rely to a great extent on price proposals developed and submitted by contractors. Price proposals are developed by contractors from their cost estimating systems. Therefore, sound estimating systems are fundamental to negotiating fair and reasonable noncompetitive contract prices.

Cost estimating systems should use available data to develop accurate and reliable proposal estimates. Recognizing the government's vulnerability in negotiating noncompetitive contract prices, the Congress passed the Truth-in-Negotiations Act in 1962, 10 U.S.C. 2306a, as amended. The act, intended to protect the government against inflated cost estimates, requires contractors to submit cost or pricing data to support noncompetitive price proposals and to certify that the data submitted are accurate, complete, and current.

"Estimating System" is a term used to describe a contractor's system for generating estimates that forecast costs based on available information. Estimating systems include the organizational structure, estimating policies, procedures, methods, and techniques used by a contractor to generate cost estimates and other data included in price proposals.

The adequacy of an estimating system depends on many variables, and the relative importance or necessity of each is determined by the particular conditions present at each contractor location. In general, reliable systems should provide for the maintenance and use of appropriate source data, sound estimating techniques, including appropriate judgment, and a consistent approach. They should also provide for adherence to established policies and procedures, documentation of the rationale and support for estimates, and periodic assessments of the reliability of the estimates produced.

We reviewed contractor estimates for labor and other direct costs totaling $885 million in 35 prime contract proposals and found weaknesses in the methods used to develop the estimates. Among other things, we found that some contractors did not have written estimating procedures for developing the estimates, and some failed to adequately document the methods and supporting data used to develop the estimates.

Questionnaire responses from DCAA auditors working at 247 major contractor locations show that a significant number had similar weaknesses in their estimating systems. For example, 13 percent of the contractors

did not have written estimating policies and procedures. Also, about 25 percent of the contractors with written policies and procedures did not have procedures for one or more important estimating tasks such as documenting the rationale and support for estimates, and updating proposals with current information.

At several locations where we did our work, estimates were developed on the basis of judgment without any analytical support. Some judgmental estimates were not reconciled with historical costs even though the contractor had been producing the same or similar items for several years. Questionnaire responses show similar methods were used by other contractors. For example, engineering estimates instead of actual labor cost data were used to estimate manufacturing labor costs on 31 percent of the contracts for programs in the third or higher year of full-scale production.

We also found that contractors did not always have procedures for comparing estimates to the cost of performance as a basis for assessing the accuracy and reliability of their estimating practices. About 13 percent of the contractors, according to questionnaire responses, made no comparisons while 23 percent made comparisons on half or fewer of their contracts.

The estimating weaknesses identified at the contractor locations we reviewed resulted in estimates that were not accurate and reliable. Because the weaknesses were not always identified and eliminated during contract negotiations, some prices were higher than warranted. We were not able to determine the effect on contract prices in all cases, however, because some contractor accounting systems did not record actual costs for items included in proposals. Examples of estimating weaknesses are discussed in the following sections.

## Contractor Labor Estimates

We reviewed labor estimates at five contractor locations. The estimates, totaling $500 million, were included in 16 contract proposals.

Our review showed that the Raytheon Company's Equipment Division consistently overestimated the need for highly skilled engineers and the number of engineering drawing changes needed. The company's reliance on judgment and lack of verifiable support contributed to excessive engineering labor estimates in both areas. We reviewed engineering labor estimates totaling $12.4 million in seven price proposals for firm fixed-price contracts awarded to Raytheon between 1982 and 1984.

Navy contracting officers negotiated engineering costs of $11.9 million in the seven contracts.

As shown in table I.1, actual costs for the seven contracts through June 1987 were $8.2 million, or 33.5 percent less than Raytheon's estimates. When overhead and profit are considered, the estimating error increased the contract price proposals by about $11.9 million.

While the difference cannot be attributed solely to weaknesses in estimating engineering skill mix and drawing changes, we believe these problems contributed significantly. Raytheon officials told us the company experienced lower labor rates than proposed because inflation was lower than expected and that these lower rates also contributed to the underrun. We did not evaluate how labor rates were estimated. In addition, Raytheon officials noted the estimating process was complicated because of major design changes and variations in the combinations of hardware components for the missile fire control systems.

**Table I.1: Raytheon Engineering Labor Estimates**

Dollars in thousands

| Program | Contract number | Proposed | Actual costs[a] | Difference from proposed | |
|---|---|---|---|---|---|
| | | | | Amount | Percent |
| TARTAR | 82–5217 | $2,734 | $1,949 | $785 | 28.7 |
| TARTAR | 83–5209 | 612 | 196 | 416 | 67.9 |
| TARTAR | 84–5212 | 3,728 | 1,917 | 1,811 | 48.6 |
| TARTAR | 84–5512 | 2,339 | 1,355 | 984 | 42.1 |
| Seasparrow | 82–5224 | 1,453 | 1,560 | (107) | (7.3) |
| Seasparrow | 83–5210 | 1,260 | 1,056 | 204 | 16.2 |
| Seasparrow | 83–5214 | 260 | 204 | 56 | 21.5 |
| **Total** | | **$12,386** | **$8,237** | **$4,149** | **33.5** |
| Add-ons for indirect costs and profit | | | | 7,781 | |
| Effect on contract price proposals | | | | $11,930 | |

[a]Although some additional costs will be incurred they are expected to be minor

The effect of the overestimates on contract prices was reduced to $10.4 million during contract negotiations.

