

FINAL REPORT

**AN ASSESSMENT  
OF THE CONSTRUCTION  
ADVERTISEMENT DATE PROCESS  
WITHIN THE VIRGINIA DEPARTMENT  
OF TRANSPORTATION**



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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

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## **ABSTRACT**

At any given time, there are typically 3,500 highway construction projects being prepared for advertisement by the Virginia Department of Transportation (VDOT). To determine why some of these projects miss their projected advertisement dates, this study analyzed the process used to establish them. Because VDOT's preconstruction engineering process relies on the Program Project Monitoring System (PPMS) to relay information, the researchers devoted a significant amount of time to analyzing the strengths and weaknesses of this system.

The researchers suggest ways for VDOT to (1) establish target dates that better reflect its real potential to get the work done, (2) minimize the number of preventable, last-second advertisement date delays attributable to job performance problems, and (3) build into PPMS and the overall scheduling process the realization that unforeseen problems will occur some percentage of the time.

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## **INTRODUCTION**

The Virginia Department of Transportation's (VDOT's) advertisement of a highway construction project can be the culmination of as many as 65 distinct preconstruction activities. Appendix A presents an overview of this process, which involves work by VDOT's central office divisions, district office sections, and residencies. Typically, at any given time, 3,500 highway projects are being prepared for advertisement. Project advertisements are an extremely important "deliverable" for VDOT. The monthly advertisement is crucial for the financial well-being of the firms that make up Virginia's road building industry. Further, the scheduling of particular projects sends an important signal to the public and elected officials that projects which will meet their transportation needs are progressing toward completion.

Since the 1980s, VDOT's target advertisement dates for projects have been made public, in part to help the road building industry plan its work. When a large number of these projects and/or high-dollar projects fail to meet their target advertisement dates, a host of problems are created for VDOT. Over time, missed advertisement dates give VDOT an undesirably high cash balance. Both the high cash balance and the unmet expectations strain VDOT's relationship with the industry, citizens, and elected officials. Future projects can fall behind schedule, which can have negative effects on employee morale and efficiency. In short, when the monthly advertisement significantly differs from the published schedule, this may be viewed as a problem with VDOT's performance as an organization.

In the fall of 1993, VDOT's Assistant Commissioner for Planning and Programming and VDOT's Division of Programming and Scheduling asked the Virginia Transportation Research Council (VTRC) to conduct a study of VDOT's methods for setting activity target dates. VDOT uses a consultant-developed information system, the Program Project Monitoring System (PPMS), to schedule, coordinate, and monitor preconstruction activities. A number of aspects of the preconstruction process have changed since the development of PPMS in the mid-1980s, and it was thought that the target date calculation routines might need revision.

## PURPOSE AND SCOPE

The purpose of this study was to ascertain why certain of VDOT's construction projects miss their scheduled advertisement dates. The objectives of the study were as follows:

1. Determine why some projects are not advertised on time.
2. Determine the strengths and weaknesses of PPMS as an information system.
3. If appropriate, develop recommendations for improvement in the process.

## METHODOLOGY

Initially, the purpose of this study was to conduct a statistical analysis of advertisement dates using a recent sample of highway construction projects of various types. For some project types, the researchers planned to make statistical comparisons of actual completion times for activities with the PPMS time allowances ("time standards") for those same activities. The observed discrepancies would guide the formulation of revised statistical models for projects of particular types, with the goal of predicting the length of the preconstruction process more accurately in the future. Soon after the study began, however, it became clear that a number of factors, some PPMS related and some not, influenced whether projects were advertised on time. In many cases, the accuracy (or lack thereof) of the PPMS time standards did not seem to be the most immediate reason for missed advertisement dates.

The researchers were unable to find an efficient way to download project data from PPMS for the statistical analysis. It appeared that the data would have to be either manually re-entered from PPMS screen prints and/or located in the paper files for projects, recorded, and re-entered. Consequently, the researchers were unable to do statistical comparisons of PPMS time allowances for activities versus actual completion times.

