PERFORMANCE AUDIT

DEPARTMENT OF TRANSPORTATION

CONSTRUCTION STAFFING LEVELS

Report to the Arizona Legislature
By the Auditor General
September 1990
90-4

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September 28, 1990

Members of the Arizona Legislature
The Honorable Rose Mofford, Governor
Mr. James S. Creedon, Acting Director
Department of Transportation

Transmitted herewith is a report of the Auditor General, A Performance Audit of Department of Transportation's construction staffing levels. This report is in response to the requirements of Chapter 68 of the 1989 Session Laws.

We found that the Department has strengthened management of its construction staff since our 1987 audit. Construction engineering costs for ADOT-managed projects were within one percent of departmental goals between January 1, 1987 and April 30, 1990. However, staffing costs for consultant-managed projects exceeded goals by approximately $3.6 million, or 18 percent, during the same period. ADOT needs to review consultant projects to determine why costs are above goals.

In addition, we found that the Department's efforts to improve methods for estimating the need for construction staff have not been successful to date. Without corrective measures, ADOT's computer-based staffing projections will continue to be unreliable.

My staff and I will be pleased to discuss or clarify items in the report.

Sincerely,

Douglas R. Norton
Auditor General

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SUMMARY

The Office of the Auditor General has conducted a performance audit of the Arizona Department of Transportation's (ADOT) construction staffing levels in response to the requirements of Chapter 68 of the 1988 Session Laws. This is the third and last in a series of reports addressing the requirements of Chapter 68.

This report is a follow up to our 1987 performance audit of ADOT staffing levels. The 1987 audit found that the Department had not adequately controlled construction staffing levels between fiscal years 1982-83 and 1986-87.

Although ADOT Has Improved Control of Staff-Related Costs, Additional Controls Are Needed To Ensure That The Department Meets Its Cost Goals For Consultant-Managed Projects **(see pages 7 through 13)**

ADOT has improved its management of staff-related costs since our 1987 report. Staff-related costs were very close to agency goals for projects managed by its own staff--only $278,000 above goal amounts, or less than one percent--during the period of our review. However, during the last three fiscal years, highway projects managed by private consultants were above the Department's staff-related goals by almost $3.6 million or 18 percent.

Because the Department was unable to provide needed information in a timely manner, we were unable to complete further analysis regarding ADOT's staffing levels, or determine the reasons the Department has been unable to meet its cost goals for consultant-managed projects. Data sufficient to perform our analysis was not provided until seven weeks after the scheduled end of our audit fieldwork.

Department Efforts To Improve Construction Staffing Estimates Have Been Inadequate **(see pages 15 through 20)**

The Department's attempt to improve computer estimates of construction staffing needs has been, thus far, unsuccessful. Upgrading this

capability would benefit ADOT. Because current computer forecasts are poor, Department managers have to rely heavily on their own judgment and experience in estimating and controlling staffing. For example, in almost one-half of the cases we reviewed, Department managers adjusted system forecasts, up or down, by 40 percent or more. Estimates made by ADOT managers, however, have not been much better than the computer estimates. Actual staff utilization has ranged from 97 percent higher to 200 percent lower than that predicted by ADOT managers.

Shortcuts taken by ADOT have undermined the agency's efforts to upgrade computer estimates. A key element in ADOT's computer forecasts is its planning values. These values, expressed in terms of labor hours needed per roadway mile for a construction activity (i.e., 1,000 man hours per mile of earthwork), have never been updated. Attempts by ADOT to update its planning values have been unsuccessful due to a variety of factors, ranging from poor sampling techniques to self-imposed deadlines. Consequently, unless corrective measures are taken, the Department's computer-based staffing projections will continue to be unreliable.

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INTRODUCTION AND BACKGROUND

The Office of the Auditor General has conducted a performance audit of the Arizona Department of Transportation's construction staffing levels in response to the requirements of Chapter 68 of the 1988 Session Laws. This is the third and last in a series of reports addressing the requirements of Chapter 68.

The Arizona Department of Transportation (ADOT) is organized into five divisions: Administrative Services, Transportation Planning, Aeronautics, Motor Vehicles, and Highways. This report focuses on the activities and staffing costs of the Highway Operations Group within the Highways Division.

The Highway Operations Group manages all highway construction in Arizona.[1] The actual construction of roads is performed by private contractors selected through a competitive bidding process. The specific activities performed within the Highway Operations Group, called construction engineering, include the following:

- inspection and materials testing of roadway construction to ensure procedures and materials meet plans and specifications;
- surveying;
- reviewing roadway design drawings;
- approving all payments to contractors for labor and materials;
- monitoring force accounts;
- processing contractor claims; and
- reviewing and approving change orders.

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(1) In addition to managing construction, the Highway Operations Group is also responsible for maintaining all State highways.

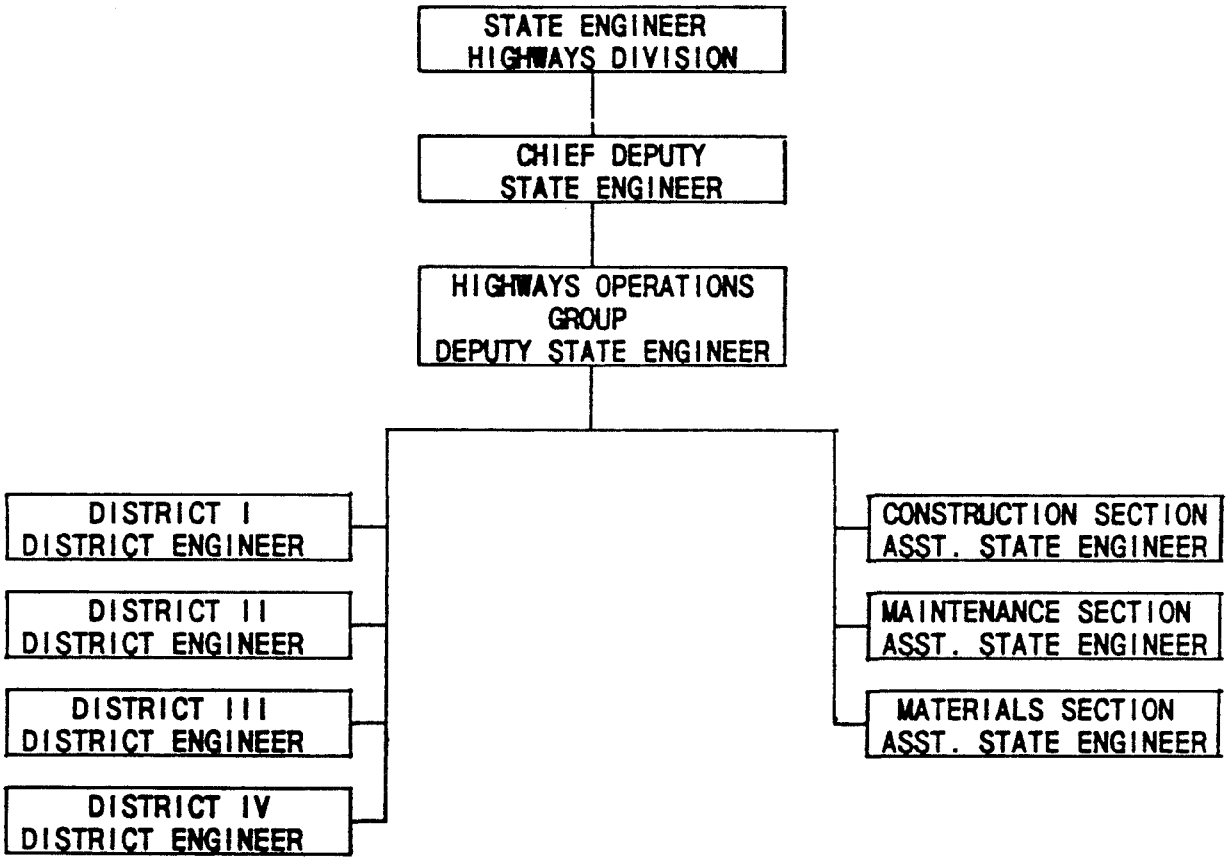
Although most of these activities continue to be the responsibility of full-time ADOT personnel, the Department contracts with private engineering firms, and hires temporary and seasonal personnel to augment in-house staff. ADOT has also begun transferring some quality control and surveying responsibilities to the contractors.