In its price proposals for all seven contracts listed in table I.1, Raytheon's estimates of skill mix included substantially more highly skilled engineers than needed. Raytheon estimated that senior engineers would be required for 35.7 percent of the proposed engineering labor efforts. Also, available skill mix data for six of the seven contracts showed Navy

contracting officers accepted a skill mix with senior engineers accounting for 34.8 percent of the total.

We found that Raytheon used senior engineers for only 21.9 percent of the engineering labor efforts. Moreover, Raytheon used considerably more lower skilled engineering personnel, such as engineering assistants, draftsmen, and clerks, than it proposed. Raytheon proposed to use these personnel for 12.4 percent of the work but actually used them for 27.5 percent. Since the average pay rate for lower skilled personnel was about half that for senior engineers, Raytheon was able to reduce its engineering labor costs.

Raytheon's estimates for individual engineering tasks were based on judgment without considering actual skill mix experience from prior contracts. Raytheon officials told us that actual skill mix data was not available for individual engineering tasks before 1986 even though both programs covered by the seven contracts had been in production for more than 10 years. In 1986 and 1987, Raytheon changed its estimating procedures for engineering skill mix to give its estimators historical skill mix data (by engineering tasks) that should be considered during the estimating process.

Raytheon also overestimated the number of engineering drawings that would need to be changed for one of the missile fire control systems. Four of the seven price proposals we reviewed were for this system. The drawing change estimates were important because they formed the basis for 25 to 57 percent of the engineering labor hours proposed for the four contracts.

On each of the four proposals, Raytheon estimated that 30 percent of the engineering drawings would need to be changed. DOD technical evaluators questioned the 30-percent estimates and recommended that it be reduced to 20 percent or less. They explained that because these contracts had overlapping production periods, the number of drawing changes needed would be substantially below Raytheon's estimate.

Navy contracting officers, however, negotiated an average of 28 percent for drawing changes. Actual drawing changes on the four contracts ranged from 4 percent to 15 percent, much less than Raytheon estimated and contracting officers negotiated.

Raytheon's proposals and related documentation did not support or explain the basis and rationale for the 30-percent drawing change estimates. Raytheon officials told us the estimates were based on prior contract experience but could not provide any data or documents supporting how the estimates were developed.

Raytheon's estimating procedures for engineering drawing changes were revised in 1985. The revised procedures provide for analyzing and using drawing change data from prior contracts to propose engineering labor costs on future contracts.

We found a similar weakness in the way Honeywell's Defense Systems Division estimated support labor costs.[1] Honeywell's estimates were based on judgments even though several years of experience from prior contracts was available. We also found Honeywell's procedures for estimating support labor costs did not specify how the estimates were to be developed or require its estimators to compare actual and estimated costs to test the accuracy and reliability of its estimating practices.

Honeywell included $30.5 million for support labor costs in 10 contract proposals for the production of antipersonnel and antiarmor mines from 1981 to 1985. We found Honeywell's support labor estimates were generally higher than costs on prior production contracts. Honeywell estimators told us they considered historical support labor costs but did not use these costs as a basis for their support labor estimates. The estimators also told us they did not document why their estimates were substantially higher than prior costs.

An Army evaluation team and DCAA recommended that Honeywell's estimates for the 1983 contracts be reduced because they exceeded labor hours experienced on prior contracts. The contracting officer achieved some reductions during price negotiations.

We reviewed actual support labor costs incurred by Honeywell and found the costs were consistently less than proposed and negotiated for the 10 contracts. Proposed and actual costs are shown in table I.2.

[1]Support labor includes inspection, production control, and several categories of engineering labor.

**Table I.2: Honeywell Support Labor Estimates**

| | Year | Proposed | Actual | Difference Amount | Difference Percent |
|---|---|---|---|---|---|
| **Antiarmor mines** | 1981 | $1,589,483 | $1,580,677 | $8,806 | 0 6 |
| | 1982 | 2,099,583 | 1,839,878 | 259,705 | 12 4 |
| | 1983 | 2,121,620 | 1,435,768 | 685,852 | 32 3 |
| | 1984 | 3,100,389 | 2,309,973 | 790,416 | 25.5 |
| | 1985 | 2,664,181 | 2,194,031 | 470,150 | 17 6 |
| **Total** | | **11,575,256** | **9,360,327** | **2,214,929** | **19.1** |
| **Antipersonnel mines** | 1981 | 2,265,582 | 1,724,596 | 540,986 | 23.9 |
| | 1982 | 4,099,812 | 3,808,858 | 290,954 | 7 1 |
| | 1983 | 2,971,867 | 2,024,375 | 947,492 | 31 9 |
| | 1984 | 4,660,891 | 4,273,984 | 386,907 | 8.3 |
| | 1985 | 4,934,698 | 3,898,900 | 1,035,798 | 21 0 |
| **Total** | | **18,932,850** | **15,730,713** | **3,202,137** | **16.9** |
| **Total** | | **$30,508,106** | **$25,091,040** | **5,417,066** | **17.8** |
| Add-ons for indirect costs and profit | | | | 11,198,984 | |
| Effect on contract price proposals | | | | $16,616,050 | |

The effect of the overestimates on contract prices was reduced to $10.9 million during contract negotiations.