Four tasks were conducted to meet the study objectives:

1. *Attendance at the monthly advertisement meetings at VDOT's Central Office over a period of 18 months.* After the meetings, the researchers "debriefed" the staff of VDOT's Programming and Scheduling Division about what had occurred at the meeting and asked questions about various issues that had arisen, the history of specific projects, why certain decisions had been made, etc.
2. *Telephone and/or face-to-face interviews with VDOT Division Administrators and/or their assistants in the Location and Design, Environmental, Right of Way, Urban, Secondary Roads, Structure and Bridge, Construction, and Programming and Scheduling Divisions.*

3. *A review of VDOT manuals, reports, and memoranda on PPMS, the preconstruction process, and ad date procedures and a review of the literature on transportation project information management systems and scheduling methods.*
4. *“Hands on” use of PPMS after training by Programming and Scheduling Division staff.* The researchers used PPMS to investigate the detailed history of various projects and created ad hoc reports using the SuperNatural system.

A limitation of the methodology was that VDOT field employees and district staff were not interviewed about the scheduling process. Although written reports and interviewees offered views about the field’s perceptions of the process, the researchers did not independently validate them.

## FINDINGS AND DISCUSSION

### Overview

The most basic finding of the study was that **money drives the system**. Virtually everyone interviewed emphasized this point. What this means operationally is that initial advertisement dates are administratively fixed, based on financial projections. The target start and completion dates for the various preconstruction activities are then calculated backward from the desired advertisement date. If problems arise, VDOT has established procedures by which field or central office units can request a revision of the target dates (including the advertisement date) within PPMS. Requests for revisions are sometimes denied, however, for a variety of reasons. When this occurs, staff may feel the advertisement schedule is unrealistic.

VDOT has widely known reasons for setting target dates in this way. First, it has an unsurpassed record of spending all available federal funds (often including a portion of other states’ unobligated balances). Second, VDOT wants to ensure that a specified percentage of the cost of a project is in hand before work on it begins. Although these are sound reasons for administratively fixing the initial advertisement dates, this practice does not reflect the complexity of the project, how much staff is available to get the work done, etc. If unconsidered factors threaten the advertisement date, or one of the target dates, they are dealt with after the fact.

Because advertisement dates are initially set with a focus on the availability of funds, the initial predictions are likely to be optimistic. Indeed, projects can be behind schedule even before they start. Statistically, the process for setting initial advertisement dates produces target date estimation errors that are predominantly in one direction—too little time is allowed. This suggests that the PPMS time standards are not average time requirements for activities. If the time standards were truly averages, the estimation errors would be more varied—PPMS would allow too much time for a number of projects. With the 1991 and 1995 early retirement programs, any tendency by PPMS to underestimate how long activities will take is compounded by the fact that less experienced employees are doing the work in many parts of VDOT.

## **Reasons Projects Miss Projected Advertisement Dates**

There appear to be three fundamental reasons projects miss their scheduled advertisement dates:

1. inaccurate scheduling assumptions
2. unexpected events
3. job performance problems.

It appears that some of the missed advertisement dates could have been avoided—the project was delayed for a reason within VDOT’s control. In other cases, however, the project was delayed for a reason largely or totally out of VDOT’s control. Often a missed advertisement date could be attributed to more than one reason. The list does not include every possible reason, just those the researchers heard with some frequency.

### **Inaccurate Scheduling Assumptions**

Reasons 1-7 represent “inaccurate scheduling assumptions.” This category represents *underestimates* of what is required to get projects ready for advertisement, *overestimates* of resources available to get the work done, or both.

1. PPMS time standards (i.e., time frames) for one or more activities were too short. For example, PPMS may allow 4.5 months for the completion of a particular activity on a certain type of project, but the activity may very often require 5.5 months to complete.
2. One or more activities were completed very late, but target dates were not revised (or not revised to the same extent).
3. Staff time was diverted to a higher priority project.
4. Fewer staff hours were available for the project than anticipated.
5. Staff available to work on the project were less experienced than anticipated.
6. The project was shifted from state funds to federal funds.
7. There was a delay in getting a consultant on board.

Some of these inaccurate scheduling assumptions are built into PPMS in the form of outdated time standards for activities. Other kinds of inaccurate scheduling assumptions likely reflect the



fact that the PPMS personnel module, which could provide information to managers on available staff time, is not used.<sup>1</sup>

The use of the term *inaccurate scheduling assumption* is not meant to imply that an assumption is necessarily a poorly made one. An inaccurate assumption may be based on the best (or only) information available. For example, the 1991 and 1995 early retirement programs resulted in heavy losses of particular kinds of knowledge and experience within VDOT. VDOT managers may have a very difficult time predicting the learning curves of the remaining employees since, in many instances, typical job progressions could not occur.