Organization and Staffing

The Highway Operations Group carries out its responsibilities through staff in four engineering districts and its central office. (See Figure 1)

FIGURE 1

HIGHWAY OPERATIONS GROUP



Source: Arizona Department of Transportation

District construction staff, organized into areas encompassing several construction units, oversee construction activities, and provide on-site

inspections. Construction units typically include engineering specialists, quality control technicians, survey personnel, materials testing staff, and records clerks.

Construction staff are funded primarily from the ADOT construction budget established each year by the Transportation Board. Construction funds are derived from the Highway User Revenue Fund (HURF) which consists of revenues from the gasoline tax and other transportation-related fees. HURF funds and construction staff positions are not appropriated by the Legislature; both are determined by the Department, based on total construction activity. The five-year construction program adopted by the Transportation Board in June 1990, projects construction costs of $2.4 billion for fiscal years 1990-91 through 1994-95. During the previous three years (January 1, 1987 through April 30, 1990) construction engineering costs were approximately $110 million, or 10 percent of total construction costs. As of June 30, 1990, the Highway Operations Group had budgeted 650 full-time employees (FTEs), 581 of which are filled. Most of these positions are allocated to the four construction districts.

Previous Audit Findings

Our 1987 performance audit of ADOT's construction management function found that the Department had not adequately controlled construction staffing levels. We also found that the Construction Engineering Manpower Management System (CEMMS) was not being effectively utilized. Although repeatedly informed of problems with the system, Department managers took little action to correct deficiencies, or ensure system utilization.

Based on our findings, we recommended ADOT consider other options, such as using more consulting engineers and contracting more construction engineering functions, before increasing its construction staff to meet the needs of its growing construction program. We also recommended that the Legislature establish and monitor construction staffing levels to ensure staffing patterns reflect the Department's fluctuating workload.

We recommended that ADOT upper management make a firm commitment to address its problems with the manpower management system to ensure that staff and other resources are used efficiently and effectively.

In its response to our audit, ADOT strongly disagreed with the Finding that it was overstaffed, and submitted information indicating construction engineering staffing levels were generally less than needed, rather than too high. The Department acknowledged the need to improve CEMMS utilization and correct system deficiencies.

Since the 1987 audit, ADOT has taken several actions to improve control of construction engineering staffing. The Department currently limits the number of construction engineering staff to 585 FTEs rather than at its authorized level of 650. The Department uses consultant administrators to manage some projects, and has contracted with engineering firms to provide technicians on an as needed basis to handle activities when ADOT staff are not available. ADOT management issued a memorandum stating its expectations that all staff would utilize CEMMS and other Departmental systems in managing their construction staff. In addition, the Department is in the process of revising its manpower management system.

Audit Scope and Purpose

Our audit focused on the staffing levels required by ADOT's Highway Operations Group to effectively and efficiently manage Arizona's highway construction program. The report presents findings in two areas:

- the extent to which ADOT has met its construction staffing goals in recent fiscal years, and
- ADOT's ability to estimate its needs for construction engineering staff.

Our audit was conducted in accordance with generally accepted governmental auditing standards. However, our ability to complete our audit work was limited because ADOT could not provide us with reliable financial information in a timely manner (see page 12).

The Auditor General and staff express appreciation to the Director and staff of the Arizona Department of Transportation for their cooperation and assistance during the audit.

FINDING I

ALTHOUGH THE ARIZONA DEPARTMENT OF TRANSPORTATION HAS IMPROVED CONTROL OF STAFF-RELATED COSTS, ADDITIONAL CONTROLS ARE NEEDED TO ENSURE THAT THE DEPARTMENT MEETS ITS COST GOALS FOR CONSULTANT-MANAGED PROJECTS

The Arizona Department of Transportation (ADOT) has made improvements in managing staff-related costs. Although the Department has all but eliminated excess costs for projects managed by its own staff, consultant-administered projects substantially exceeded cost goals during the last three fiscal years. We were unable to complete further analysis regarding ADOT's staff levels or determine why consultant-administered projects exceeded cost goals, due to time constraints as a result of the Department's inability to provide timely financial information.

ADOT construction staff are engaged primarily in Construction Engineering (CE) activities.(1) The Department also hires consultants to perform Construction Engineering on some projects, either because of staff shortages when construction begins or because of the projects' complexity. Thus, CE costs are an important measure for determining the Department's efficiency in controlling both construction and consultant staffing. The Department establishes CE cost goals as a means of evaluating its ability to control staff-related costs. These goals are based on a percentage of the contractor payments for each project, and vary according to the size of the project. For example, the goal for smaller projects ($25,000 and under) is 25 percent of contractor payments, while for larger projects (over $20 million) the goal is much lower--6 percent. Our 1987 report on construction management (Report number 87-11) used construction engineering costs as a measure of staffing efficiency, and a similar approach has been taken in this report.

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(1) These activities, such as testing the density of concrete or weighing aggregate materials, allow the Department to ensure that the construction work performed by private contractors conforms to ADOT's requirements and specifications and to gather documentation for contractor payments.

ADOT Has Improved Efficiency of In-House Staff But Consultant Costs Are Well Above Goals

ADOT has reduced its in-house construction staff, but exceeds cost goals for projects managed by consultants. Even though the highway construction program has grown substantially, construction staff levels are lower than previous years. Overall, ADOT's in-house construction-related staffing costs were within $278,000 or less than 1 percent of its goals during the last three years. However, the cost of using consultants to manage projects exceeded Departmental goals by 18 percent, or almost $3.6 million during the same period.

We analyzed staff related costs for the period January 1, 1987 through April 30, 1990.(1) A comparison of CE costs with cost goals presented in Table 1 (see page 9) and Table 3 (see page 11) estimates the efficiency in which staff-related expenditures are made by ADOT during a given time period. The analysis included construction projects which accrued costs during the period and compared actual CE costs to the costs that would be expected if the Department met its CE goals.(2) Since our analysis included some projects started prior to January 1, 1987 and completed during the review period, as well as projects started during the review period and still underway as of April 30, 1990, we applied the appropriate CE cost goals only to project costs incurred during our review period.

In-House staff levels - Overall, ADOT has reduced in-house staff even as its construction program grew significantly. During fiscal year 1985-86 the Department had 614 field staff supervising $184.7 million in construction activity. By the end of fiscal year 1988-89, when the construction program peaked at $303.6 million, the Department's permanent construction staff was 578.

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(1) We obtained expenditure information from the ADOT Transportation Accounting System (TRACs) general ledger and memo ledger files for July 1, 1988 through April 30, 1990 and from pre-TRACs accounting systems for January 1, 1987 through June 30, 1988. January 1, 1987, was purposely selected as the start date for our analysis because it corresponded to the approximate end date of the staff analysis in our 1987 report on construction management.

(2) CE cost goals used in this report were derived from over $1 billion in contractor payments. A total of $828,265 in payments withheld from contractors by ADOT, as a result of liquidated damages assessed for exceeding scheduled construction end dates, were not included in our calculation.

In-House Staff Related Costs - Between January 1, 1987 and April 30, 1990, (Table 1), staff-related costs for projects managed by ADOT were $278,000, or less than one percent above the Department's CE cost goals for the period. The CE cost analysis shows costs were above goals in all but two categories, notably in projects over $20 million, where the Department's CE costs were more than $1 million over cost goals. However, the Department was well below its staffing goals in projects of $5 to $10 million, achieving CE costs of 7 percent of total project costs, well below its 9 percent goal. ADOT was also under its goal by approximately $492,000 for projects between $1 million and $2 million.