Honeywell officials cited a shortened production schedule, lower labor rates, changes in inspection procedures, and the transfer of engineers as reasons for the variances on the 1983 contracts. These reasons may account for some of the variance, but our comparison of proposed and actual costs showed the company consistently incurred lower labor costs during the 5-year period.

If Honeywell's estimating procedures had required its estimators to compare actual support labor costs with its estimates, the estimators would have been aware that support labor estimates were consistently excessive. We believe excessive support labor estimates were negotiated in the prices for the 10 contracts.

Our work at Texas Instruments, Incorporated, showed the company's price proposal for a 1983 Navy contract overestimated direct manufacturing labor costs for the production of 41 infrared detection sets. We believe the overestimate occurred because the company did not use current historical data to develop its estimate. Further, the lack of sufficient and timely cost and pricing data to support proposed costs

contributed to the government's inability to evaluate and negotiate manufacturing labor costs.

Texas Instruments did not use the most current historical labor cost data that was available to estimate direct manufacturing labor cost for the 41 sets. The more current data should have been used because it included labor costs for the assembly of infrared sets at about the same rate expected on the proposed contract. In contrast, the historical data used by the company was for several years of lower rate production.

DCAA's audit report on Texas Instruments' initial price proposal questioned 37 percent of the estimated costs and noted that the proposal was inadequate in some respects. DCAA auditors questioned the company's proposed escalation rates for labor and recommended a rate about 30 percent less. However, the proposed escalation rates were later approved by the government. DCAA also recommended using a labor improvement curve that was more favorable to the government than the curve proposed by the company. According to the government technical analysis report, the company did not provide cost and pricing data to support its curve. In addition, the auditors and technical analyst questioned the company's proposed 10-percent labor variance rate as excessive because it was not supported.

The Navy contracting officer's pre-negotiation memorandum stated that the company's estimating system did not provide a full measure of cost visibility, thus precluding meaningful assurance of the precise labor cost. Texas Instruments officials told us the company provided additional data to support its labor improvement curve about 10 days before price agreement. We found, however, that the additional data did not include the most current production experience and was not audited. During negotiations, Texas Instruments and Navy officials did not agree on an amount for direct manufacturing labor. According to the negotiation memorandum, the Navy contracting officer accepted the company's proposed labor improvement curve and labor variance rate. The escalation rate the Navy accepted was slightly lower than the company proposed. The Navy contracting officer retired and was not available to discuss how labor costs were negotiated.

We calculated manufacturing labor costs incurred by Texas Instruments from work order cost records because the company does not maintain costs by contract. As the comparison in table I.3 shows, incurred costs

were about $10,200 (25 percent) less per set than the company estimated. When add-ons and profit are included, this amount increases to $68,800 per set or about $2.8 million for all 41 sets.

**Table I.3: Texas Instruments' Manufacturing Labor Estimate**

| | Cost per set | |
|---|---|---|
| | Labor | Total[a] |
| Proposed | $40,800 | $275,400 |
| Incurred | 30,600 | 206,600 |
| **Difference** | **$10,200** | **$68,800** |

[a]Includes add-ons and profit at the rates proposed.

The effect of the overestimate on the contract price for all 41 sets was reduced to about $1.5 million during contract negotiations.

Texas Instruments' estimate for manufacturing labor costs included a 10-percent labor variance. According to a company spokesperson, actual labor variance costs are not identified in the company's incurred cost records and the 10-percent rate must be added to incurred cost for a valid comparison between estimated and incurred manufacturing labor costs. We adjusted incurred costs for the labor variance. However, the Defense Contract Administration Service Office at Texas Instruments believes the company has not demonstrated that the costs intended to be recovered by the variance are incurred.

Since 1981, DCAA has repeatedly questioned Texas Instruments' estimating system and warned government contracting officers that the company's estimating methods may not provide a sound and reasonable basis for evaluating and negotiating fixed-priced contracts. In a September 1987 report on the company's estimating system, DCAA concluded that

"...the contractor's current estimating system, procedures, and practices are inadequate, and therefore unacceptable, to assure proposals and the final certified contract price are based on accurate, complete, and current cost or pricing data."

The government contract administration office at Texas Instruments has placed the company in a "Contractor Improvement Program." The program is designed to focus attention on contractors that need to correct unsatisfactory performance and requires the contractors to prepare written corrective action plans to resolve estimating system problems. Until the plan is implemented, the government contract administration

office monitors the company's proposals and advises DOD contracting officers to exercise caution in pricing contracts.