## **Unexpected Events**

Reasons 8 through 17 illustrate the kinds of unexpected events that can cause projects to miss their target advertisement dates.

8. Toxic soil, an endangered species, a grave site, or a similar problem was discovered.
9. The scope of the project changed significantly.
10. There were problems with utility relocations.
11. There were problems with right-of-way acquisition or with relocations of individuals or businesses.
12. The priorities of a local government, citizens, or the Commonwealth Transportation Board changed.
13. A locality stated it would be responsible for one or more preconstruction activities and reneged.
14. Funding ran out, so the project had to be delayed.
15. Project costs greatly exceeded the estimate.
16. Design changes necessitated additional steps in the process or repetition of earlier steps.
17. Unanticipated public hearings were required. In some cases, projects scheduled for a combined location and design hearing had to be switched to a two-hearing project. In other cases, it was anticipated that a willingness could be posted, but citizen response to the project necessitated a hearing.

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<sup>1</sup> One reason that the personnel module cannot be used is that data have not been entered into it.

The items in this category often represented “surprises” to some extent, particularly the environmental problems. Several items represented external sources of delay, over which VDOT may have had little control.

Reasons 11, 12, 16, and 17 fall into a particular category of unanticipated events. In these cases, VDOT’s response to the requests of local governments or citizens resulted in an inability to meet advertisement dates.

### **Job Performance Problems**

The third category of reasons that projects miss their advertisement dates is job performance problems, either within VDOT or on the part of an external agency or a consultant.

18. An internal VDOT approval or submission did not occur on time.
19. Paperwork was lost.
20. An external agency or authority failed to act or issue a permit.
21. An incomplete or deficient project “package” was submitted to the Construction Division.
22. Errors or omissions occurred in VDOT or consultant-produced plans.
23. An employee(s) knew the project was behind schedule but suppressed that fact (may have thought “time could be made up somewhere else”).
24. VDOT units did not provide important project information to each other.

Not surprisingly, VDOT managers and staff seem most disturbed when a missed advertisement date is attributable to a job performance problem, rather than an inaccurate scheduling assumption or unexpected event.

VDOT managers told the researchers that the job performance problems that contribute to missed advertisement dates do not necessarily reflect a lack of motivation on the part of employees. Indeed, one of the reasons employees may be reluctant to admit that a project is behind schedule is because they want to do a good job and are convinced that time can be made up.

Inexperience also contributes to job performance problems. The early retirement programs removed many of the most experienced employees from the Central Office and the districts—the individuals best qualified to answer certain questions from fellow employees. This surely hindered information seeking by the remaining VDOT employees. In addition, this less experienced staff may not know how to resolve particular issues or recognize the severity of certain problems.

Many of the job performance reasons that projects miss their advertisement dates are related to lapses in communication. The preconstruction process is sufficiently complex and time-sensitive, and its success typically dependent on the work of so many different units that a lack of communication can very often significantly delay a project. The importance of communication is evident from the behavior of VDOT units when a decision is made to “fast track” a project: behavior becomes more proactive, there is more active information seeking, and communications between units are personalized (more telephone calls, fewer e-mails and written memoranda).

Some lapses in communication reflect staff resistance to using PPMS, as is discussed in the next section. Despite the shortcomings of PPMS, some of the lapses in communication within VDOT could be avoided if more people took advantage of PPMS’s target date monitoring capabilities. Many (if not all) central office divisions with preconstruction responsibilities assign target date monitoring responsibilities to one or more employees. Although there is some information gathering on target dates within divisions, the amount of time devoted to it varies.

In other instances, more proactive personal communication would probably have been needed to keep a project on schedule. Although a number of managers said they encourage employees to be proactive and seek out information on the status of projects, it is clear from the advertisement meetings that information seeking does not always occur. Information seeking may be more important than ever before, with so many fewer employees responsible for the same volume of work. The personnel shortage may foster employee beliefs that they do not have time to be seeking information.