TABLE 1

STAFF-RELATED COST ANALYSIS FOR ADOT-ADMINISTERED PROJECTS BY PROJECT CATEGORY JANUARY 1, 1987--APRIL 30, 1990

Project Category	CE Goal Amount	Actual CE Costs	Favorable (Unfavorable) Variance
$0-25,000	$460,355	$572,851	($112,496)
$25-50,000	389,214	557,161	(167,947)
$50-100,000	778,685	1,065,672	(286,987)
$100-500,000	8,118,972	8,962,992	(844,020)
$500-1 million	7,313,477	7,548,729	(235,252)
$1-2 million	11,151,866	10,660,249	491,617
$2-5 million	21,804,675	22,133,098	(328,423)
$5-10 million	13,759,636	11,368,505	2,391,131
$10-20 million	10,680,438	10,771,371	(90,933)
Over $20 million	11,976,706	13,071,496	(1,094,790)
All Categories	$86,434,024	$86,712,124	($ 278,100)

Source: State of Arizona, Office of the Auditor General staff analysis of construction and construction engineering expenditures for the period January 1, 1987--April 30, 1990.

As indicated in Table 2, the Department has shown steady progress in reducing the overall staffing costs for projects managed by in-house staff during the period of our review. Costs fell from almost 11 percent of contractor payments in January-June 1987 to 8.96 percent in the first ten months of fiscal year 1990. This reduction occurred during a time when ADOT's construction program was increasing--total contractor payments rose to a peak of $303.6 million in fiscal year 1988-89.

TABLE 2

STAFF-RELATED COST ANALYSIS FOR ADOT-ADMINISTERED PROJECTS BY FISCAL YEAR JANUARY 1, 1987--APRIL 30, 1990

Fiscal Year	Contractor Payments	Actual CE Costs	CE Percent Achieved
1986-87(a)	$105,911,174	$11,602,456	10.95%
1987-88	266,002,709	25,754,189	9.68
1988-89	303,622,115	27,870,181	9.18
1989-90(b)	239,765,655	21,484,949	8.96

(a) January 1, 1987--June 30, 1987, only.
(b) July 1, 1989--April 30, 1990, only.

Source: State of Arizona, Office of the Auditor General staff analysis of construction and construction engineering expenditures for the period January 1, 1987--April 30, 1990.

Consultant-administered projects - Total staff-related costs for consultant-administered projects exceeded goals by approximately $3.6 million during the period of our review (Table 3, page 11). The

Department's policy of hiring consultants was instituted as a means of addressing peak construction requirements or obtaining special expertise without increasing permanent staffing levels. Although the use of consultants may have enabled ADOT to limit the number of its in-house construction staff, the Department has incurred higher costs--18 percent above its staffing goals--on projects managed by consultants.

TABLE 3

STAFF-RELATED COST ANALYSIS FOR CONSULTANT-ADMINISTERED PROJECTS BY PROJECT CATEGORY
January 1, 1987--April 30, 1990

Project Category	CE Goal Amount	Actual CE Costs	Favorable (Unfavorable) Variance
$0-500,000	$331,027	$476,864	($145,837)
$500-1 million	599,564	941,770	(342,206)
$1-2 million	207,720	164,246	43,474
$2-5 million	1,514,558	2,727,804	(1,213,246)
$5-10 million	931,781	1,105,104	(173,323)
$10-20 million	2,864,293	4,638,914	(1,774,622)
Over $20 million	13,528,443	13,512,111	16,332
All Categories	$19,977,386	$23,566,813	($3,589,428)

Source: State of Arizona, Office of the Auditor General staff analysis of construction and construction engineering expenditures for the period January 1, 1987--April 30, 1990.

CE costs in excess of the Department's established goals for consultant-administered projects[1] occurred in all but two project

(1) Cost goals for consultant-administered projects are generally higher than for those projects managed by ADOT staff. For example, the CE goal for consultant-administered projects over $20 million is 10 percent compared to 6 percent for ADOT-administered projects.

categories. Costs were below goals for projects with total contracted costs of $1 to 2 million and those with total costs over $20 million. However, costs exceeded goals in the other five project categories, particularly for those with total costs of $2-5 million and $10-20 million.

ADOT believes it may have underestimated the costs needed by consultants for project administration. The Department noted that the goals used for consultant-administered jobs were based on fewer than 20 projects and "good judgement." ADOT further noted that many of the projects contained in our review were of a "highly specialized nature," resulting in many "nonstandard construction conditions." For example, during our review period CE costs of $720,875 were incurred by one consultant for inspecting structural steel components at the fabrication mills which were located out of state. According to ADOT these types of charges are unusual and were not included in the original goals.

ADOT's Inability To Provide Timely Data Impeded Our Analysis and Limited Follow Up On Staff-Related Costs

Because the Department did not provide reliable data in a timely manner, we could not complete our analysis to determine whether ADOT is maintaining appropriate staff levels, or to determine the reasons ADOT has been unable to meet its staff-related cost goals. We requested financial data beginning in April 1990, but received incomplete and unreliable data tapes over a four-month period. The Department was able to submit financial information with sufficient documentation of its reliability only on August 16, 1990, seven weeks after the scheduled conclusion of our audit fieldwork. In addition, project records submitted by the Department did not contain key information such as the dates projects began and ended, and total contract amounts. A one-month delay in obtaining reliable data on labor distribution further hampered our review.

As a result, no time was available to complete our analysis or determine the reasons for the seemingly excessive consultant costs, and still meet our October 1, 1990, reporting deadline set by statute. For example, reviewing compliance with cost goals was not the only method by which we

intended to evaluate current staffing levels. We had also planned to track staffing levels over time within each of the four districts to determine whether individual districts were using temporary workers and consultant administrators rather than permanent employees to meet peak construction demands; and not using temporary workers or consultant administrators when in-house staff were available.

RECOMMENDATION

1. ADOT should investigate the reasons why CE costs for consultant-managed projects were above its goals ($3.6 million). If ADOT determines the goals for consultants have underestimated the costs needed, ADOT should revise the goals accordingly. Otherwise, ADOT should take steps necessary to ensure that excessive costs are curtailed in the future.

FINDING II

DEPARTMENT EFFORTS TO IMPROVE CONSTRUCTION STAFFING ESTIMATES HAVE BEEN INADEQUATE

Recent efforts by the Arizona Department of Transportation (ADOT) to improve computer estimates of its construction staffing needs have been unsuccessful. Shortcuts taken in efforts to upgrade its manpower management system have undermined the reliability of key elements of the system. If ADOT is to more effectively plan and control staff-related expenditures, corrective measures are necessary.

Our Office concluded in 1987 that ADOT's manpower management system, the Construction Engineering Manpower Management System (CEMMS), was not being effectively utilized. The system, which uses a computer model to project staffing requirements, was developed, in part, as a result of Legislative concern over the Department's control of nonappropriated staff resources.(1) At the time of our last review, we found that critical system elements were outdated, data was miscoded, and ADOT management did not fully support the system. Since then, ADOT has worked to improve the system. The Department spent approximately $700,000 to enhance the system's reporting capabilities, and make it more user friendly by replacing the computer software component. Considerable time and effort has also been expended in upgrading system planning values.

ADOT's Attempts to Improve Its Manpower Management System Have Been Unsuccessful

Departmental actions toward improving manpower management through computer-based staffing projections have been inadequate. Although ADOT

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(1) Funding for construction staff is not appropriated by the Legislature, but comes instead from the Highway User Revenue Fund. Staffing levels are determined by the Department, based on its assessment of construction activity.

needs accurate manpower projections, a variety of factors, ranging from self-imposed deadlines to poor sampling techniques, have undermined the Department's attempts to improve the system.

<u>Improved manpower projections needed</u> - Computer-based projections are an integral part of ADOT's decision-making process, as indicated by the following examples:

- the Department's Deputy State Engineer incorporates manpower projections in assessing Statewide staffing requirements;
- District Engineers use manpower projections in deciding staff deployment within their jurisdictions; and
- Area and Resident Engineers review manpower projections in assessing staffing requirements for individual construction projects.

