MULTNOMAH COUNTY AUDITOR'S OFFICE

Roadway Capital Projects

Strengthen Management Controls

March 1999

Suzanne Flynn
Multnomah County Auditor

SUZANNE FLYNN, Auditor
Multnomah County
1120 SW 5th Avenue, Room 1410
Portland, Oregon 97204
Telephone (503) 248-3320
Telefax 248-3019
www.multnomah.lib.or.us/aud

MEMORANDUM

Date: 3/18/99

To: Beverly Stein, Multnomah County Chair
Diane Linn, Commissioner, District 1
Serena Cruz, Commissioner, District 2
Lisa Naito, Commissioner, District 3
Sharron Kelley, Commissioner, District 4

From: Suzanne Flynn, Multnomah County Auditor

Subject: Audit of the Roadway Capital Projects

The attached report covers our audit of the Transportation Division in the Department of Environmental Services which was included in the FY98-99 Audit Schedule initiated by the previous Auditor. The Transportation Division was very involved throughout the audit process offering suggestions and initiating changes as the audit progressed. Because of the Division's responsiveness and level of involvement, we took a different approach to this audit. Areas of weakness, suggestions for improvement, and actions taken by the Division during the audit are integrated into the body of the report. There is not a recommendation section in the report. Instead, the Division responded to the audit with a project plan outlining a process to address the issues in the report.

Our Office will place a strong emphasis on follow-up and will re-visit the Division within a year to monitor their progress towards implementing the project plan.

We appreciate the cooperation and assistance extended to us by the management and staff of the Department of Environmental Services.

Audit Team: Craig Hunt, Senior Management Auditor
John Hutzler, Senior Management Auditor

Table of Contents

Summary

The County Transportation Division is responsible for managing a safe and balanced regional transportation network of major east County arterials, roads in the unincorporated areas, and the Willamette River bridges and bikeways. Since 1983, the Division's responsibility has been reduced from 1000 miles to 350 miles of roads as cities have assumed more control. The County retains jurisdiction over some roads in Gresham and the smaller cities. The Bridge Section in the Division maintains the six Willamette River Bridge crossings as well as other bridges within Multnomah County. The Planning Section develops a long-range, capital improvement plan every two years. The Engineering Section designs and completes construction of specific road projects identified in the plan.

Our review focuses on planning and project management of roadway capital projects. The objective of our audit was to determine whether systems are in place to ensure that roadway capital projects are properly planned and effectively managed.

Road projects generally involve staff from Planning and all six units of the Engineering Section. However, most of the staff devoted to roadway capital projects are from the Design, Construction and Project Engineering Units, which collectively have approximately 20 employees. County engineers design road projects, contract for construction and manage the project to completion. Roadway capital construction contracts managed by Engineering vary in size from a few thousand dollars to several million dollars. Since January 1996, Engineering has advanced or completed approximately 40 roadway capital projects worth over $19,000,000.

Project management differs from operational management. In contrast to many County services that are on-going, those supplied by Engineering have a definite start and finish and result in a unique product. Projects proceed by inter-related or dependent steps. Careful planning and monitoring are required to ensure that projects are completed on time, at the least possible cost, and at an acceptable quality level.

Events in the recent past have impacted Engineering's ability to provide effective project management. During the last 3 years, Engineering has dealt with staff turnover, emergency roadway projects from winter storms, increased development, and the lack of a full-time

transportation director. We believe that these circumstances, combined with an absence of written procedures have weakened project management systems.

Careful planning provides the groundwork for good management. Improvements are needed in the roadway capital planning process. Criteria used to prioritize roadway projects should be thoroughly reviewed. Information in planning documents could be better communicated and management could better monitor implementation of roadway capital plans. Management began addressing these issues during our audit.

We used the Project Management's Institute's Guide to the Project Management Body of Knowledge (PMBOK) to assess project management controls over roadway capital projects in Engineering. PMBOK provides guidance for project management through principles and techniques to control project risk. We found that improvements could be made in each of the PMBOK areas of Integration, Scope, Time, Cost, Quality, Human Resources, Communications, Risk, and Procurement.

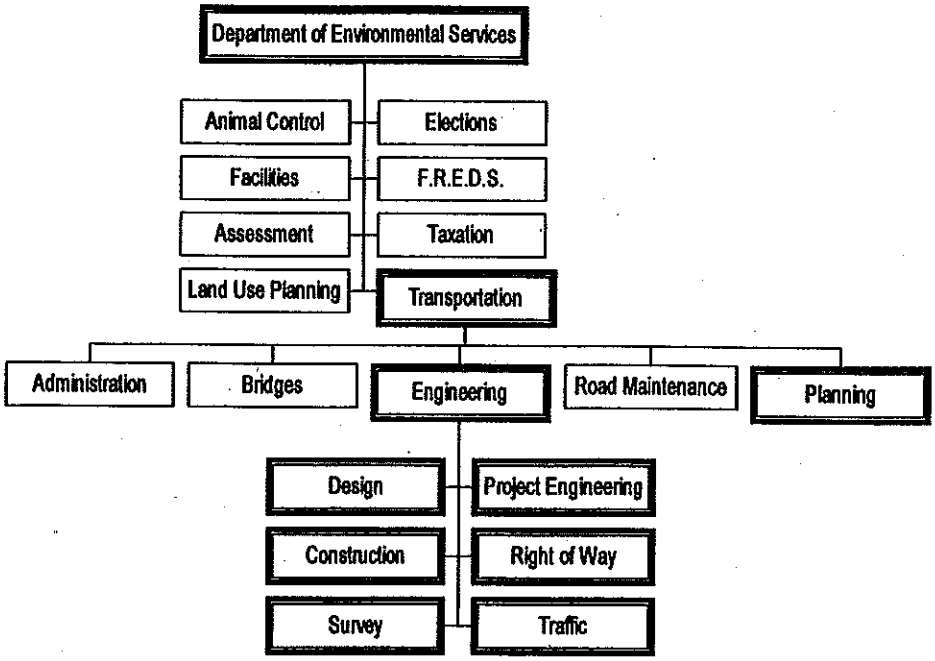
During the audit, we discovered that Engineering was in general agreement on the significant improvements that were needed. Given this environment, we modified our approach to the audit. Rather than narrowing our attention to specific problems and conducting quantitative analyses to determine their fiscal impacts, we broadened the audit to examine controls throughout the entire capital project management system for roads. We focused on working with management to address a broad range of project management issues. Engineering's dedicated commitment to process improvements provides us with a high level of confidence that needed improvements will be made.