VDOT’s decentralized organizational structure may contribute to other lapses in communication. Responsibility for completion of certain preconstruction activities and authority over the people and resources needed to complete those tasks are sometimes vested in different places (see Appendix B). For example, although central office divisions are accountable for the status of projects at the monthly advertisement meetings, much of the actual work is done in the districts. Since decentralization seems likely to continue, communication tools and the level of willingness to share information will continue to affect VDOT’s ability to advertise projects on time.

### **Importance of Activity Dates**

Some division administrators expressed the view that more of the communication within VDOT needs to focus on activity target dates, rather than advertisement dates. The focus on advertisement dates fosters a belief that time can be made up by some other group somewhere further along in the process. The interview respondents acknowledged that right-of-way functions, being at the end of the process, are often adversely affected by these beliefs. If right-of-way time frames are greatly compressed (as a result of target dates missed earlier in the process), property owners’ perceptions of VDOT may be unfavorable.

If a problem is not made known until the monthly advertisement meeting (which focuses on projects scheduled for advertisement within 120 days), it may be impossible to solve the problem

and still meet the target advertisement date. Depending on the nature of the problem, the date may be moved, staff may be reassigned in order to make the date, or a decision may be made to remedy the problem administratively (i.e., with additional contract provisions after advertisement). Each of these approaches has drawbacks for VDOT. Interview respondents stated that even though meetings are held to discuss projects 6 months before advertisement, some things still come to light that cannot be resolved in 6 months. This underscores the problem of focusing too exclusively on advertisement dates, rather than activity target date.

### **The Program/Project Management System (PPMS)**

PPMS operates under ADABAS and is a part of COMPLETE (Bergstralh-Shaw-Newman, Inc. and Computer Consultants, Inc., 1991). As implemented, PPMS fulfills a valuable role within VDOT. The system electronically links functionally and geographically separate units within VDOT by providing detailed information on the status of a large number of projects that are in various stages of the preconstruction process. As Appendix A shows, VDOT work units are highly interdependent during the preconstruction process. Work units are responsible for the timely entry of activity start and completion dates into PPMS so that up-to-date information on the status of projects will be continuously available. Relevant information such as project status and funding are provided through different types of screens intended to meet the information needs of different kinds of users. A bulletin board feature alerts users to updates to the schedule, and standard reports can be ordered to track various aspects of the schedule.

Once an advertisement date is established based on anticipated funding, the system automatically back-calculates the target dates for intermediate activities. These calculations are based on preset time and personnel “standards” (i.e., estimated requirements) for specific activities that are programmed into the system. The units involved in the project then have the opportunity to review the target dates established for the activities. However, since the advertisement date is already set based on funding, divisions may be hesitant to mention anticipated problems in meeting target dates. If the advertisement date is changed, activity target dates must be manually recalculated and entered into PPMS individually.

### **Reliability of PPMS Data**

PPMS has a credibility problem within parts of VDOT. Some users think the information in PPMS is not reliable because work units do not always enter data in a timely fashion (e.g., activity start or completion dates may not be entered until well after the fact). For this reason, it is not the sole source of information staff use to track project status and the schedule. Divisions use it as one source of information along with the Six Year Plan, the short-range schedule, and other documents.

Another reason for the credibility problem is a suspicion by users that the standards used to calculate target dates are no longer accurate since they have not been adjusted to reflect the

changes in VDOT's work force following the 1991 and 1995 early retirement programs or the changes in environmental regulations. The objective validity of the standards is also questioned by those who remember that the standards were compressed in the latter part of the 1980s because of Governor Baliles' directive to reduce preconstruction time by 20%. (Transportation funding had increased markedly following the ½¢ increase in the sales tax that was earmarked for transportation.)

There are two aspects of the problem with standards. First, any changes in the standards must be made manually, and there is no routine procedure in place to adjust the standards as changes in the process or staffing occur. Second, even if the standards were revised, PPMS does not have the capability to automatically adjust the existing schedule to reflect these changes. Since the target dates are calculated by backward chaining, it is not easy to adjust the dates once the project is initially scheduled. Those responsible for maintaining the target dates within the system must make changes to each project's target dates manually. This labor-intensive task cannot always be accomplished in a timely manner given the large number of projects within PPMS at any given time. Only projects scheduled after the standards were adjusted would automatically reflect the revised standards.