However, current system forecasts have been poor and of limited value in decision making. As a result, Department managers have had to rely more heavily on their own judgment and experience in estimating and controlling the size of Construction Engineering staff. A review of the in-house monitored construction projects completed since fiscal year 1987, demonstrates this lack of faith in current forecasting. Considerable routine adjustments to projections have been made by supervising engineers during that time. For almost one-half of all projects reviewed, system projections were modified, up or down, by 40 percent or more.

However, estimates made by ADOT's supervising engineers have not proven much better at projecting or controlling staff utilization than current computer forecasts. The relationship between project staffing plans based primarily on engineers' judgment and actual staff utilization is weak. Actual staff utilization has ranged from 97 percent higher to over 200 percent lower than that predicted by supervising engineers. In 40 percent of all projects CEMMS recorded as completed since fiscal year 1987, engineers' original estimates were off by more than 25 percent from actual hours worked. Because various factors can disrupt anticipated staff arrangements, it is apparent that more reliable computer-based projections would assist ADOT in exerting more control over its staffing resources.

Key system element remains flawed - The Department's attempt to upgrade its computer-based staffing projections has, thus far, been unsuccessful. A principal cause of discrepancies in the computer projections is inaccurate planning values. These values, expressed in terms of labor hours needed for a construction activity per roadway mile (i.e., 1,000 man hours per mile of earthwork) had not been updated since the system's implementation in 1982. To date, ADOT has not been able to develop an adequate data base from which to accurately derive these key elements.

Initially, ADOT attempted to gather data on each construction project completed since 1983 (estimated to be approximately 660 projects). As ADOT assumed future staffing requirements would be related to past performance, analysis of historical data was appropriate. One method to ensure the validity of future projections is to analyze the appropriate population in its entirety, as ADOT attempted.

ADOT abandoned this original strategy. The Department's central office construction section began soliciting project data on labor distribution from the four ADOT districts "Late in 1987 or early in 1988..." However, due to the following factors, a complete set of data on manpower usage for the various kinds of construction projects was never assembled.

- District Response Was Untimely

  The ADOT employee coordinating the data collection project reported that, despite repeated requests, "district response was still slow or incomplete..." Therefore, ADOT was unable to meet either its original deadline or its revised deadline of March 31, 1988, for collecting the necessary data.

- Data Quality Was Poor

  A second reason for abandoning the original plan was related to data quality. Miscoding time charges have historically plagued the CEMMS data base. Miscoded time charges were documented during our Office's 1987 audit, and coding errors continue to compromise the system's data base. The extent of the data quality problem was never fully explored by ADOT, and though it may have been possible to correct errors through additional research, according to a Departmental manager ADOT decided that the time needed to identify and correct errors would be prohibitive. Given the poor quality of project data available, the validity of any results would have been questionable.

- **Time Constraints Were Prohibitive**

  The Department's objective was to complete renovation of its manpower management system in time for our Office's current audit. A significant delay in information would have affected ADOT's ability to meet this goal.

ADOT undermined the utility of its new planning values for predicting staffing needs by using unsound methodological shortcuts. In July 1988, with time running out, ADOT decided to calculate new planning values from a limited sample of data from completed projects. If done correctly, sampling is a legitimate way to reduce data requirements, while still achieving justifiable results. However, the sample techniques employed by ADOT were deficient.

The sample was not randomly selected; it was handpicked by district personnel. In addition, it was too small: the planning values were derived from labor usage obtained from, at the most, 16 projects. Some planning values were based on data from only a single project.(1)

Follow-up analysis performed by ADOT clearly demonstrated the weaknesses of the newly derived values as predictive tools. ADOT tested its new values on a second sample of 40 completed construction projects. The differences between staff projections and actual staff usage were substantial, varying by thousands of hours in many cases. For example, in one case, the projection was under the actual figure by almost 3,000 hours, a 1,558 percent difference. In an attempt to correct this problem, ADOT revised the planning values so that projected hours conformed more closely to the actual hours in its second sample of 40 projects. However, ADOT had no way of knowing whether the second sample was more valid than the first. The Department approved these revised values in August 1989.

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(1) One-hundred-thirty-seven projects (approximately 21 percent of the number available) were used to calculate planning values for 17 different types of construction projects. To ensure more credible results, a larger sample would have been required. Of note, an outside consultant hired by ADOT has confirmed that the sample drawn by ADOT, even including the additional projects from the validation sample, was marginal.

Corrective Measures Needed for ADOT's New Manpower Management System To Work Effectively

Unless corrective action is taken, ADOT's updated manpower management system, renamed the Construction Management Plan (CMP), will not function as intended. The Department should consider postponing implementation of CMP's revamped computer forecasts until it can reliably assess construction staffing needs.

Despite some setbacks, implementation of the updated manpower management system is scheduled for the near future. Problems in the implementation of CMP's software component, ARTEMIS, have caused delays of several months. However, initial training on ARTEMIS has been completed, and the Department plans to implement the new system sometime during the Fall of 1990. The system is scheduled to be operational in January 1991.

ADOT should consider delaying implementation of CMP's revamped computer forecasts until the problems associated with staffing projections can be resolved. It is important the new system demonstrate reliability early on. The present system lost credibility with the Districts, in part, because of its inability to accurately predict staffing requirements. At the time of our last audit, ADOT personnel described the present system's projections as "only slightly effective" and "nearly useless". Some District personnel have already expressed skepticism about the new system, and if it fails to perform according to expectations, we believe it too could rapidly lose credibility.

By continuing to update planning values as new projects are completed, ADOT believed that it would be able, in the near future, to improve staffing projections generated through CMP. Our analysis suggests that even if staffing projections could be made more reliable through continued updating, it might take several years to correct the problem.

Additionally, other aspects of the computer model, aside from its planning values, have not been tested by either our Office or by ADOT,

and could also be invalid. For example, as part of the system upgrade, District productivity has recently been factored into the computer model; however, these productivity factors have not been validated. Consequently, it is possible that even if the system's planning values were valid, staff projections would continue to be inaccurate. The Department should consider obtaining expert advice regarding the testing of other aspects of the model.

Finally, ADOT should take steps to ensure that the data on labor usage are accurately reported. Without accurate data, the computer model will not work effectively, and the adage "garbage in-garbage out" will apply. Since accurate reporting is apparently still a significant problem, ADOT should consider options to ensure time is recorded correctly. One option would be for ADOT to use trainers to work with field staff as the new system is implemented. ADOT's Highway Maintenance Group used this with some degree of success when the new highway maintenance system was implemented.

RECOMMENDATIONS

1. The Department should postpone implementation of its new manpower management system's revamped computer forecasts until it can reasonably assure the staffing projections made by CMP are valid.

2. The Department should also consider options such as employing trainers to address problems related to the accurate reporting of labor utilization.

ARIZONA DEPARTMENT OF TRANSPORTATION

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James S. Creedon
Acting Director

ROSE MOFFORD
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September 28, 1990

Mr. Douglas R. Norton
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Dear Mr. Norton:

My staff and I have completed our review of the audit report on ADOT's construction staffing levels; some of the conclusions contained in the report give me serious concern. ADOT does not concur with the recommendation to postpone the full implementation of the Construction Management Plan (CMP).

ADOT throughout the past years has demonstrated clearly its ability to reduce and control both construction staffing and construction engineering (CE) costs. The conclusions of the audit are misleading, because three very important elements were omitted in the analysis:

SPECIALTY ENGINEERING COSTS

While the auditor's report acknowledges that many projects contained in the review were of a "highly specialized nature" resulting in many non-standard construction conditions, no adjustments were made for these non-standard projects. The audit team should have included in its analysis and comparisons adjustments of $720,000 for specialty engineering costs on consultant-managed projects.