## Other Direct Cost Estimates

Our review of other direct cost[2] estimates was performed at four contractor locations. We examined estimates totaling $385 million for 14 other direct cost elements included in 19 proposals.

Contractors did not have written estimating procedures for 9 of the 14 other direct cost elements we reviewed. Contractor estimates for several elements were based largely on judgment without verifiable data and some other direct cost estimates were based on flawed methodology or incorrect data. Questionnaire responses show similar weaknesses at other contractor locations. For example, responses on 91 price proposals show that 26 percent contained at least one major cost element that was based on judgment with little or no support.

We were unable to determine what costs were actually incurred because contractor cost accounting systems did not record costs for all of the other direct cost estimates included in price proposals. Specific examples of estimating weaknesses follow.

Our work at General Dynamics Land Systems Division showed the company did not have written procedures for estimating miscellaneous material costs. Moreover, General Dynamics officials could not provide documents showing how proposed miscellaneous material costs had been developed or the data used to support its estimates.

General Dynamics included $55.5 million for miscellaneous material in three contract proposals for the production of tanks. DCAA and other government evaluators questioned the estimates because they were based on judgment without supporting data. Army contracting officers, however, included about $39.4 million in negotiated contract prices for these costs. According to the summaries of negotiations, the contracting officers and government evaluators believed the company was incurring some costs for miscellaneous material. However, actual costs incurred could not be determined because the company does not properly account for miscellaneous material costs.

[2]We defined other direct cost elements as those including items such as scrap, rework, raw materials, engineering changes, and miscellaneous materials. These items were estimated on the basis of rates, percentage factors, or cost estimating relationships.

The lack of written estimating procedures at General Dynamics has been identified by others. In July 1986, a law firm retained by the company to assess contract pricing practices recommended that procedures be established to

- formalize the data collection and proposal preparation process,
- establish a central file to support contract proposals and subsequent updates, and
- require estimators to document the method and data sources used to develop estimates.

In March 1987, DCAA also reported that General Dynamics needed to establish written estimating procedures before government negotiators could rely on the company's estimates for contract pricing purposes. One deficiency specifically cited by DCAA was the need for adequate written estimating policies and procedures for cost elements such as miscellaneous material.

General Dynamics officials told us they were drafting written procedures for estimating miscellaneous material and several other direct cost elements. The procedures will identify specific cost accounts to be used and will require estimators to document the rationale used in developing future estimates. When estimates differ from prior cost data, estimators will be required to explain the differences.

At Boeing Vertol Company, we found that estimates for a material scrap, loss, and rework cost element were based on judgments, which were not supported by verifiable data. Like General Dynamics, Boeing Vertol did not have written estimating procedures for this other direct cost element.

Boeing Vertol proposed $31.5 million for material scrap, loss, and rework in three contracts for modernization of helicopters by applying percentage rates to proposed material production costs. DCAA questioned the estimates because they were based primarily on judgment without verifiable support. DCAA also reported that Boeing Vertol did not maintain actual scrap statistics.

Negotiation records for these three contracts show contracting officers were aware that Boeing Vertol could not factually support the estimated material scrap, loss, and rework costs. The contracting officers, however, included about $17.9 million, or 57 percent, of the proposed costs

in the negotiated contract prices. The amounts negotiated by the contracting officers were generally based on either a review of Boeing Vertol's procurement records for prior contracts or discussions with company personnel.

Boeing Vertol officials told us they did not maintain complete and accurate records for these costs. As a result, we were not able to determine actual costs for material scrap, loss, and rework. We were told the company plans to begin accounting for these costs by January 1988.

At Martin Marietta Orlando Aerospace, we found weaknesses in the way raw material costs were estimated on an Air Force contract for navigation and targeting equipment. Specifically, the company used inappropriate methods in developing the support for its raw material estimate of $15.8 million for flight hardware.

Martin Marietta's raw material estimate was calculated by applying a factor of 3.9 percent[3] to certain factory material costs. DCAA reviewed the factor and advised the contracting officer that it was based on judgment. DCAA recommended a 1.3-percent raw material factor for pricing the contract, and the contracting officer included the lower factor in the government's negotiation objective.

During contract price negotiations, Martin Marietta gave the contracting officer data showing the raw material experience from a similar program was about 9.1 percent. Martin Marietta officials said they were only proposing a 3.9-percent factor for the new contract because it would require less raw material than the similar program. Based on the company's data and rationale, the contracting officer abandoned the 1.3-percent negotiation objective and accepted the contractor's proposed 3.9-percent factor. We could not determine what raw material costs were incurred because the company's records do not identify the costs.

We analyzed the data Martin Marietta submitted during negotiations and found the raw material factor for the similar program should have been 4.3 percent rather than 9.1 percent. Martin Marietta estimators overstated the factor because it was developed from incomplete data. Thus, the contracting officer relied on incorrect data and did not detect Martin Marietta's excessive estimate. After we discussed this matter

[3]We changed the percentage rates used in this example to protect Martin Marietta proprietary data, but did not change their relationships.

with Martin Marietta officials, the company revised its procedures for estimating raw material costs.