In addition to this report, we provided a detailed, technical report of our analysis to management and reviewed it with them. We extended the time normally provided for an audit response so that a project plan could be prepared. The Division's response conveys a strong commitment to high quality project management and details a plan for addressing issues in this report. Engineering intends to make provisions for proposed changes in their 1999-2000 budget. This office will perform audit follow-ups at later dates to ensure that proposed changes have been implemented.

Background

Overview

Transportation is one of eight divisions within the County's Department of Environmental Services, a diverse department whose responsibilities range from Animal Control to Elections. The Transportation Division plans cooperatively for future transportation needs, develops improvements in the system and maintains the County surface street system. The Transportation Division is organized into five sections – Administration, Bridges, Engineering, Road Maintenance and Planning.



The County Transportation Division is responsible for managing a safe and balanced regional transportation network of major east County arterials, roads in the unincorporated areas, and the Willamette River bridges and bikeways. For many years Multnomah County has planned, designed, constructed and maintained a roadway system that is regarded as one of the best in the country. As a result of the transfer of many local roads to cities, the system of County roads has declined from approximately 1000 miles of roads in 1983 to approximately 350 miles today. The Bridge Section in the Division maintains the six

Willamette River Bridge crossings as well as other bridges within Multnomah County.

Roadway Capital Projects

This audit focuses on roadway capital projects. The Bridges and Road Maintenance Sections were not included. One of the most important functions of Engineering is to implement the Transportation Capital Improvement Plan and Program, which includes roadway capital projects. Road projects often involve staff from Planning and all six units of the Engineering Section. But most of the staff devoted to roadway capital projects are from the Design, Construction and Project Engineering Units, which collectively have approximately 20 employees.

Within the scope of its capital improvement functions, Engineering provides project management, produces project designs and plans, acquires and administers rights of way, prepares plans, specifications and estimates for competitive bidding, and performs construction engineering and field survey services.

While in-house engineers design most construction projects, contractors perform the actual construction. The Project Engineers manage the construction contracts. Staff within the Survey Section provide surveying and the Construction staff inspect the quality of completed work. Roadway capital construction contracts vary in size from a few thousand dollars to several million dollars. Since January 1996, Engineering has advanced or completed approximately 40 roadway capital projects worth over $19,000,000.

Because most projects are unique, there is always a degree of uncertainty. Projects are usually divided into phases marked by the completion of one or more work products to provide better management control. Collectively, the project phases are known as the project life cycle. For roadway capital projects, the phases of the project life cycle generally include:

- planning and development
- preliminary design
- right-of-way
- detail design
- contract award
- construction
- close-out

Engineering uses two primary performance measures for capital construction management. For all projects completed, the total of the contract awards has consistently been less than 105% of the total of project managers' estimated construction costs. In addition, the total of final project costs has been less than 105% of the total contract awards.

Recent Events

There have been many changes in Transportation over the last three years. In July 1995, the Director of the Transportation Division, also the County Engineer, became the Director of the Department of Environmental Services although he retained his title as Director of Transportation. The new manager of Engineering became the new County Engineer. Day-to-day management of the Division became the responsibility of a management team composed of the five section managers who met with the Director twice a month. In July 1998, the DES Director hired a new Director of Transportation from outside the Division.

Historically, Engineering was organized by function. Staff were grouped by functional specialty, such as planning, road design, traffic engineering, inspection, construction management, etc. Projects were viewed as limited by function; they were planning projects, design projects or construction projects. In recent years, Engineering has experienced a restructuring of roles and responsibilities, shifting from a functional organization to a more project-based organization. The project manager is responsible for a roadway capital project from conception to conclusion and is viewed as the leader of a project team, made up of planners, surveyors, inspectors, etc. Project managers are now responsible for both the design and construction phases of the project.

Until recently, Engineering has also been a relatively stable organization with low staff turnover and promotion from within. Staff were familiar with one another's qualifications and expectations, and had forged clear working relationships. Recent retirements of experienced personnel have resulted in substantial reshuffling of positions and a significant number of new hires. As the project manager role has evolved and positions have been filled with new staff, well-established roles and relationships have been disrupted.

Engineering has recently dealt with widespread damage to County roads caused by the winter storms of 1996 and 1997. Both storms

caused severe damage to roads and restricted travel in rural areas of East and West County. Engineering worked diligently to restore and reopen damaged roads as soon as possible. During the last several years, Engineering has also responded to provide support for increasing development demands.

Scope and Methodology

The objective of our audit was to determine whether systems are in place to ensure that roadway capital projects are properly planned and effectively managed. As part of our review, we examined roadway capital improvement plans and programs from County transportation as well as other jurisdictions. We visited roadway construction projects in process during the summer months. We reviewed the most recent (1983) audit of Engineering, and we reviewed project management literature.

We conducted extensive interviews with personnel, including DES and transportation directors, the county engineer, administrative services manager, transportation planning manager and personnel, engineering service administrators, project managers, inspectors, materials testers, project support staff, and computer support staff. We also spoke with representatives from other jurisdictions, utility representatives, and contractors.

We used the Project Management Institute's Guide to the Project Management Body of Knowledge (PMBOK) as a framework to assess project management controls over roadway capital projects in Engineering. The PMBOK Guide describes generally accepted practices for managing project integration, scope, time, cost, quality, human resources, communication, risk management, and procurement.

Our review was limited to examining roadway capital project management systems. We did not examine bridge, bikeway or pedestrian project management systems. This review was included in our FY97-98 audit schedule, and was conducted in accordance with generally accepted government auditing standards.