LIQUIDATED DAMAGES

Liquidated damages is "the daily amount set forth in the contract price to cover additional costs incurred by a state highway agency because of the contractor's failure to complete the contract work within the number of calendar days or workdays specified." The audit team did not include in its analysis and comparisons adjustments of $1.7 million for inhouse-managed projects and $2 million in consultant-managed projects for liquidated damages.

TIME PERIODS OF THE CONTRACTS

While ADOT understands the Auditor General's desire to cover the time period from the close of the last audit through April 30, 1990, the only accurate method is to evaluate all costs upon completion of a project. ADOT has met its goals in the control and management of a tremendously large and complex highway construction program. An accurate comparison of the consultant-administred engineering costs, taking into account the three issues not addressed in the audit, to the goals set by ADOT for all projects managed by private consultants reflects a figure of $1.2 million (or 6%) less than the ADOT goal.

As a result of questions raised regarding the audit during the data sampling procedure, ADOT sought the assistance of an independent consultant to evaluate the validity of the method used. That evaluation found

the methods to be sound. Further, the Federal Highway Administration (FHWA) approves ADOT's construction engineering costs on all federal-aid projects, and they found ADOT's costs, staffing and construction management system to be appropriate.

FHWA, the American Association of State Highway and Transportation Officials (AASHTO) and member departments, all recognize the need for engineering judgment in the application and use of any construction management program. The role of the registered professional civil engineer in the management of the construction program is vital to its success. The exercise of this engineering judgment was not given consideration by the audit team, although it is an integral part of the program.

The audit report states that the system's planning values have not been updated since the system's implementation in 1982. This is incorrect; the planning values were updated in 1988.

The circumstances leading to delays in the audit staff's receiving information in a timely manner was unfortunate. Clearer communications between the audit staff and ADOT's staff would have prevented most of these problems.

In summary the Arizona Department of Transportation is a much more professional orgnization than your report reflects.

Attached to this letter is a detailed response to the audit report. Included are several attachments which address various issues raised in the report.

Thank you again for the opportunity to make comments on your findings. I appreciate the fine working relationship we have with your staff and commend them for their conduct while visiting this agency.

Sincerely,

James S. Creedon
Acting Director

JSC:vn
Attachments

ARIZONA DEPARTMENT OF TRANSPORTATION

Response to the Performance Audit
of the
Construction Staffing Levels

RESPONSE TO FINDING I

ADOT does not concur with the conclusions or recommendation contained in Finding I. ADOT is managing construction engineering (CE) costs effectively and efficiently. As indicated in the Auditor General's Report, CE costs on ADOT-administered projects have decreased from 10.95% in 1986-87 to 8.96% in 1989-90. This decrease resulted from efforts to monitor and control construction staffing levels and other CE costs.

The report indicates that on consultant-administered projects, CE costs exceeded ADOT's goal and implies that ADOT is incurring seemingly excessive consultant costs. The report's conclusions and recommendation regarding this charge are erroneous. Three important elements were omitted from the analysis of these costs:

SPECIALTY ENGINEERING COSTS

The consultant working at the Roosevelt Bridge incurred costs of $720,875 for inspecting structural steel components at the fabrication mills throughout the United States. Although mentioned in the audit report, this $720,875 was not reduced from the $3.6 million difference. Correction for this element alone reduces this amount to $2.9 million. These specialty engineering and inspection charges were incurred but were not added to the goals, although they were required and established by supplemental contract agreements.

The auditor's report acknowledges that many projects contained in the review were of a "highly specialized nature', resulting in many "non-standard construction conditions." More specifically, 16 of 33 projects (or 48%) of the projects were unique as follows: four multilevel interchanges; Roosevelt Lake Bridge; three small, rural, remote bridges; four rest areas and state parks; and four tunnel projects.

LIQUIDATED DAMAGES

Liquidated damages are defined as "the daily amount set forth in the contract to be deducted from the contract price to cover additional costs incurred by a state highway agency because of the contractor's failure to complete the contract work within the number of calendar days or workdays specified." (Ref. CFR 630.302i)

A total of $2 million in liquidated damages should have been accounted for in the analysis of consultant-administered projects. This correction would reduce further the reported differences between the CE goal and actual costs from the $2.9 million figure indicated above to $900,000. Inclusion of liquidated damages for ADOT-administered projects also changes the reported overage to a difference of $1,425,750 under the goal.

On August 23, 1990 a letter documenting liquidated damages was sent to the Auditor General for consideration. Final payment vouchers were also furnished as verification of these assessments. Distribution of liquidated damages between ADOT-administered projects and consultant projects is as follows:

	ADOT	CONSULTANT
Assessed	$ 817,390.00	$ 10,875.00
Pending	886,360.00	1,955,300.00
	$1,703,750.00	$1,966,175.00

TIME PERIODS OF THE CONTRACTS

ADOT's analysis, using total costs for the entire period on consultant-administered projects, finally reduces the above $900,000 overage by an additional $2.1 million ($1.2 million under the goal). The method of analysis used by the auditors of partially analyzing incomplete projects caused the largest amount of reported overruns.

Attachment 1 shows how the method applied by the auditors of using a time period to compare goals and costs provides an approximate, inaccurate picture of CE cost differences. This is due to the time lag in the billing cycle of the accounting process. The most accurate method of determining CE costs is to evaluate all costs upon completion of a project. The grand total of all projects shows a CE cost of 8.1% prior to January 1, 1987; a CE cost of 13.0% between January 1, 1987 and April 30, 1990; and a CE cost of 11.8% after April 30, 1990. This misrepresents the CE cost as being 1.2% higher than actual costs during the sample time.

Based upon the $179,713,231 million construction costs sample audited during the time period, multiplied by the 1.2% difference in CE costs, the audit method used contains approximately $2.1 million more costs than when total project costs are used. Therefore, ADOT disagrees that additional controls are needed, as ADOT has met and exceeded cost goals for consultant-managed projects when allowances are made for specialty engineering charges, liquidated damages and time periods for contracts.

In estimating engineering costs for construction projects, goals are established as guidelines. These guidelines provide a tool and "target value" to use in establishing approximate costs for construction engineering. When using the tightest management control methods, engineering costs still will vary from project to project due to individual characteristics of the job.

The audit team recognized dynamic situations encountered during the course of almost any highway construction project. As a result, during the course of the audit a list of "Factors Affecting Staffing", which ultimately affects goals, was developed by the auditors and concurred in by all ADOT Construction Management personnel. These factors, beyond ADOT's direct control which ultimately affects goals, were developed by the auditors and concurred in by all ADOT Construction Management personnel. These factors cause construction engineering staffing levelss and costs to vary outside estimates or "goals". Some examples of these factors are:

The adequacy of the contractor's original work schedule.
The contractor's ability to maintain predictable and reasonable productivity rates.
Claims filed by the contractor.
Environmental/archaeological issues arising after start of construction.
Weather.
The availability of materials.
Accidents encountered at the project's site.

The original CEMM system was established following the guidelines and recommendations of the "Construction Engineering Manpower Management, System Design Manual." This was prepared under the national pooled fund study administered by the Federal Highway Administration and several sponsoring state agencies. The manual states: "Engineering judgment can and should always be used as a means of overriding any distribution regardless of method used." We have applied this guideline to all aspects of the CEMMS program.

Attachments 2, 3 and 4 present further evidence of ADOT's continual effort in reducing CE costs, whether managed by ADOT or by consultant engineers.

Attachment 2 shows a five-year increase in the construction program from $196 million per year to $375 million per year, while the construction staff has remained at an average of 580 people.

Attachment 3 shows the effect of the construction cost index on ADOT and consultant CE costs and how the cost figures shown on Page 10 (Table 2) of the audit report are affected by this cost index. During the time period of this audit, between 1986-87 and 1989-90, the construction cost index has reduced from 100 to 90, indicating ten percent (10%) more work is being accomplished for the dollars expended. Also, during this same period inspectors' and technicians' salaries have increased by 12.75%, thus indicating less inspection hours are available for this increased dollar amount of work. These factors further show ADOT's progress in reducing overall staffing costs.