Texas Instruments included $32 million for a material scrap and general work order[4] factor in its proposal for production of missiles. The company developed the estimate by applying an 18-percent factor to proposed material costs. Texas Instruments did not have written estimating procedures for developing the factor. According to Texas Instruments officials, the factor was based on experience from a prior production contract. DCAA was unable to determine the factor's validity, however, because of inadequate supporting documents. As a result, DCAA recommended a 7.7-percent factor developed by a government technical analyst for contract pricing purposes.

During negotiations, Texas Instruments reduced the proposed factor to 14 percent but the supporting documents provided by the company were not adequate for the contracting officer to assess the reasonableness of the factor. The contracting officer, however, included a 12.6-percent factor, or about $22 million in the negotiated contract price for this cost element. The contracting officer told us the rate was based on an undocumented projection performed by a government contract analyst. We could not identify costs incurred by Texas Instruments for scrap and the general work order factor.

[4]Material costs for general work orders not associated with a particular fabricated part or subassembly.

# Questionnaire Responses on Contractor Cost Estimating Systems

To obtain additional information on defense contractors' cost estimating systems and practices, we sent two questionnaires to DCAA auditors who reviewed contractors' estimating practices and price proposals. The first questionnaire asked about the cost estimating policies and procedures of selected defense contractors. The second questionnaire asked about the methods and data sources used by contractors to develop price proposals for contracts awarded from July 1985 through June 1986. Both questionnaires were completed between December 1986 and February 1987.

The questionnaire responses indicated several areas where contractor policies, procedures, and practices could be improved. Furthermore, many of the areas where improvements could be made related to weaknesses identified during our work at contractor locations.

According to DCAA auditors, about 85 percent of the defense contractors had written policies and procedures for cost estimating. Thirteen percent of the contractors, however, did not have written policies and procedures, and during their last fiscal year, these contractors received about $3.8 billion in government contracts.

About 41 percent of the contractors had adequate procedures for major estimating tasks such as documenting the rationale and support for estimates and reviewing estimates for accuracy and completeness. However, about 25 percent of the contractors had no procedures for one or more major estimating tasks, and another 33 percent had procedures that DCAA auditors considered minimally adequate.

Questionnaire responses regarding specific contract proposals showed that estimating practices could also be improved. For example, on 108 contract price proposals containing vendor quotations, 72 percent were not adjusted to reflect reductions typically achieved during price negotiations with vendors.

On 55 of the 127 price proposals containing major subcontracts, questionnaire responses showed the contractors did not always comply with Federal Acquisition Regulation requirements. Specifically, contractors did not evaluate subcontract cost and pricing data on 36 percent of the proposals, and did not give subcontract evaluations to government contracting officers on another 29 percent.

We also requested information to determine whether contractors were estimating costs based on production experience as it became available. About 56 percent of the contract price proposals (71 of 127) were for

programs in the third or higher year of full-scale production. About 31 percent of the contract proposals contained estimates for manufacturing labor costs that were based on engineering estimates.

We also asked whether the contract price proposals contained major cost elements developed from a rate or factor that was not included in a forward pricing agreement. Ninety-one of the contract price proposals included at least one such element. According to DCAA, most rates or factors used in the 91 proposals were based primarily on historical data. About 24 (26%) of the proposals, however, had at least one rate or factor based primarily on judgment with little or no support.

## Contractor Policies and Procedures

The 247 contractors on which we received information from DCAA auditors had revenues ranging from $14 million to $6 billion in their most recently completed fiscal year (1985 or 1986) and received about $99 billion in revenues from government contracts during that year. Our sample included 23 of the top 25 fiscal year 1986 DOD prime contractors which accounted for 49 percent of the contract awards.

### Thirteen Percent Do Not Have Written Estimating Policies and Procedures

According to DCAA auditors, about 85 percent of the contractors (212 of 247) had written estimating polices and procedures. However, as shown in table II.1, 13 percent (31) did not have written policies and procedures.

**Table II.1: Estimating Policies and Procedures**

| | Yes | No | Cannot determine |
|---|---|---|---|
| Contractor had written estimating policies and procedures | 212 (85%) | 31 (13%) | 4 (2%) |
| Total government contracts received in most recent fiscal year (billions) | $93.4 | $3.8 | $1.7 |

### More Than Half the Contractors Had No or Minimally Adequate Procedures for Important Estimating Tasks

In the judgment of DCAA auditors, 25 percent of the contractors with written procedures (52 of 212) did not have procedures for one or more of five important estimating tasks. Thirty-three percent (71 of 212) had minimally adequate procedures to deal with one or more of the tasks. About 41 percent (87 of 212) had procedures judged to be adequate for all tasks. Table II.2 summarizes the DCAA auditors' assessment of the adequacy of contractors' procedures for the five estimating tasks.