### **Access to Needed Information**

Although the reliability of the data is one key influence on the use of any information source, another key influence is how easily information can be accessed and entered. Information can be accessed from PPMS by either viewing on screen or by ordering a variety of standard batch reports. For the occasional user, it may be difficult to determine which screen has the relevant information. For both occasional and frequent users, the reporting mechanisms are not concise, simple, or timely. As is characteristic of the COMPLETE system, reports cannot be previewed on the screen before printing. Since reports are standard, users do not have the flexibility within PPMS to create their own reports with individualized information and/or formatting. This capability is available to some extent if SuperNatural is used to create ad hoc reports. Access to SuperNatural, however, is restricted by the Information Systems Division, and some preconstruction divisions do not have access to SuperNatural.

Simply stated, PPMS does not meet the needs of many of the potential users. For example, one screen within PPMS compares target and actual completion dates for activities and displays "early" or "late" flags as appropriate. Unless a user is willing to spend a considerable amount of time, however, there is no easy way of figuring how early or how late the activity was completed. If a manager wants to analyze staff performance on meeting target dates, valuable time is spent transferring the data into spreadsheets that permit this kind of analysis. Very few of the managers interviewed during this study are hands-on users; several commented that they "did not have time to use PPMS."

## **Workload Assessment and Planning**

As designed, PPMS was to consider available resources by linking with other information systems such as the Workload Assessment System (WAS). As currently used within VDOT, PPMS considers number of staff required in its target date calculations, based on fixed standards. Because the personnel information is not in the system, these requirements are not automatically balanced with staff availability. Without the available personnel module, PPMS cannot be used to assess the overall workload that multiple projects represent. As a result, preconstruction divisions estimate their available staff hours and how they can best be distributed across large numbers of projects in different stages of development.

Information on available personnel is particularly important in decision making about when consultants should be used to get the work done. In the interviews, the researchers were told that the field is sometimes reluctant to hire consultants because they are concerned that doing so would reflect poorly on their performance. If the personnel planning module were available in PPMS, it could be used to demonstrate the objective need for consultants in particular situations, perhaps reducing these concerns. Without data in the personnel planning module, a VDOT unit cannot easily analyze its total workload and balance in-house and consultant labor.

According to some division administrators, consultant labor is not always available when it is needed. One division administrator commented that four of the eight consulting firms that his division calls upon have too much work. If needs for consultant help could be anticipated earlier, these problems might not occur so often.

With the significant retirement losses in 1991 and 1995, the lack of a usable personnel planning module in PPMS has become all the more problematic. Without it, it is difficult to plan the most efficient use of the remaining employees' time, and the absence of this planning capability may contribute to beliefs that target dates are unrealistic.

### **Desirable Characteristics of a Preconstruction Engineering Management System**

Based on the review of the literature on project information management systems, certain capabilities characterize superior project information systems (AASHTO, 1991; McPherson, Mooring & Nedwidek, 1990; Persad, O'Connor & Hugo, 1990; Markow, 1995). These capabilities are listed here, with comments on PPMS's current capabilities.

1. *Multiproject environment.* The interaction of activities is an integral component of the planning process. Since PPMS schedules activity dates without regard to the status of other projects or staffing availability, it does not effectively incorporate the complexities and interrelationships inherent in VDOT's multiproject environment.

2. *Workload analysis.* Since PPMS does not consider the multiproject environment, at any given time it cannot directly analyze the total workload of a specific unit and incorporate this information for scheduling purposes.

3. *Simulation.* If information were provided on total workloads, including numbers of staff (and possibly their experience), the effects of fast-tracking projects, or compressing activity time frames, could be considered before decisions were made. The inclusion of staffing level information in the analysis would provide better information about the performance of both the overall organization and distinct units. Another benefit would be the ability to simulate workloads to identify potential problems before they affect the overall schedule. For example, if management was considering advancing a project's advertisement date, simulation could be used to estimate the impact that might have on other projects. Similarly, if another project's advertisement date had to be delayed for some reason (e.g., toxic soil), it would be useful to determine whether another project's advertisement date might be advanced with simulation. An added benefit would be that managers could better anticipate their needs for assistance from other VDOT units or the consulting industry. Although PPMS does have a simulation capability, the on-line system must be suspended in order to use it. This is clearly undesirable and, as a result, this component of the system is not used.