Attachment 4, the "Survey of Western Association of State Highway and Transportation Officials' Construction Engineering Costs", shows only four western states with costs lower than Arizona's. The Federal Highway Administration allows fifteen percent (15%) CE costs; ADOT's 9.2% is well below this value.

RESPONSE TO TIMELINESS OF DATA IMPEDING FURTHER ANALYSIS

Although ADOT recognizes that there were difficulties associated with obtaining selected data, it is the Department's opinion that data availability issues could have been resolved at a much earlier point in the audit process if appropriate communication channels had been established between the Auditor General's staff and ADOT's senior management. Information requests by the Auditor General's staff were fragmented among many areas within ADOT. ADOT senior management was not made aware of any significant issues related to the timeliness of data until late in the audit.

All requests for information by the Auditor General were addressed promptly, and every effort was made to provide accurate and timely data. The Department placed a high priority on responding to the Auditor General's requests.

The requested data spanned two complex systems and required the creation of multiple, customized computer programs and reports, plus the manual review of over 1,000 project files for non-computerized data. Normally, when new computer programs are created to extract information from automated data files, there should be an early validation process by the user of the data. The responsible user area in ADOT was not contacted by the Auditor General's staff to validate data until late July--one month after the scheduled completion date for field work.

The circumstances leading to delays in the Auditor General's staff's having all the information needed for further analysis was unfortunate. Most of these difficulties could have been avoided if the Auditor General's team had advised ADOT's senior management of the precise data requirements and time line at the initiation of the audit, coordinated data requests among the appropriate areas, and requested ADOT's assistance with data validation earlier in the process. In recent audit efforts the Auditor General's staff met with the re-

sponsible senior administrator at an earlier stage of the audit to outline information needs. This important step would have ensured that the Auditor General's requirements were fully met within the required time frames.

RECOMMENDATION RESPONSE

ADOT has investigated CE costs for consultant-managed projects and disagrees that they are above goals. In fact, CE costs were approximately $1.23 million under goals. However, ADOT will continue to monitor carefully and evaluate each individual project to assure goals and guidelines are reasonable.

In accordance with the recommendations of the 1987 audit report, the Department used more consulting engineers to administer projects. Twenty-one percent of the CE costs represented in this audit were paid to consultant engineers, and as anticipated by ADOT, costs were higher than on those administered by in-house staff.

RESPONSE TO FINDING II

ADOT disagrees with this finding. The results of this audit show ADOT has successfully used the CEMM system and engineering judgment to exceed the established goals. The use of the words "inadequate", "unsuccessful", and "flawed" is totally misleading and misrepresentative of the system. It is difficult to comprehend how a system can be judged as "unsuccessful" when it has not yet been fully implemented, and how values are judged to be "inaccurate" when they have not been fully tested.

Attachment 5 is from a Federal Highway Administration's review of ADOT'S Construction Manpower Management System. The summary and comments state:

> "ADOT is to be commended on their use of their Construction Management Program by all facets of their construction personnel. They have made improvements to their construction program in their goal to administer construction related activities on a statewide basis to assure quality construction is achieved in the most economical manner."

The improvement to the system is adequate and as accurate as practicality permits. The sampling techniques were carefully executed to represent the best data within the database. Dr. John P. Zaniewski, P.E., Professor of Engineering Mathematics at Arizona State University, in his report dated July 19, 1990, entitled: "EVALUATION OF CONSTRUCTION MANPOWER ESTIMATE, for the Arizona Department of Transportation", on page 31 states: "Overall the construction manpower planning process seems to be reasonable..." He continues on page 32 under the same heading: "Considering the limitations of the raw data base, ADOT has done a good job in the development of the data bases used to establish the standard planning values."

Feedback received from users in the field indicates that manhours obtained from the new planning values are predicting much closer to the staffing hours than were the manhours obtained by using the old planning values. Furthermore, the users expressed great satisfaction with the new planning method for its ease of application and simplicity. It is not clear what is meant by the statement, "The Planning values...had not been updated since the system's implementation in 1982." They were, in fact, updated in 1988.

Again, Dr. Zaniewski states on page 9 of his report: "...the number of projects required for a complete factorial design would be 1792." He continues on page 13: "Since the services that ADOT contracts change from time

to time, e.g. the use of contractor staking, traffic control requirements, and end product specifications, it is unlikely that the Department will ever be able to establish a truly statistically sound data base for estimating the manpower requirements for all of the factors. This level of detail is probably not warranted even if the data were available."

The methodology used by ADOT to develop the new planning values was very sound, considering the quality of the data, as stated by Dr. Zaniewski. The sampling technique was chosen to compensate for the size of the sample, i.e., the users were asked to provide projects that were as free of error as possible.

The number of activities were reduced from 63 to 26 to simplify the process and to ensure accurate reporting of manhours. In addition, the Construction Management staff will soon be engaged in an extensive and continuous job-site training program, leading to a successful implementation and proper maintenance of the system.

It should be noted that the Arizona Department of Transportation is on the cutting edge of technology development with its efforts to develop a state of the art manpower management system.

RECOMMENDATION RESPONSE

The Department does not agree with postponing implementation of its new manpower management system and revamped computer forecasts. The revamped planning values (computer forecasts) are presently in use and are producing satisfactory results. As additional information is added to the data base, the accuracy of the forecast values will be checked constantly and revised as needed. If necessary, ADOT may engage Dr. Zaniewski to assist in further refinements of our forecasting methods.

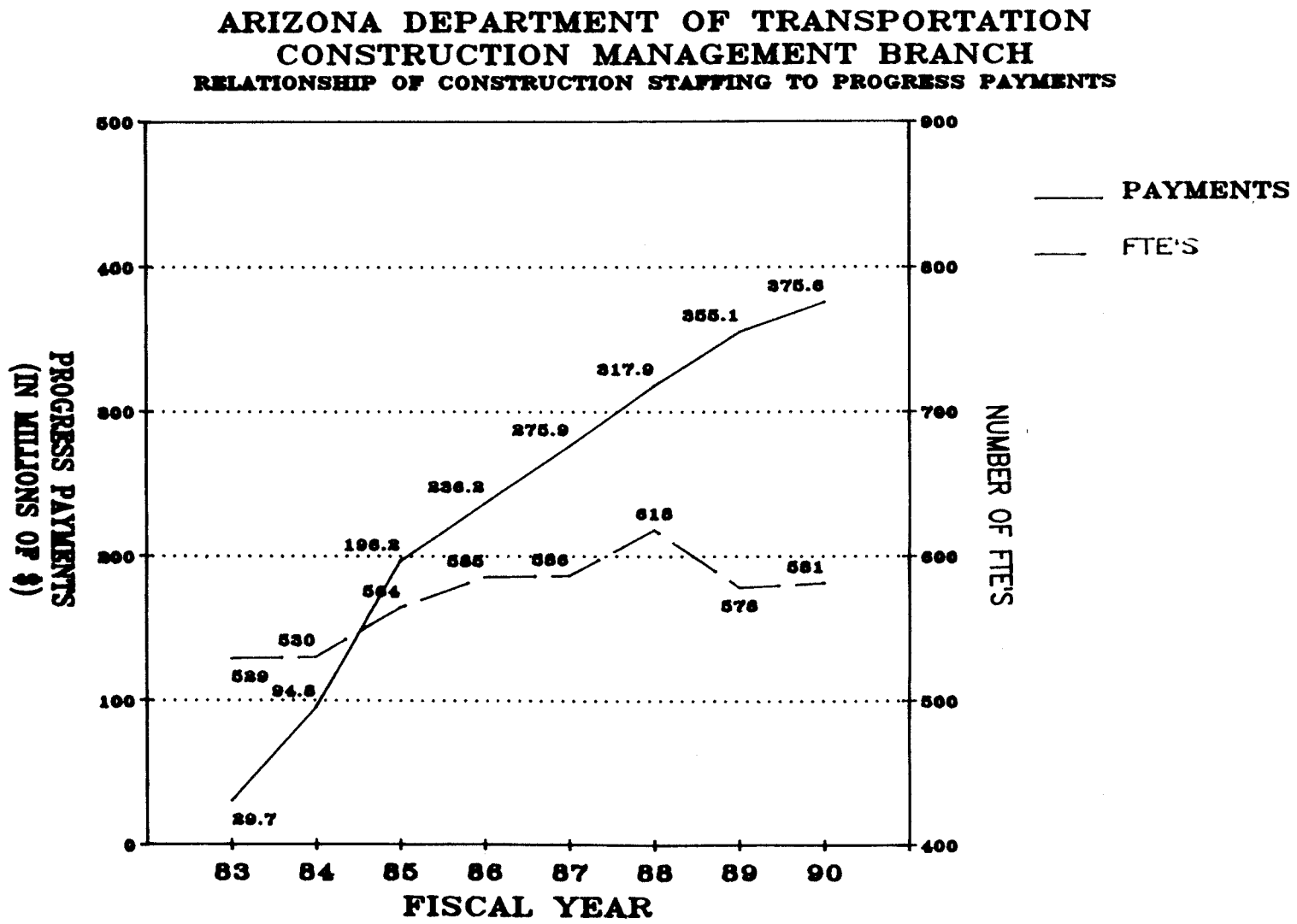
The Arizona Department of Transportation will provide "hands on" training at the user locations to address problems related to the accurate reporting of labor utilization.