Approach

We recognized early in the audit process that Engineering was motivated and committed to process improvement. Management made improvements to capital project systems as the audit progressed. During the audit, we also felt that there was general agreement on the significant process improvements that were needed. Given this environment, we modified our approach to the audit. Rather than

identifying specific problems and conducting quantitative analyses to determine their fiscal impacts, we broadened the audit to examine controls throughout the entire capital project management system for roads. Since management was already motivated to make needed improvements, we focused on working with management to address a broad range of project management issues.

In addition to this report, we provided a detailed, technical report of our analysis to management and reviewed it with them. We extended the time normally provided for an audit response so that a project plan detailing process improvements could be prepared.

The Division's response conveys a strong commitment to high quality project management and lays out a detailed plan for addressing issues in this report. Central to the Division's plan is the development of a Comprehensive Project Delivery System (CPDS). The project plan sets up a framework that will involve all levels of management and staff in developing a CPDS to improve capital project processes. The scope of this plan is extensive and will take approximately 18-24 months to complete. We will monitor the plan's progress as it is implemented.

Many positive changes were already underway as the audit progressed. These changed are noted in italics throughout the report.

Audit Results

Planning and Project Management

Successful completion of roadway projects requires careful planning and management, which are addressed in the three remaining sections of this report: Capital planning, project management and program management. Capital planning identifies, prioritizes and allocates funds to roadway projects through a collaborative process with residents and cities in the County. Once a roadway project is initiated, effective project management practices are critical to ensure that the project is completed on time, within budget and at a high quality level. Management of the capital program involves controlling overall operations and continually monitoring the results of ongoing projects.

Improvements are needed in roadway capital planning processes. Information in the plan could be updated and better communicated to stakeholders. Management also needs to monitor how well the capital plan is carried out.

Although Engineering has some processes in place to manage roadway projects, project management systems should be strengthened. Engineering has faced many pressures over the last several years that have weakened project management systems, including reshuffling of positions, new staff, road damage from winter storms and increased development demands. Recognized project management practices exist to assist Engineering in improving current management systems.

Engineering will need to institutionalize project management practices to better control the capital program. The roadway capital program could be more effectively coordinated and monitored with systems that summarize project information.

Roadway Capital Planning

The objective of the Roadway Capital Improvement Plan (Plan) is to identify and set priorities for road projects. The Roadway Transportation Capital Improvement Program (Program) implements the Plan by assigning available revenue to the highest ranked capital projects. A schedule is established of ranked projects for each fiscal year for funding. The Plan and Program are currently combined with plans and programs for bridge, pedestrian and bikeway capital projects into a single document, the Multnomah County Transportation Capital Improvement Plan (CIP). Our review was limited to roadway capital projects. We did *not* review the capital improvement plans or programs for bridge, pedestrian or bicycle projects.

A formal roadway planning process is completed every two years. However, capital projects can be identified at any time during the year. Regional projects included in the County's Plan compete for federal and state funds with projects of other jurisdictions in the region through Metro's regional transportation planning process.

The Plan identifies and ranks potential capital projects. Potential projects are identified through input from citizens, community associations, as well as cities within the County. Other data is collected by the Transportation Division and used to identify hazardous or congested roads and roads in need of reconstruction. Most projects included in the Plan appear in prior Plans; few new roadway capital projects are identified each two-year planning cycle.

Engineering's mission includes implementing the Program. The Program schedules roadway capital projects in various funding categories over a five-year period. Program adjustments are made in interim years between the two-year planning cycle. The Program assigns available resources to the highest ranked projects within each funding category in the Plan subject to their constraints. Scheduling of a highly ranked project may be constrained by a lack of resources, pending environmental studies, utility construction or right-of-way acquisition that delay or impact the timing within the five-year Program.

Other jurisdictions and the East Multnomah County Transportation Committee review the Plan and Program before the CIP is approved by the Board of County Commissioners. Although cities may be informally notified of mid-course adjustments to the Program which affect projects scheduled in the second year of the Program, there is no formal external review or approval of such changes.

Improvements are needed in roadway capital improvement planning processes. Based on our review of prior County CIP documents, it appears that the quality of the Plan and Program has declined. Financial information, and constraints could be better communicated, and the readability of the report could be improved. Management could also better monitor the implementation of the Program.

Planning recognizes these conditions and has already begun addressing them.

Ranking Criteria

Each capital project is ranked using evaluation criteria. Points are assigned based upon a project's designated priority and street classification. Priority criteria include hazardous conditions, levels of service, road condition, and funding availability. Bonus points are assigned to rank projects within priority and funding categories. Examples of bonus criteria include economic development, transit routes, designated land use, and street importance.

Project ranking criteria have not been revised in at least 10 years. During this time, the nature of the County's road system has changed. With the transfer of local roads to the cities, roads remaining under County jurisdiction serve the region as a whole. The funding situation has also changed. County road fund dollars dedicated to capital construction have diminished. To compete more effectively for regional funds, alignment of the County's criteria with regional criteria is an important consideration. The Planning section took steps in the most recent Plan to address this problem by adapting the Plan to include another funding category that recognized regional priorities.

The Plan outlines a process to review the project ranking criteria and to modify the computer program that ranks the projects based on any changes to the criteria. This process has not always been followed. Accordingly, the Plan's ranking criteria should be thoroughly reviewed through a process involving all stakeholders.

The computer program that tracks ranking criteria and prioritizes projects is not flexible. The criteria are currently "hard-coded" into an old program that does not allow modifications to the criteria. Software revisions are needed that will allow modifications of the ranking criteria during the planning process.

Planners reported that reliable data is difficult to obtain for some of the ranking criteria, and other criteria are difficult to interpret and apply. For example, we were told that projected and current level of service data is difficult to obtain and economic development information is difficult to apply. Inaccurate or inconsistent rankings could result in misallocation of scarce capital resources to less critical projects.

Selection of roadway capital projects involves both objective and subjective criteria. For example, professional judgement is required to allocate resources among funding categories (arterials, collectors, signals etc.). While we recognize that more subjective criteria and political consensus have a role to play in project selection, the Program could better describe that role.

Planning intends to review the Plan criteria within the next year. Planning is also working with Computer Support to reprogram the Plan's ranking system in Microsoft Access to allow flexibility.