4. *Prioritization.* VDOT managers and workers would benefit from a tool that could guide their time allocations based on a prioritized list of projects. PPMS effectively assigns equal priority to a large percentage of all active projects. It is apparent from the advertisement meetings, though, that certain projects certainly have the highest priority in management's view. A related component that would be highly useful would be the capability to prioritize projects and their activities.

5. *Performance tracking.* The capability to analyze the overall preconstruction process is highly desirable. One critical component of this is how often dates change for projects. PPMS currently has a limited ability to track changes in target dates: it does not retain more than two previous sets. Although this design fits the need of many users, it is difficult to analyze the overall process. If PPMS retained more information about previous target dates, periodically revising the standards would be easier.

The preconstruction engineering process within VDOT involves the coordination and integration of many activities performed by many units. With such a complex process, and with the recent loss of many experienced employees, remaining staff must have guidance about the highest priority uses of their time. A preconstruction engineering management system that integrated the monitoring functions of PPMS with the personnel planning and simulation capabilities described could greatly aid VDOT in identifying target date problems and subsequently resolving them. With additional enhancements to PPMS, the advertisement dates that are made public might have a stronger basis in VDOT's true ability to get the work done.

## CONCLUSIONS

- *VDOT manages to get hundreds of construction projects “on the street” every year despite the problems discussed in this report.* As one of only five departments of transportation in the United States that are responsible for almost all of a state’s roads, construction project scheduling is a considerably larger, more complex task for VDOT than for most other departments of transportation. VDOT has lost a large number of experienced employees who cannot be replaced in the foreseeable future. Against that backdrop, VDOT needs to find ways (1) to establish target dates that better reflect its real potential to get the work done, (2) to minimize the number of preventable, last-second advertisement date delays attributable to job performance problems (especially communications lapses), and (3) to build into PPMS and the overall scheduling process the realization that unforeseen problems will occur some percentage of the time. At present, the scheduling process seems to be based entirely on “best case scenario” planning for all projects. Consequently, when problems arise, preventing adverse effects on the monthly advertisement dates is difficult.
- *Several things about the current scheduling process are not likely to change.* Project scheduling will continue to be greatly influenced by the availability of funds and any requirements associated with particular funding sources (e.g., federal funds). Spending all available federal funds will continue to be a top priority in the scheduling process. Since environmental permits have a life of only 3 years, VDOT will not be able to have numerous projects “on the shelf” in the event problems occur. In addition, because of the Federal Highway Administration’s requirement that VDOT’s federal-aid program be financially constrained, VDOT’s ability to substitute projects is very limited. Localities will continue to have the ability to shift project priorities. Road construction will continue to be a seasonal activity, which affects VDOT’s ability to balance the total amount of the monthly advertisements. Some projects will miss their target advertisement dates because of changes in priorities. Other projects may be delayed because of delays in securing federal approval of the statewide transportation improvement program. If initial advertisement dates continue to be set based on financial projections, rather than the characteristics of projects, there will be a need to revise target dates as more information becomes known.
- *At a time when VDOT is confronted with significant losses of experienced staff and managers, it has never been more critical to evaluate the preconstruction process.* To improve VDOT’s ability to project target dates more accurately and meet them a higher percentage of the time, modifications and enhancements should be made to both the overall process and PPMS. Although PPMS has shortcomings as an information system, the researchers do not think they are the primary reason projects miss their advertisement dates. PPMS is not the only means by which VDOT units can communicate information or resolve questions about project status, although it is very important in that regard. Lapses in communication and unresolved questions about project status appear to underlie many missed dates.



## RECOMMENDATIONS

The researchers developed 15 recommendations to improve VDOT's project development process significantly. They are provided here for VDOT's consideration.

### **Improve Knowledge of the Preconstruction Process**

The preconstruction process is very complicated, and in the wake of the early retirements, many VDOT employees have new responsibilities and few experienced co-workers to consult when problems arise. Different units within VDOT may not have a thorough understanding of what other units do or of the problems that other units encounter. It is important for all of those involved in preconstruction to recognize the ways in which their work is interdependent.