**Table II.2: Assessment of Procedures for Selected Estimating Tasks[a]**

Figures in parentheses in percent

| Estimating task | Number of Contractors with No procedures | | Minimally adequate | | Adequate procedures | |
|---|---|---|---|---|---|---|
| Selecting appropriate data and alternatives or adjustments to data | 21 | (10) | 45 | (21) | 144 | (69) |
| Selecting appropriate methods and techniques | 21 | (10) | 46 | (22) | 145 | (68) |
| Documenting rationale and support for estimates | 16 | (8) | 56 | (27) | 139 | (66) |
| Performing overall review | 7 | (4) | 26 | (12) | 179 | (84) |
| Updating proposals with current information | 27 | (13) | 36 | (17) | 149 | (70) |

[a]Total number does not add to 212 because of non-responses

## Most Contractors Can Compare Estimates to Actual Costs, but Some Cannot or Do Not

To assess the accuracy and reliability of estimating practices, contractors should compare estimates with the cost of contract performance. The comparisons can be made by using either proposal estimates or budget estimates. If budget estimates are used, they need to be comparable to the proposal estimates.

Not all contractors, however, are able to link budget and proposal estimates. About 47 percent of the contractors can link budget and proposal estimates for all or almost all cost categories. As shown in table II.3, the remaining contractors can link budget and proposal estimates for some cost categories.

**Table II.3: Ability to Compare Budget and Proposal Estimates[a]**

| | Contractors | |
|---|---|---|
| | Percent | Number |
| Can compare all or almost all categories | 47 | 116 |
| Can compare major cost categories plus other costs that make up major categories | 35 | 86 |
| Can compare costs only at the level of major categories like labor and materials | 11 | 27 |
| Cannot compare estimates to actual costs | 2 | 5 |
| Other | 5 | 11 |

[a]Total number of contractors does not add to 247 because of non-responses

We asked how frequently contractors compared proposal and budget estimates to the costs of performance when not required to do so by the government. As shown in table II.4, about 35 percent of the contractors compared proposal estimates to actual costs on most contracts, while 13

percent made no such comparisons. In addition, 53 percent of the contractors compared budgets with actual costs on most contracts, while 16 percent made this comparison on half or less of their contracts.

**Table II.4: Frequency That Contractors Compare Estimates to Actual Costs[a]**

| | Contractor compares proposal estimates to actual costs | | Contractor compares budgets to actual costs | |
|---|---|---|---|---|
| **Frequency** | **Percent** | **Number** | **Percent** | **Number** |
| For most contracts | 35 | 86 | 53 | 129 |
| For 50% or fewer | 23 | 57 | 16 | 38 |
| No comparison | 13 | 31 | Not applicable | |
| No basis to determine | 29 | 71 | 31 | 77 |

[a]Totals do not add to 247 because of non-responses.

## Methods and Data Used to Develop Price Proposals for Noncompetitive Contracts

Our analysis of questionnaire responses dealing with the methods contractors used to estimate costs for 127 noncompetitive fixed-price contracts awarded during DCAA management year 1986 is discussed in the following sections. The price proposals for the 127 contracts had a total dollar value of $14.4 billion and ranged from $2.6 million to $1 billion.

### Material Cost Estimates

Our questionnaire focused on direct material cost estimates associated with subcontracts and vendor purchases. Of the 127 contract price proposals, 126 (or 99%) contained material cost estimates that amounted to $5.1 billion. Fifty-five of the 126 proposals contained noncompetitive subcontracts of $1 million or more. The estimates for major subcontracts in 54 of the 55 proposals totaled $1.9 billion.

### Some Cost and Pricing Data Was Not Provided to Contracting Officers

The Federal Acquisition Regulation requires contractors to obtain cost and pricing data on major (exceeding $1 million) noncompetitive, prospectively priced subcontracts, evaluate the data, and give it to the contracting officer before negotiations.

According to DCAA auditors, on 9 of the 55 proposals containing major noncompetitive subcontract proposals, cost and pricing data were not obtained from all prospective subcontractors as required. On 20 of the 55 proposals, cost and pricing data were not evaluated as required, and on another 16, evaluations were not provided to the contracting officer.

Table II.5 presents information on major prospectively priced subcontracts.

**Table II.5: Compliance With Federal Acquisition Regulation Requirements for Major Noncompetitive Subcontracts[a]**

| Requirement | Contractors: Complied Percent | Contractors: Complied Number | Contractors: Did not comply Percent | Contractors: Did not comply Number | No basis to determine Percent | No basis to determine Number |
|---|---|---|---|---|---|---|
| Obtain cost and pricing data | 78 | 43 | 16 | 9 | 6 | 3 |
| Provide data to contracting officer before negotiations | 60 | 33 | 16 | 9 | 24 | 13 |
| Evaluate data | 47 | 26 | 36 | 20 | 16 | 9 |
| Provide evaluations to contracting officer before negotiations | 38 | 21 | 29 | 16 | 33 | 18 |

[a]Based on 55 proposals that contained major subcontracts

## Practices Used in Determining Inflation and Decrement Factors

Contractors used inflation factors in material estimates amounting to $4.5 billion on 80 percent (101 of 126) of the price proposals containing direct materials. On nearly 27 percent of the proposals (27 of 101), the inflation rate was based primarily on the estimators' judgment. The remaining proposals used a variety of other sources to estimate inflation, including outside economic (34 percent) and corporate (27 percent) forecasts.