Communication and Accountability

The 1998-2002 Program could better define and communicate decision-making processes. Without such controls, the Program is less likely to be perceived as fair and objective by stakeholders. The reasons for changes to the Program should be documented and clearly communicated to stakeholders.

Although they are adjusted for inflation, project cost estimates in the Plan and Program are not routinely reviewed and revised. Cost estimates in the 1998-2002 Plan were recently re-evaluated and found to be unrealistically low. This resulted in "sticker shock" to some stakeholders when cost adjustments were finally made.

The availability of resources for projects in the Program is unclear. Engineering could clarify this by estimating available resources, applying those resources to the prioritized projects, and scheduling what can be completed with the projected available funds. The 1998-2002 Program includes partially funded and unfunded projects. We doubt that stakeholders could get a clear picture of planned projects from the most recent Program.

A well-defined process is essential for projecting capital expenditures over time. Prior Programs scheduled multi-year project dollars over a multi-year period rather than lumping all resources dedicated to the project in the first year.

The Plan did not adequately explain how some projects were scheduled into the Program or why certain projects were not scheduled even though they were more highly ranked. One project was included in the Program although it did not appear in the Plan's list of potential projects. Constraints that prevent a highly ranked project from being scheduled in the 5-year Program should be documented.

In some earlier CIP reports, it was easier to follow projects from the Plan to the Program because names were consistent, programmed projects were listed in order of the Plan's ranking, and project costs in the Plan were traceable to the Program. In prior years, the impact of constraints on the scheduling of projects was clearly documented.

The Division does not monitor or report its performance in meeting the Program's schedule and cost estimates. Monitoring performance in this way could provide important feedback to management. Some causes of failure to meet Program expectations, such as the winter storms of 1996 and 1997, are unavoidable. But, other possible causes, such as unrealistic cost or revenue projections, poor utility coordination, design delays, or inadequate project management systems, may be overlooked if performance is not monitored. An effective performance reporting system would also assist Engineering in explaining to stakeholders the reasons for any necessary adjustments.

Project Management

In contrast to on-going County operations, each roadway capital project managed by Engineering has a definite start and finish and results in a unique product. Projects usually include constraints and risks regarding cost, schedule and performance outcome. Project management is a set of principles, practices and techniques to help control project schedule, cost, and performance risks. It inevitably requires balancing competing demands among scope, time, cost and quality and among stakeholders with differing needs and expectations.

Although they overlap in many areas, project management differs from operational management. For example, the unique characteristics of road projects are defined more broadly early in a project and become more explicit and detailed as the project team develops a better and more complete understanding of the features required to satisfy the needs which the road must meet.

The Project Management Institute (PMI) has identified nine topic areas to define the scope of project management knowledge:

- integration
- scope
- time
- cost
- quality
- human resources
- communications
- risk
- procurement

Within each of these topic areas, the PMI Guide to the Project Management Body of Knowledge (PMBOK) describes *generally accepted* principles, practices and techniques to help manage project risks and capitalize on opportunities for success.

"Generally accepted" means that the practices described are applicable to most projects most of the time and that there is widespread consensus about their value and usefulness. It does not mean that they are or should be applied to every project. We used PMBOK as a framework for identifying weaknesses in project management processes that, in our judgement, represent significant risks to the achievement of the objectives of roadway capital projects and the Roadway Capital Improvement Program. Program and project managers must exercise their professional judgement in determining what level of project management is appropriate for any given project.

Project Integration

The objective of project integration is to bring the elements of project management (scope, cost, time, quality etc.) together into an overall project plan that can be used to implement the project and control changes to it. For example, the project plan would typically include the scope statement, cost estimates, and performance measurement baselines for schedule and cost. The project plan can be simple or detailed depending on the size, complexity and risk of the project. Regardless of whether the project plan is simple or complex, sound project management principles suggest that every project should have an approved project management plan.

Generally, project plans have not been prepared by Engineering for several years. During the last 3 years, Engineering has dealt with staff turnover, emergency roadway projects from winter storms, and the lack of a full-time transportation director. We believe that these circumstances, combined with an absence of written procedures have weakened project management systems.

> *During our review, management expressed its intention to begin preparing project schedules and work plans again.*

A comprehensive project management information system is another vital component needed to draw together and manage all elements of the project. To effectively carry out and control projects, Engineering will need to further develop their project management information systems. Once fully developed, project management systems should have the capacity to collect and distribute information necessary for overall monitoring and control of the project from initiation through closing.

> *During our review of capital projects, Engineering began training project managers to use Microsoft Project and began setting up project information files on the local area network. The Project Management Institute's PMBOK guide has been distributed to all project managers.*

Project Scope Management

Project scope management ensures that all the work required -- and only the work required -- to complete a project successfully is included. In the construction phase of roadway capital projects, Engineering generally follows scope management processes established by contracting requirements and the Oregon Department of

Transportation (ODOT) Construction Manual. However, Engineering processes for project scope management in the pre-construction phases need improvement.

We believe the planning process would be improved by assigning the project manager to work with planners in developing a scope statement, identifying project constraints and assumptions, and estimating project resource requirements before a project is included in the Roadway Capital Improvement Plan. A written project scope statement would provide a documented basis for making future project decisions and would ensure a common understanding of project scope among all stakeholders.

> *The new Director of Transportation has indicated that he is considering the assignment of a project manager to each project in the earliest planning stages.*

The scope statement includes the justification for the project, a brief description of the facility to be constructed, and a list of sub-products that must be completed. Project objectives should be stated as quantifiable criteria for schedule, cost and quality that must be met for the project to be considered successful. We encourage Engineering, to develop project objectives that are performance-based and linked to the project justification.

The definition of project scope breaks down the work into small enough components that cost, time and resource requirements can be accurately estimated. When scope definition is inadequate, final project costs can be expected to be higher because of the inevitable changes that can cause rework, increase project time, and lower the productivity and morale of the workforce.

> *Engineering is developing a template of pre-construction tasks that can be used for most projects.*

As a project progresses, changes in scope may be necessary. Systems for influencing the factors that create changes in scope, determining that a scope change has occurred, and managing changes when they occur are necessary. While the ODOT manual provides guidance for construction contract change control, improvements are needed for controlling changes in the pre-construction phases. Engineering should consider developing policies and procedures defining the scope change control process.