*Recommendation 1: Provide preconstruction process training for employees at all levels, with the goal of creating an environment in which people not only understand their own jobs well but also understand the impact of their jobs on the other parts of the process.*

### **Emphasize Importance of Timely, Accurate PPMS Data Entry**

Although PPMS is potentially a very efficient way for VDOT units to share information about the status of numerous projects, its value hinges on prompt, accurate data entry by those responsible for an activity. Accurate information on activity start and completion dates is a necessary input for periodic updates of the time standards.

*Recommendation 2: Make PPMS more credible by holding work units accountable for timely, accurate entry of data. PPMS system maintenance is an important component of the work of the divisions involved in preconstruction. Supervisors should stress its importance.*

### **Broaden Access to SuperNatural for Customized PPMS Reports**

The current standard batch reports available in PPMS do not meet the monitoring needs of all divisions involved in preconstruction. Although SuperNatural can be used to create customized reports, all divisions do not have access to it.

*Recommendation 3: Make ad hoc reporting capabilities available to each individual responsible for monitoring project status within a division or section. Although other alternatives should be investigated, as an interim measure, the Information Systems Division should*

*provide access to and training in the use of SuperNatural or ESPERANT<sup>2</sup> for each person with project-monitoring responsibilities.*

### **Revalidate PPMS Time and Personnel Standards**

There is a sufficient basis to believe that the target date calculation routines within PPMS are no longer accurate. This contributes to staff beliefs that target dates are unrealistic and creates antagonism between units when target dates are missed. A thorough reassessment of the time and personnel (“manpower”) standards that are used for target date calculations in PPMS is warranted. It is important to analyze actual completion times for activities as part of this task. This task would best be performed by a single unit (possibly a consultant) using a consistent, objective methodology. It is likely to be a very time-consuming task because historical project data cannot be easily transferred from PPMS into another software package for statistical analysis. This task would likely require one or more individuals full time for some period of time because it would be so data intensive.

*Recommendation 4: Revalidate the activity time standards within PPMS, based on historical data from recent projects.*

### **Implement the PPMS Manpower Module**

It is not sufficient, however, to merely revalidate the standards within PPMS. Managers need to be able to compare available staff hours with the typical time and personnel requirements of projects (i.e., the standards). Staff availability needs to be a continuous input into an information system used to schedule large numbers of projects. The implementation of the manpower module to PPMS would greatly enhance decision making about the best possible uses of VDOT employees’ time.

Implementation of the manpower module might enable work units to anticipate their needs for consultant help earlier. Some of the reluctance about using consultants might also be lessened, because needs for consultant services would be better supported by data. There might be fewer problems with consultants’ unavailability if the need for them could be better anticipated with PPMS.

*Recommendation 5: Implement the existing manpower module within PPMS.*

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<sup>2</sup> VDOT has purchased ADABAS-D, which will create a relational database for the Complete system data, which includes the data in PPMS. ESPERANT allows access to this relational database in a PC Windows environment. ADABAS-D is scheduled to be on-line in July of 1996.

## **Determine the Scope of Projects with Field and/or Central Office Employee Teams**

To accurately assess project time and staffing requirements, and potential complications in a planning context, the project scope needs to be determined as early as possible. Required project activities and target dates could be determined by a team of field and/or central office employees who would conduct an on-site review of the project. Team members could hold each other accountable for meeting target dates and communicating important project information. At present, responsibility for projects tends to be diffuse within VDOT, which may hinder accountability. Although it might not be possible (or desirable) to scope every project in this way, it would be valuable to do so when the risk of an environmental problem is high.

*Recommendation 6: Conduct on-site project scoping with teams of field and/or central office employees representing different sections or divisions for the purpose of identifying required activities and deadlines and enhancing accountability.*

*Recommendation 7: Assess the potential benefits and drawbacks of scoping selected projects (where there appears to be a high risk of environmental problems, for example) before 70% of the project funds are available.*

## **Base Target Dates on the Beginning of the Survey**

There may be a substantial time lag between the authorization of preliminary engineering (PE) on a project and the date when work actually commences. Hence, if target dates are based on PE authorization, a project can be well behind schedule before it ever begins.