ARIZONA DEPARTMENT OF TRANSPORTATION
CONSULTANT ADMINISTERED PROJECTS

September 17, 1990

CE CAT	PROJECT NAME	PROJECT	PRIOR COSTS PAYMENTS TO JAN87	PRIOR COSTS CE TO JAN87	PRIOR COSTS CE%	AUDIT TIME PERIOD PAYMENTS JAN87 TO APR90	AUDIT TIME PERIOD CE JAN87 TO APR90	AUDIT TIME PERIOD CE%	TOTAL COSTS TOTAL PAYMENTS	TOTAL COSTS TOTAL CE	TOTAL COSTS CE%	CE GOAL
0-500K												24
	Pump House Wash Br	H072701C	170,407.52	39,968.05	23.5	19,061.07	5,301.58	27.8	189,468.59	45,269.63	23.9	
	Flagstaff M.P. 155	H025401C	211,793.16	75,067.55	35.4	869.72	11,391.60	309.8	212,662.88	86,576.66	40.7	
	St Johns Streets	H055401C	197,019.72	22,032.44	11.2	37,812.64	3,839.74	10.2	234,832.36	25,872.18	11.0	
	Parks Rest Area	H025904C				473,100.80	74,601.46	15.8	473,100.80	105,256.42	22.2	
	GROUP		579,220.40	137,068.04	23.6	530,844.23	95,134.38	17.9	1,110,064.63	262,974.89	23.7	
500K-1M												21
	I-19 Landscape	H201401C				553,723.88	170,301.92	30.8	554,440.99	180,034.48	32.5	
	Morgan Wash Bridge	H069501C	452,120.02	176,860.24	39.1	127,655.54	25,263.95	19.8	579,775.56	202,124.19	34.9	
	Meteor Crater R. A.	H026901C				642,837.53	131,675.10	20.5	642,837.53	134,197.99	20.9	
	Jerome State Park	H095501C		1,610.17		901,258.38	232,421.68	25.8	901,258.38	235,569.24	26.1	
	Slide Rock St Pk	H095801C		8,114.90		938,684.57	290,442.74	30.9	938,684.57	298,557.64	31.8	
	Ashfork Hill EB	H025301C	951,792.37	174,211.93	18.3	2,789.18	43,898.26	566.7	954,581.55	218,399.17	22.9	
	GROUP		1,403,912.39	360,797.24	25.7	3,166,949.08	893,803.65	28.2	4,571,576.58	1,268,882.71	27.7	
1M-2M												19
	Shonto Wash Bridge	H076801C				1,093,261.76	164,246.02	15.0	1,093,261.76	164,246.02	15.0	
	GROUP					1,093,261.76	164,246.02	15.0	1,093,261.76	164,246.02	15.0	
2M-5M												16
	Shea Blvd	362 6	1,931,709.78	478,908.46	24.8	214,482.66	14,446.61	6.7	2,146,192.44	493,355.07	23.0	
	Knox - Baseline	H054501C	2,366,855.93	369,498.99	15.6	-13,858.84	32,731.68	236.2	2,352,997.09	402,230.67	17.1	
	Seneca - Becker Butte	H041801C	2,387,308.41	376,144.49	15.8	20,234.42	22,617.96	111.8	2,407,542.83	398,762.45	16.6	
	Valencia - Bantam Rd	S010301C	2,458,825.33	453,410.16	18.4	58,381.92	29,851.01	51.1	2,517,207.25	483,261.17	19.2	
	Red Rock State Park	H095701C		739.07		843,474.96	423,817.45	50.2	2,590,275.23	651,207.49	25.1	
	Iron Springs Road	S004701C	2,034,394.16	14,353.00	.7	668,077.55	163,998.25	24.5	2,702,471.71	178,351.25	6.6	
	S.R. 64 - Tusayon	H049004C				2,864,768.53	437,692.99	15.3	2,864,768.53	437,692.99	15.3	
	Williams Streets EB	H078004C				3,040,700.55	642,863.00	21.1	3,072,068.96	658,531.31	21.4	
	Avra Valley	H060004C				765,029.54	41,593.10	5.4	3,241,394.97	316,446.86	9.8	
	Tucson Blvd	S010501C	3,282,034.03	461,356.67	14.1	102,797.94	30,929.93	30.1	3,384,831.97	492,286.60	14.5	
	Honolovi State Park	H097501C				1,856,718.69	629,013.57	33.9	3,500,289.81	866,039.57	24.7	
	GROUP		14,461,127.64	2,154,410.84	14.9	10,420,807.92	2,469,555.55	23.7	30,780,040.72	5,378,165.43	17.5	
5M-10M												14
	Toltec T.I.	H015004C				5,783,365.22	847,353.73	14.7	5,783,365.22	855,304.06	14.8	
	I-10 Tunnel	H011601C	9,493,377.98	601,487.51	6.3	107,186.19	189,162.20	176.5	9,600,564.17	808,937.28	8.4	
	GROUP		9,493,377.98	601,487.51	6.3	5,890,551.41	1,036,515.93	17.6	15,383,929.39	1,664,241.34	10.8	
10M-20M												12
	Squaw Peak/I-10 T.I.	H085904C				9,375,036.51	2,049,379.22	21.9	11,108,653.56	2,530,802.81	22.8	
	Roosevelt Bridge	H051604C				14,202,198.01	3,064,461.41	21.4	18,577,610.60	3,642,537.76	19.6	
	I-10 Tunnels	H011701C	19,630,139.61	1,359,407.57	6.9	-18,263.95	320,634.01	755.6	19,611,875.66	1,718,932.63	8.8	
	GROUP		19,630,139.61	1,359,407.57	6.9	23,695,498.47	5,434,474.64	22.9	49,298,139.82	7,892,273.20	16.0	
>20M												10
	I-10 Tunnels	H011801C	21,552,501.29	1,308,450.73	6.1	2,183,591.06	921,519.17	42.2	23,736,092.35	2,269,838.72	9.6	
	I-10 19th - 15th Ave	H010004C	849,881.96	48,730.99	5.7	27,104,875.13	1,947,027.04	7.2	27,954,757.09	2,008,862.04	7.2	
	Price Road Tunnel	H082104C				28,986,554.45	2,579,829.08	8.9	28,986,554.45	2,596,184.25	9.0	
	I-10 / I-17 T.I	H006101C	10,328,634.14	522,272.64	5.1	19,505,793.28	2,210,068.85	11.3	29,834,427.42	2,829,732.58	9.5	
	I-10 / I-17 T.I.	H006001C				31,557,679.24	2,992,923.85	9.5	32,046,338.70	3,306,765.91	10.3	
	I-10 / I-17 T.I.	H004604C	9,909,567.35	628,997.58	6.3	26,487,542.93	2,700,339.96	10.2	36,397,110.28	3,415,727.35	9.4	
	GROUP		42,640,584.74	2,508,451.94	5.9	135,826,036.09	13,351,707.95	9.8	178,955,280.29	16,427,110.85	9.2	
	GRAND TOTALS		88,208,362.76	7,121,623.14	8.1	180,587,421.06	23,445,438.12	13.0	281,192,295.26	33,057,894.44	11.8	

Attachment 1



Attachment 2

STAFF RELATED COST ANALYSIS FOR ADOT ADMINISTERED PROJECTS BY FISCAL YEAR

Construction Costs and CE Costs Adjusted to Equivalent 1986-87 Construction and Salary Levels.