Project Time Management

Failure to effectively manage the scheduling of project activities can result in higher costs, inconvenience to the travelling public, and loss of credibility. Timely completion of a project can be ensured by:

- accurately identifying the activities that must be performed
- developing a schedule and resource requirements
- managing any changes that occur

Most road projects are defined and scheduled in terms of broad project phases (Design, Right of Way, Construction). Since the activities necessary to develop the work products of each phase are not specified, activity durations and resource requirements are not estimated, and activities are not sequenced or scheduled.

> *Engineering has recently required project managers to submit their proposed construction schedule as part of the design review process.*

Project managers should submit a proposed project schedule as soon as possible after the project is authorized. Dependencies between activities need to be identified and activities sequenced. Project managers should estimate the durations of all activities and document the assumptions on which they base their estimates. Documenting assumptions regarding the scheduling of shared resources is particularly important so that management can coordinate the demand for such resources over multiple projects.

> *All project managers are receiving training in the use of Microsoft Project, which will become the Division's standard for project management software. This software supports the elements of project scheduling described above.*

An approved project schedule and performance reporting against a schedule baseline are critical to schedule control. In recent years, few management systems were in place to control the schedule of design and development work on capital projects. Oral project status reports at monthly staff meetings have been the principal tool for management to monitor project progress. Engineering does not currently track performance measures relating to time.

We encourage management to broaden the scope of project audits to include the entire project, rather than just the construction phase, and to include project schedule management as an explicit topic of review

in project audits. Project audits can serve an important function by documenting the causes of construction delays, the actions taken to expedite the construction schedule, and lessons learned from schedule control.

> *Engineering has recently begun to audit the project development process.*

Project Cost Management

Cost management ensures that projects are completed within the project budget. Effective cost management involves:

- determining the types and quantities of resources needed for project activities
- estimating the costs of these resources
- allocating costs to project activities over the time of the project
- managing changes to the project budget

We found that management of construction contract costs was fairly strong. Our concerns regarding costs focus on establishing a project cost baseline earlier in the project and tracking *all* costs associated with the project against an overall project budget.

The project plan should identify the types and quantities of resources required for the project, including in-house resources (engineers, survey crew, field inspectors, materials testers, project support, etc.) as well as resources to be procured (construction contract services, consultant services, etc.). Currently, only the cost of the construction contract for a project is estimated and budgeted. Data sources and assumptions supporting planning estimates could also be better documented. Except for construction bid items, historical cost information is not readily available for developing project cost estimates.

Determining resource requirements and estimating costs are necessary prerequisites for developing a project cost budget. Cost budgeting provides a baseline for management to monitor project costs in total and over time intervals as the project progresses. Accordingly, the cost budget sets the stage for cost control. Management could also monitor project cost variances and inform stakeholders of changes. While the construction process has contract cost control processes, in-house project costs could be better controlled.

Management reports that the DES cost accounting system does not effectively support project based budgeting and project cost management. Engineering developed its own information system for construction contract cost control. The Transportation Division, in collaboration with the Association of Oregon Counties, is now developing a new cost accounting system. The Division should take steps to ensure that the need for capital project cost management information is addressed in the system development process.

Project Quality Management

Project quality management increases the likelihood that the project will accomplish its purposes. Quality management should address the management of the project as well as the quality of the product. By minimizing rework, sound quality management helps to control costs, increase productivity, and meet stakeholder expectations. It should involve:

- identifying relevant quality standards
- determining how to satisfy them
- monitoring specific project results to determine whether they comply with standards
- identifying ways to eliminate causes of unsatisfactory performance
- regularly evaluating overall project performance to meet assurance standards

Engineering performs numerous quality control activities over the project's lifecycle, but has focused primarily on the product quality. For example, Engineering performs internal reviews for design and conducts inspection and materials testing during construction. However, project managers did report that inspection resources were not always adequate to insure project quality.

Recent improvements are beginning to address project management processes. Engineering has established some quality objectives for project management. An overall measure of contract cost management is calculated for each project, and the net result over all completed contracts is a Key Result reported annually in the County Budget.

Developing quality objectives and performance measures in other PMBOK areas could improve project management. Quality management could be improved by strengthening quality planning and further improving project management processes.

Written quality policies and procedures are needed to formally express management's quality objectives for all phases of a project and to

describe the project quality systems. Quality objectives, including the responsibilities, processes, and resources needed to fulfill those objectives, should be described in the project plan.

Project managers, inspectors and materials testers did not always agree on who was responsible for certain quality control activities. The ODOT Construction Manual delineates quality management responsibilities among the project manager, inspectors and materials testers. Additional training is needed to ensure that ODOT standards are followed and that project managers, inspectors and materials testers understand and carry out their responsibilities on projects. Any planned departures from standard procedures should be described in the project plan.

> *Overall, we have observed movement towards improving project management processes. Microsoft Project training has begun and Engineering initiated construction audits that address both process and product quality issues and identify areas for improvement. In response to this audit, management has drafted a plan to develop a comprehensive project delivery system that will address project management processes.*

Project Human Resources Management

Historically, the Engineering Section was organized by function, and projects were viewed as limited by function. Projects were either planning projects, design projects or construction projects. As a result, different managers might work on the same capital road project depending upon the stage of completion.

In recent years, Engineering has experienced a restructuring of roles and responsibilities. Increasingly, the project manager is responsible for a roadway capital project from conception to conclusion and is viewed as the leader of a project team. Project managers are now responsible for both the design and construction phases of the project, and the new Director has indicated that he would like to see project managers assigned to road projects in the earliest planning phase.

Although management encourages project staff to see themselves as members of a team, most individual team members remain accountable to functional managers and identify themselves with their function rather than their project(s). Team development can be

complicated when individual team members are accountable to both a functional manager and to the project manager.

Until recently, Engineering has also been a relatively stable organization with low staff turnover and promotion from within. Staff familiar with one another's qualifications and expectations had established well-understood working roles and relationships. Recent retirements of experienced personnel have caused substantial reshuffling of positions and a significant number of new hires.