Contractors also used vendor quotations to estimate material costs in 108 (86 percent) of the price proposals. However, on 78 of the 108 proposals, the contractors did not include an adjustment—commonly called a decrement factor—for reductions typically achieved during price negotiations with vendors. Table II.6 contains information on the use of decrement factors.

**Table II.6: Use of Decrement Factors to Adjust Vendor Quotations[a]**

| | Contractors: Percent | Contractors: Number |
|---|---|---|
| Decrement not used | 72 | 78 |
| Decrement based on historical data | 19 | 20 |
| Decrement based on other methods | 9 | 10 |

[a]Based on 108 proposals containing vendor quotations

## Labor Costs Estimates

Ninety-three percent of the proposals (118 of 127) contained direct manufacturing labor costs estimated at $949 million. As shown in table II.7,

different types of accounting data were used to determine manufacturing labor. For example, job order or lot cost data were used for 52 percent (61 of 118) of the proposals, while engineering estimates were used for 24 percent of the proposals.

**Table II.7: Cost Accounting Data Used to Estimate Direct Manufacturing Labor Costs[a]**

| | Contractors | |
|---|---|---|
| | Percent | Number |
| Job order/lot cost data | 52 | 61 |
| Engineering estimates | 24 | 28 |
| Standard cost data | 9 | 11 |
| Process cost data | 2 | 2 |
| Cannot determine/other | 13 | 16 |

[a]Based on 118 proposals with manufacturing labor estimates.

Ninety-one percent (116 of 127) of the proposals contained engineering labor costs estimated at $550 million and contractors also used various methods to estimate these costs. According to DCAA auditors, 56 percent of the proposals (65 of 116) estimated engineering labor costs by projecting the staff level needed to perform engineering functions or tasks. Contractors used historical data to estimate engineering costs on 37 of the 116 proposals.

## Relationship of Program Maturity to Methods and Data Used to Estimate Labor Costs

About 56 percent of the proposals (71 of 127) were for programs in their third or higher year of full-scale production, while 31 percent (39) were for programs in development or an early production period (second year of production or less). The remaining proposals were either for spare parts or the production period could not be determined.

We believe that estimates for programs in the third or higher year of full-scale production should consider production experience. About 50 percent of the proposals for programs in the third or higher year of full-scale production estimated labor rates from prior production experience. Still, 40 percent of the proposals estimated labor rates on general categories such as employee job classifications or departments. Table II.8 compares the methods and data used to estimate selected labor costs by stage of production.

**Table II.8: Production Phase and Primary Data or Method Used to Estimate Labor Costs[a]**

| | Development/ first 2 years production | | Third year or higher production | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| **Data used to estimate direct manufacturing labor costs** | | | | |
| Job order/lot cost | 15 | 43 | 42 | 63 |
| Standard/process cost data | 8 | 23 | 4 | 6 |
| Engineering estimates (other) | 11 | 34 | 21 | 31 |
| **Total** | **34** | **100** | **67** | **100** |
| **Direct labor rate used to develop engineering and other labor costs** | | | | |
| Forward pricing rate agreement | 13 | 38 | 12 | 18 |
| Program/contract specific rate | 3 | 9 | 12 | 18 |
| Plant-wide average labor rate | 7 | 21 | 26 | 40 |
| Other | 11 | 32 | 15 | 24 |
| **Total** | **34** | **100** | **65** | **100** |
| **Primary method of categorizing employees to develop labor rates** | | | | |
| By department or function | 24 | 71 | 26 | 40 |
| By plant or work location | 0 | | 3 | 5 |
| By type of work performed | 9 | 26 | 33 | 50 |
| Other | 1 | 3 | 3 | 5 |
| **Total** | **34** | **100** | **65** | **100** |
| **Method used to estimate engineering labor costs** | | | | |
| Estimated staff level needed to perform engineering functions or tasks | 17 | 51 | 36 | 55 |
| Estimated historical hours/costs on similar programs | 15 | 43 | 18 | 27 |
| Other | 1 | 6 | 11 | 18 |
| **Total** | **33** | **100** | **65** | **100** |

[a]Based on 39 contracts in development or first 2 years of production and 71 in their third year or higher of full-scale production. Individual categories may not add to this total because not all contracts contain the specific cost or the rate. The "other" category includes proposals for which more than one primary method or rate was used to develop estimates for a cost category.

## Estimates of Rates and Factors for Direct Costs

On 72 percent of the price proposals (91 of 127), contractors estimated at least one major cost element using a rate or factor that was not part of a forward pricing agreement. The direct costs on the 91 proposals totaled about $7.2 billion.