Fiscal Year	Adjusted Contractor Payments	Adjusted CE Costs	CE Percent Achieved
1986-87 (a)	$105,911,174	$11,602,456	10.95%
1987-88 (b)	289,133,379	25,373,585	8.78%
1988-89 (c)	348,080,647	27,297,270	7.84%
1989-90 (d)	265,769,642	20,760,401	7.81%

a) Actual values January 1, 1987 - June 30, 1987, only.

b) Adjusted using Const. Index of 92 compared to 100 for 1986-87. CE costs adjusted using 1.5% salary increase.

c) Adjusted using Const. Index of 87. CE costs adjusted using 5% accumulated salary increase.

d) Adjusted using Const. Index of 90. CE costs adjusted using 6.25% accumulated salary increase. July 1, 1989 - April 30, 1990, only.

(WASHSRT1.WK1)

ARIZONA DEPARTMENT OF TRANSPORTATION
CONSTRUCTION OPERATIONS SERVICES - FIELD REVIEW BRANCH
SURVEY OF WASHTO STATES CONSTRUCTION ENGINEERING COSTS

SEPTEMBER 10, 1990

WASHTO STATES	OVERALL CE %	BREAKDOWN OF CE %	ITEMS INCLUDED IN CE COSTS
ALASKA	NOT AVAILABLE AT THIS TIME	NONE	ALL CHARGES TO CONSTRUCTION PROJECTS
HAWAII	NOT AVAILABLE AT THIS TIME	NONE	ALL CONSTRUCTION AND POST-DESIGN CHARGES TO CONSTRUCTION PROJECTS
IDAHO			
NEW MEXICO			
UTAH	NOT AVAILABLE AT THIS TIME	NONE	ALL FIELD PERSONNEL CHARGES WITH A 15% MAXIMUM LIMITATION ON ALL PROJECTS
WASHINGTON	NOT AVAILABLE AT THIS TIME	NONE	ALL FIELD AND HEADQUARTERS PERSONNEL CHARGES TO CONSTRUCTION PROJECTS
COLORADO	12.7% (10.2% DIRECT & 2.5% OVERHEAD)	NONE	ONLY CONSTRUCTION FIELD PERSONNEL(DIRECT COSTS) & SUPPORT HEADQUARTERS STAFF (OVERHEAD COSTS)
NEVADA	12%	0 TO 4 MIL = 15% 4 MIL TO 7 MIL = 10% OVER 7 MIL = 5%	ALL CHARGES TO CONSTRUCTION PROJECTS
CALIFORNIA	11% TO 12% (ESTIMATE ONLY)	NONE	ONLY FIELD OPERATIONS PERSONNEL ONLY
WYOMING	10.3%	NONE	ALL CONSTRUCTION AND ADMINISTRATION COSTS TO ADMINISTER PROJECTS
NORTH DAKOTA	10% IN HOUSE - 15% CONSULTANT (ESTIMATE)	NONE	ONLY CONSTRUCTION ENGINEERING COSTS AFTER BID AWARD DATE
MONTANA	10%	0 TO 1 MIL = 12% 1 MIL & UP = 10%	ALL COSTS BY LAB, SURVEY, OFFICE, MATERIALS AND INSPECTION - OTHER OVERHEAD COSTS ARE INCLUDED
ARIZONA =======	9.2% IN HOUSE 12.5% CONSULTANT ========== ==========	VARIES BY CONTRACT AMOUNT ==========	ALL ENGINEERING CHARGES TO CONSTRUCTION ========== PROJECTS AFTER BID ADVERTISEMENT. ==========
OREGON	9%	LESS THAN $100,000 = 10% $100,000 TO 1 MIL = 9% OVER 1 MIL = 8%	ALL CONSTRUCTION FIELD PERSONNEL ONLY
OKLAHOMA	8%	NONE VARIES BY FA & STATE PROJECTS	ONLY CONSTRUCTION ENGINEERING COSTS AFTER BID AWARD DATE
TEXAS	7% (ESTIMATE ONLY)	NONE	ALL CHARGES TO CONSTRUCTION PROJECTS
SOUTH DAKOTA	5% (ESTIMATE ONLY)	NONE	ONLY CONSTRUCTION FIELD PERSONNEL AND CONSULTANT PERSONNEL

Memorandum

U.S. Department of Transportation
Federal Highway Administration

Washington, D.C. 20590

Subject: Construction Engineering Workforce Information System Review - Arizona Department of Transportation

Date: JUL 16 1990

From: Chief, Construction and Maintenance Division
Office of Highway Operations

Reply to Attn of: HHO-31

To: Mr. Edwin M. Wood
Regional Federal Highway Administrator (HRA-09)
San Francisco, California

Attached are two copies of Ms. Melisa Ridenour's trip report which discusses a "state-of-the-practice" review of the Construction Engineering Workforce Information System (CEWIS) in use by the Arizona Department of Transportation (ADOT). The results of this "fact finding" are provided in the attached paper.

This review is part of a 1990 nationwide review of the various workforce management systems in use by the State highway agencies. Once this nationwide review is completed, a summary report will be developed and distributed.

Please forward a copy of this report to the Arizona Division. Also, please extend our thanks to the members of your staff, the Division Office and the ADOT for their hospitality and assistance.

William A. Weseman

Attachments

SUMMARY

The results of this "fact finding" are included in the attached paper I have prepared on Arizona's Construction Management Program. Briefly, ADOT is currently in a transition period with the implementation of a revised construction management system referred to as the Construction Management Program. Their original system was modeled after the "Construction Engineering Manpower Management System Design Manual", a National pooled Fund Study in 1978. This system has been utilized since 1983.

As of July 1990, the revised system should be in use state-wide. The major changes between the original and revised systems are (1) five year projection capabilities, (2) unit of measurement for the standard planning values based upon man-hour per mile, (3) reduction in planning activities, (4) modifier applied in an indirect manner, (5) contractor's actual work schedule can automatically be taken into consideration, and (6) "state-of-the-art" computer language provided. The "state-of-the-art" language facilitates the ease in obtaining specially tailored information by creating different scenarios.

The use of a construction management system has support from all levels of the construction personnel. This is essential if the best use of the available information provided by this management tool is to be obtained.

The CMP indicates the number of inspectors needed but does not address their skill levels; although, it does indicate how many man-hours will be needed for a specific activity.

At the present time, the CMP is not utilized to determine such items as recruitment policies and training plans. The Program does have the capabilities to aid in their development.

A copy of the guidelines used and the notes taken during this review are attached to the file copy of this report.

Comments

ADOT is to be commended on their use of their Construction Management Program by all facets of their construction personnel. They have made improvements to their construction program in their goal "to administer construction related activities on a statewide basis to assure quality construction is achieved in the most economical manner".

ADOT has not stopped there. They continue to strive for improved excellence by revising their previous Construction Manpower Management System. The future looks bright for their new system. It has the power to aid them in developing future policies and programs pertaining to such items as training plans and recruitment needs.

ADOT's Construction Management is currently asking for representation on the project scheduling committee. This would enable them to provide input on the effect of moving projects based on the availability of construction personnel.