As the project manager role has evolved and positions have been filled with new hires or staff reassignment, well-established roles and relationships have been disrupted. Roles and responsibilities of project staff are not clearly defined and documented. As a result, it is not always clear to project staff what their responsibilities are on a particular project.

Engineering could develop a template for a responsibility assignment matrix that defines the roles, responsibilities, and reporting relationships of a typical project. Although the project team should be free to adapt and change responsibility assignments to suit the demands and the staffing of a particular project, such changes should be documented. The project responsibility assignment matrix should be distributed to all project stakeholders.

Engineering staff currently are assigned to projects by management with little opportunity for project managers to provide input for the staffing they feel the project requires. Project managers could provide input and promote a cooperative environment by meeting with the County Engineer and Engineering Service Administrators as a group to schedule staffing resources among projects.

Project managers, particularly new project managers, would likely benefit from training in general management and interpersonal relations skills, such as leading, communicating, negotiating, delegating, motivating, team building, and dealing with conflict.

> *The County Engineer has recently directed all project managers to participate in the County's conflict management training.*

Additional steps could be taken to foster team development. Regular project team meetings should also be considered. Training in how to work in teams should be provided to all employees to facilitate the transition to a project-focused organization.

Team development training has recently begun. Management has also begun to include the field inspectors in the final design review. Both actions are positive steps towards team development.

Contractors have not always furnished staff with the appropriate experience to manage County projects. Contractors have also replaced key staff assigned to a project with inexperienced staff. Engineering should take steps to ensure that provisions in the ODOT Construction Manual regarding the qualifications of contractor staff are strictly enforced.

Project Communication Management

Determining and satisfying the information needs of project stakeholders is the essence of project communication management. Project communications should be addressed as a part of the overall project plan, although the level of formality will vary with the size of the project and the organizational diversity of the stakeholders. Critical to effective communication management are performance reporting processes that provide timely information about how project resources are used to achieve project objectives. We found evidence of breakdowns in project communication, which could be attributed to inadequate communication planning.

Most of the detail of project communication management should be contained in Engineering policies and procedures, and standard contract provisions. Standard communication practices could then simply be referenced in the project plan, with departures from standard practice described in detail.

Performance reporting should provide information on scope, schedule, cost and quality. Performance reporting on roadway capital projects has historically been informal and limited. Status reports were provided orally by project managers during monthly Engineering staff meetings. Until recently there were no specific requirements for the form or content of status reports.

The County Engineer has recently directed project managers to report in writing on the percent completion of major elements of the project work breakdown structure (design, right of way, and construction).

Performance reporting on roadway capital projects should include an analysis of cost and schedule variances, which compares actual project results to planned or expected results. Accordingly, an effective performance reporting system is dependent upon the development of the project baselines described in the sections on project scope, time, and cost.

Currently, project communication is limited by the quality of data available. The Department's cost accounting reports are not timely enough for effective project management. In developing its new cost accounting system, the Transportation Division should consider the project management information needs of Engineering. The existing DES cost accounting system has not served these needs effectively. The new system has greater flexibility and the potential, in conjunction with the project support database, to provide meaningful and timely cost performance reporting.

To improve the quality of cost information, all engineering staff should be trained to take full advantage of the new cost accounting system. Labor hours should be conscientiously tracked, properly allocated among projects, and reviewed for accuracy. Project managers should be able to timely compare the project's budget to actual costs at regular intervals from the inception of the project to its completion.

Project documentation could be improved, and few standards exist to organize project records. As a result, information on a project gathered in one phase may not be readily available in subsequent phases of a project. For example, reasons for design decisions have not always been made clear to construction project managers. Work performed pursuant to design changes ordered in the field sometimes had to be reworked at additional cost to the County when the reasons for the original design were made clear. Because there are few standards to organize project files and no checklist of documentation that must be included in project records, the quality of project records varies considerably.

Project Risk Management

Project risk management identifies, assesses and responds to project risks. The concept of project risk management includes capitalizing on opportunities as well as mitigating threats to the project. Although some controls are in place that address project risk, we found that risk management of individual roadway capital projects does not occur systematically. As a result, project managers may not be prepared to respond promptly to risk events.

Risks should be analyzed for each project. However, the degree or formality of the analysis will vary with the size, familiarity, and complexity of the work. Small projects will not require extensive risk analysis but larger projects will require more attention.

While not all project risks can be anticipated, a checklist of common risks in roadway design and construction could be developed to assist the risk identification and assessment process. Project managers should evaluate the significance of each risk by assessing the likelihood of its occurrence and its potential impact on the project. Significant project risks should be described in the project plan, along with strategies for responding to identified risks.

Although no formal system exists, we found that many project risks are routinely managed, particularly in the construction phase of the project. For example, many procurement risks are addressed through standard contract provisions. Construction materials testers are aware of risks associated with certain materials suppliers and adjust their testing regimen to control these risks.

We observed other examples of mechanisms that manage project risk in the design phase of the project. The risk of design errors or omissions is reduced by internal design reviews. The risk of design misunderstandings is reduced by assigning the same engineer to design and construction and including the field inspector in the final design review and the pre-construction conference.

Project Procurement Management

Project procurement management includes the processes required to acquire goods and services from outside the County necessary to complete a roadway capital project.

Although in-house engineers design most construction projects, actual construction is performed by contractors, with Engineering staff providing surveying and inspection work. Engineering also provides engineering review and inspection for private development within unincorporated Multnomah County. Most development is done by project agreement, whereby the County reviews improvement plans, inspects construction work, and charges developers a fee based on the estimated construction costs of the street improvements. Under these circumstances the developer generally contracts for construction and the County is not involved in project procurement processes.

Construction can be delayed by the procurement process when the need arises for professional services, such as geotechnical consulting services. Such services are routinely required on several projects each construction season, but it can be difficult to predict the specific services that an individual project will require. Contracting for such services under retainer contracts rather than on a project by project basis could avoid the delays that result when an unanticipated need for consulting services arises on a particular project. Engineering can also avoid construction delays by providing Purchasing with copies of the planned procurement schedule for projects well in advance of the submission of bid specifications.