Rates and factors used in the 91 price proposals were based primarily on historical data. However, 26 percent of the proposals (24 of 91) used at least one rate or factor that was based on judgment with little or no

support. Table II.9 displays information based on the rates and factors used in the proposals.

**Table II.9: Primary Basis for Determining Rates and Factors in Proposals by Direct Cost Element[a]**

| | Rate/factor based on historical data | | Rate/factor based on judgement | | Other/no basis to determine | | |
|---|---|---|---|---|---|---|---|
| Cost element | Number | Percent | Number | Percent | Number | Percent | Total |
| Manufacturing labor | 48 | 83 | 6 | 10 | 4 | 7 | 58 |
| Engineering labor | 40 | 78 | 4 | 8 | 7 | 14 | 51 |
| Materials | 53 | 75 | 15 | 21 | 3 | 4 | 71 |
| Other direct costs | 61 | 80 | 9 | 12 | 6 | 8 | 76 |

[a]Percentages for each line are based on the number of proposals containing the direct cost element and using a rate/factor to estimate it

# Objective, Scope, and Methodology

Our objective was to determine whether defense contractor estimating systems consistently produced accurate and reliable estimates for labor and other direct costs. At 8 locations of the top 50 fiscal year 1986 defense contractors, we reviewed the policies, procedures, and practices used to develop estimates totaling $885 million included in 35 prime contract proposals. The contractor locations are listed in appendix IV.

For the purpose of our review, we defined "other direct costs" as those which could have been discretely estimated (such as raw materials, scrap, and rework) but were estimated instead, on the bases of rates, percentage factors, or cost estimating relationships. We did not review estimates for indirect costs or direct cost estimates covered by forward pricing agreements.

To accomplish our objective, we reviewed contractor estimates for fixed-price, noncompetitive contract proposals valued at $9 million or more. Specifically, we reviewed the methods and techniques used by 4 contractors to estimate other direct costs valued at $385 million included in 19 fixed-price contract proposals. We also reviewed the methods and techniques 5 contractors used to estimate engineering and manufacturing labor costs valued at $500 million in 16 fixed-price contract proposals.

In assessing the accuracy and reliability of contractor estimates, we reviewed contractors' written estimating procedures, final proposed costs, and the methods and techniques used in developing estimates. Documents supporting the estimates were analyzed and contract performance cost data were obtained.

We reviewed audits of contractors' estimating systems conducted by DCAA and others. Government audits, evaluations, and price negotiation memorandums of individual contract proposals were also reviewed.

To obtain additional information on the adequacy of contractor estimating systems, we sent two questionnaires to DCAA field offices in December 1986. DCAA maintained about 292 resident offices at defense contractor locations that had $10 million or more in DOD negotiated contracts and were expected to continue receiving a large dollar amount of these contracts. The DCAA resident offices are responsible for reviewing the contractors' estimating practices and individual contract price proposals.

We sent the first questionnaire to all 292 DCAA resident offices and requested information about the estimating policies and procedures of

the contractor they audited. Eighty-five percent of the resident offices (247 of 292) provided information on contractors. They did not respond to an average of 0.4 percent of the questions used in our analysis, so the effective response rate was somewhat lower than 85 percent. Based on the coverage and response rate we believe that this survey represents defense contractors that regularly receive major negotiated contracts, with the exception of oil companies.

To obtain information on the methods and data sources used to estimate contract costs, we selected all fixed-price manufacturing contracts of $10 million or more that were awarded noncompetitively to U.S. contractors from July 1985 to June 1986. There were 140 of these contracts.

We sent the second questionnaire to DCAA offices that reviewed the contract price proposals and asked about the cost estimating methods used by the contractors. Information on 111 of the 140 contract price proposals was received for a response rate of about 80 percent.

DCAA auditors also sent information on 16 price proposals where the contracts were classified as competitive, but otherwise met all our criteria. Because the 16 contract prices were negotiated on the basis of cost and pricing data, we included them in our analysis. Our analysis of estimating methods, thus, includes 127 contract proposals. The average nonresponse to questions used in our analysis of this questionnaire was about 0.08 percent.

To verify the reliability of responses to both questionnaires, we interviewed DCAA auditors who completed 10 questionnaires on contractor policies and procedures, and 17 questionnaires on estimating practices. We found the responses to questions used in our analysis were generally consistent with the records that DCAA had on file.

We discussed the results of our work with DOD and contractor representatives at the locations visited. As requested, we did not obtain official comments on a draft of this report.

Our review was performed in accordance with generally accepted government auditing standards between October 1986 and July 1987.

# Contractor Locations

Raytheon Company,
Equipment Division
Bedford, Massachusetts

Honeywell Incorporated,
Defense Systems Division
Minnetonka, Minnesota

Texas Instruments,
Defense Systems and Electronics Group
Dallas, Texas

McDonnell Douglas Corporation,
McDonnell Aircraft Company
St. Louis, Missouri

Boeing Company,
Boeing Vertol Division
Philadelphia, Pennsylvania

Martin Marietta Corporation,
Orlando Aerospace
Orlando, Florida

General Dynamics Corporation,
Land Systems Division
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