Formal solicitation and procurement processes are specified by State law and County purchasing rules and are administered by the County's Purchasing Division within the Department of Support Services. These processes apply to contracts for more than $50,000. For projects between $2,500 and $50,000, the Transportation Division itself administers an informal Sheltered Market contracting program. Project managers must be familiar with different procedures for different types of contracts.

> *The Department of Environmental Services recently collaborated with Purchasing in the development of a training program for project managers on the different contracting processes. Engineering project managers received this training early in the FY 97-98 construction season.*

Contract administration is the process of ensuring that the contractor's performance meets contractual requirements. It involves the application to the contractual relationship of project management processes described in other sections of this report. Because of the legal nature of the contractual relationship, these processes are specified in contracts by reference to the ODOT Standard Conditions and the inclusion of County special conditions. However, procedures are not always followed in practice, and some project managers have been reluctant to enforce contract conditions designed to protect the County from certain project risks.

Contract management also has a financial management component. Road construction contracts appropriately specify a system of progress payments and retention of a portion of the contract amount until project completion.

Project managers should insure that written documentation is maintained for certain aspects of communication between the contractor and the County, especially warnings of unsatisfactory performance and any contract changes or clarifications. Deficiencies in project documentation may seriously compromise the County's position if a dispute arises.

Program Management

Program management is the overall management of the implementation of the roadway Transportation Capital Improvement Program. It includes Engineering's application of general management processes, such as planning, organizing, staffing, executing and controlling operations. Engineering needs written policies and procedures that require and support sound project management. Further, improved project management information systems that gather, integrate, and disseminate information generated by project management processes would enable Engineering to manage more effectively. Project management processes discussed in the previous sections of this report should ultimately combine into information needed at the program level to coordinate the capital program.

Some of our findings echo those of the last audit of Engineering conducted in 1983. Following that audit, steps were taken by the new Director of Engineering to improve project management processes. Staff were directed to develop projects plans which detailed project budget, schedule and manpower requirements. However, these changes in practice were not translated into written policies and procedures. Since new practices were never institutionalized in formal policies and procedures, practices deteriorated as management and staff were replaced.

Management reported that several unsuccessful attempts had been made to implement a comprehensive project management information system in Engineering. Implementation of such a system was a goal in several of the Transportation Division's strategic plans. Generally, these strategic goals for project management system implementation slipped further with each successive strategic plan. We identified several proposals or drafts of project management procedures, but were unable to confirm that any of these drafts had been adopted or implemented.

Project management systems are needed for program performance reporting. The only program performance measures currently reported are comparisons of the total of engineers' construction estimates for all completed projects to the total construction contract amounts for those projects, and the total of payments under those contracts to the total of the original contract amounts. No performance reporting is provided on the completion of programmed projects within programmed costs or according to program schedules.

Financial information at the program level could also be improved. As previously mentioned, project costs should be readily available for managers to monitor. Further, information regarding financial

resources available for capital projects could be improved. For example, the financial resources listed in the roadway Transportation Capital Improvement Plan is unclear. Management should also have the ability to compare total projected cost to complete all projects in process to the total of project budgets.

Project management information systems are also needed to coordinate the capital program. In a small agency with limited staff, coordination of project schedules is a critical element of effective program management. Effective coordination of project schedules allows management to make the most effective use of limited staff resources and of the construction season. Projects could be better coordinated if project managers used the project management processes and tools described in the previous sections and communicated their project plans to management, including proposed, approved and revised project schedules and project resource requirements.

Standardization of project management processes would allow management to combine the schedules and resource requirements of all projects, and better monitor the extent program objectives are met. Engineering should provide project managers with the tools for effective project management. They should also ensure through a system of policies and procedures that those tools are used consistently and that the results of project management processes are reported to management.

Responses to the Audit

Beverly Stein, Multnomah County Chair

Room 1515, Portland Building
1120 S.W. Fifth Avenue
Portland, Oregon 97204

Phone: (503) 248-3308
FAX: (503) 248-3093
E-Mail: mult.chair@co.multnomah.or.us

March 19, 1999

Suzanne Flynn
Multnomah County Auditor
1120 SW 5th Room 1410
Portland, Oregon 97204

Dear Suzanne:

Thank you very much for your and your staff's work on the Roadway Capital Projects Audit report. Rather than focus on the specifics you uncovered which I believe are well covered in your report and the Department's response, I would like to comment on your process.

The willingness of your office and our Department to work cooperatively meant that much more was accomplished than would have been under standard procedures. The Division and Department requested the audit, were very receptive to your initial findings, and moved promptly to address the major issues.

This, in turn, enabled you to broaden your scope and spend less time developing specific documentation to substantiate your major points. A win-win situation. Thank you for the cooperative spirit demonstrated in this work. I hope we will be able to use this approach, when appropriate, in the future.

The areas you have mutually identified will enable our Division to use taxpayer money more efficiently. Given the probability of increased revenue for the first time in several years, this work is very timely.

Sincerely,

Beverly Stein

MULTNOMAH COUNTY OREGON

DEPARTMENT OF ENVIRONMENTAL SERVICES
1600 SE 190TH
PORTLAND, OREGON 97233
(503) 248-5000

March 19, 1999

Suzanne Flynn
Multnomah County Auditor
1120 SW 5th Avenue Room 1410
Portland, Oregon 97204

Re: Roadway Capital Projects Audit Report

Dear Suzanne:

I appreciate the thorough and in-depth analysis provided in the Roadway Capital Projects Audit report. I believe that the Division's cooperative efforts in providing information and ideas to assist with the audit have resulted in a very useful product. This cooperative spirit is reflected in actions that the Division took to address several areas of concern, even while the audit was underway. The enclosed plan builds on the initiatives already started and represents our commitment to continued leadership in strengthening management and execution of the roadway capital improvement program.

This audit is different in its approach. It does not focus attention on specific problems. Instead, it examines controls throughout the entire capital project management system for roads. The response in turn is different. It provides a plan to improve the controls for the management system. This plan will address the issues identified in your report and provide valuable tools, concepts, and training for Division staff in managing projects of all sizes. It is likely changes in this plan will occur as we implement it. However, the goal to develop a systematic and comprehensive roadway capital project process that addresses the issues and concerns raised by the audit will not change. We recognize that timely and cost effective delivery of these projects is key to maintaining public trust in the agency's ability to solve transportation problems and use public resources wisely.

The Division's ability to commit resources to this effort will be restricted without an increase in its primary funding sources. Financial constraints notwithstanding, we will work to keep implementation of this plan a priority and accomplish its goal and major objectives.

Sincerely,

Larry F. Nicholas
Director,
Department of Environmental Services

C: Beverly Stein, Chair
Harold Lasley

PLAN OF ACTION
FOR DEVELOPMENT OF A
COMPREHENSIVE PROJECT DELIVERY SYSTEM

Goal

To develop and document a comprehensive project delivery system that addresses deficiencies raised in the Auditor's report and provides a framework of policies and procedures for managing projects of varying size and complexity.

Approach & Plan

Our approach to achieving this goal in the next 18 – 24 mos. will be to use sound project management principles and practices; in effect, to model the principles and processes of an effective project management system. These principles and processes include:

- Accountability
- Project planning, organization, and coordination
- Defining and managing project scope
- Scheduling, budgeting,and workplanning
- Cost management and control
- Quality control and performance measurements
- Communications management

This project will be referred to as the ***Comprehensive Project Delivery System (CPDS)***. The CPDS will be approached in phases to facilitate planning and provide a stronger focus on producing useful results as the project progresses. Each phase will have a statement of objectives and clearly defined deliverables. The Engineering Services Manager will be responsible for developing a workplan, budget, and schedule approved by the Division Director for each phase.. We will employ a consultant to assist with the technical components of the CPDS, provide staff training, and develop a CPDS reference manual that will comprise Division policies, procedures, and processes for capital project management.

The following plan outlines the goal and major of the CPDS project as we currently envision it. Phases 1 and 2 are fairly well defined in terms of objectives and deliverables. Phases 3 and 4 are less well defined. Near the conclusion of each phase we will re-

assess this plan and adjust it as needed to build on the progress and the information collected up to that point.

Phase 1

Objectives

- Review the audit report with key management and staff.
- Build understanding of, and support for project within staff.
- Establish effective communication and problemsolving processes among staff
- Categorize the audit recommendations into i) short term immediate action items; ii) action items fundamental to development of a CPDS to be included in remaining phases and iii) items of lesser or secondary importance that will only be addressed to the extent they bear directly on items in category ii), and budget and other resources allocated to this project allow.
- Begin implementation of items in category i)
- Clarification/definition of "cradle-to-grave" project management and "strong project manager" concepts
- Develop positive public relations strategy
- Approved FY 1999-2000 budget for this project

Deliverables

- Phase 1 workplan and FY 1999 – 2000 budget
- Categorization of issues/action items from auditor's report (refer to categories above)
- Summary of feedback and input from meeting with key staff regarding auditor's report and plans for development of CPDS.
- Consultant recruitment and selection
- Designation of project manager for phases 2, 3, 4
- Summary of issues and ideas emerging from team development session(s)
- Monthly status reports to include progress, problems, updated workplan and budget
- Fact sheet and "talking points" for public information, interviews, media inquiries, etc

Timeframe: Feb – June '99

Phase 2

Objectives

- Definition and phasing of remaining scope of work to complete principle elements of CPDS
- Develop resource requirements and cost estimate for remaining phases.
- Reach consensus on major components of comprehensive project management system (CPDS)
- Review county policy, procedures, forms, practices, and organization as relates to CPDS
- Continue implementing action items from category i) above
- Develop performance measures for management of project

Deliverables

- Consultant contract to cover remaining phases
- Specific job duties and responsibilities of Project Manager for Phases 2, 3 and 4
- Phase 2 scope of work definition, workplan and budget
- Flowchart of comprehensive project management system
- Definition of "strong project manager" responsibilities in CPDS
- List of specific documentation needed for each phase of CPDS
- Monthly status reports to include progress, problems, updated workplan and budget
- Develop internal and external Communications plan

Timeframe: Jul – Dec 99

Phase 3

Objectives

- Skills assessment tool for project manager development and training
- Assessment of current organizational structure for changes needed to support CPDS concept and processes
- Develop reference manual for CPDS (i.e., policies, guidelines, checklists, forms)

Deliverables

- List of issues and recommendations for organizational changes to support CPDS
- Phase 3 scope of work, workplan and budget; updated workplan for remaining phases

Timeframe: Dec 99 – Apr 00

Phase 4 (Implementation)

Objectives

- Remediate major shortcomings of existing projects to align with CPDS
- Address priority staff training needs
- Identify unresolved issues that need continued effort

Deliverables

- Implementation plan including financial and staff resource requirements
- Employee specific training plans
- Training sessions on priority topics
- Auditor's progress assessment

Timeframe: Apr 00 – Dec 00

Performance Measures

We believe that performance measures can serve as useful indicators of progress we are making toward the goal of the CPDS if they are accurate and timely. We will evaluate various performance measures for this project that focus on cost and completion of deliverables, planning, scope management, and employee involvement. Definition of

performance measures is included in Phase II, but identification and discussion of potential performance measures will begin during Phase I.

Quality Control

Management quality control will be accomplished through project oversight by the Division management team (TLT). The TLT will act as the Steering Committee to ensure management accountability, maintain organizational focus, and facilitate coordination of various work units and resources. The Engineering Services Manager, who is a member of the TLT, will be responsible for managing the ongoing work of the project, and accomplishing the objectives and deliverables throughout all phases of the project. The Division Director is the leader of the TLT, and by virtue of that position, will provide leadership to the CPDS Steering Committee.

We intend to hire a consultant with demonstrated experience in the field of project management. The consultant will provide technical expertise to supplement and enhance that of the Division's project management staff. During development of the CPDS, we will look for opportunities for external review and feedback from stakeholders, partners, and/or peers. We also welcome periodic review of our progress by the Auditor's office.

We believe that these measures provide effective quality control for the management and technical aspects of this project.