*Recommendation 8: Assess the potential advantages of basing activity target dates on the beginning of survey work on a project. At the least, activity target dates should be adjusted to reflect any delays that occur between PE authorization and the actual commencement of work on a project.*

## **Emphasize Target Date Monitoring**

After ensuring that project schedules are as realistic as possible and that lines of responsibility are clear, managers and supervisors need to stress the importance of intermediate (activity) target dates. The advertisement date is very important to VDOT, but each division's focus must be on the target dates for its activities. Too much focus on the advertisement date tends to foster beliefs that time can be made up on some other activity that occurs later in the process.

The Programming and Scheduling Division has recently instituted quarterly meetings within each district to discuss issues with key members of the preconstruction staff. Target date monitoring should be enhanced by these meetings, although the specific impact could not be addressed because this study concluded prior to the implementation of these meetings.

*Recommendation 9: Division and district supervisory staff should monitor target dates closely throughout a project's life. Because this is particularly important in the early years of projects, one mechanism might be status meetings held 3 years before a group of projects are scheduled for advertisement and at regular intervals thereafter.*

*Recommendation 10: Ensure that activity completion dates are carefully compared to target dates at the time of the biannual update of the Six Year Plan. If significant discrepancies are found, they should be the basis for corresponding revisions to the remaining target dates.*

### **Designate Division Contacts for Individual Projects**

Numerous divisions are typically involved in preconstruction activities. Given the very large number of projects in the system at any given time, it may be difficult for an employee to know whom to contact when questions arise about another division's activities. Designating and making known a specific contact in each division for each project could enhance communication and lessen delays attributable to uncertainty. The contact person should have a detailed knowledge of the status of the project in their division. When projects are successfully fast-tracked in VDOT, personal communication is frequently necessary.

*Recommendation 11: For each project, designate and identify a specific contact person in each division involved.*

### **Evaluate Ways to Share Costs Associated with Late Design Changes**

A number of the individuals interviewed stated that numerous design changes were responsible for a number of missed advertisement dates. Although some design changes are unavoidable, others are avoidable. Regardless of the reason, each design change increases costs and consumes time.

Design changes have occurred so frequently in some situations that utilities delay completing their plans, with the result that utility work is incomplete when the project contractor is ready to begin work. The costs of design changes beyond a certain point might be more equitably distributed among VDOT, the locality, and utility companies.

*Recommendation 12: Study the possibility of charging localities a portion of VDOT's cost for design changes that occur after plans are finalized.*

*Recommendation 13: Implement a policy to reimburse utility companies a specified amount or percentage for costs they incur as a result of late VDOT design changes. The goal would be to provide an incentive for earlier completion of utility relocation plans.*

## **Begin Development of a State-of-the-Art Project Information Management System**

PPMS is expected to meet the varied needs of all of the people involved in the preconstruction process. It falls short of meeting these needs in a number of ways, in part because the system's architecture is 10 years old. In many cases, users view PPMS as a burden, rather than as a tool that could help them do their work. Institutional knowledge and experience play critical roles in the current preconstruction process. This base of knowledge has diminished with the waves of early retirements. At no time in VDOT's history has the need for a comprehensive, state-of-the art project information management system been greater.

*Recommendation 14: The Management Information Systems Steering Committee should initiate design work on a state-of-the-art preconstruction engineering management system. The system should retain the current monitoring functions of PPMS and should also provide the following:*

- *program and multiproject scheduling*
- *simulation of the impacts of various scenarios*
- *graphical display for easy large scale analysis*
- *capability to schedule activities forward from a revised activity date*
- *automatic updating of standards and project schedules developed using outdated standards*
- *the related maintenance of data for problem identification and performance analysis*
- *the ability to manipulate and display data at the request and direction of the user*
- *compatibility with widely used spreadsheet packages so that users can incorporate additional data elements for their own use.*

Most important, this system should be redesigned to address the needs of the users throughout VDOT, including field, district, and central office units; programming and engineering divisions; and all levels of management. It is essential to include potential users at all levels in the organization in the planning process for a redesigned PPMS. Some VDOT staff feel that the current PPMS system was imposed upon them with few or no opportunities for their input.

## **Seek Ways to Improve Morale**

There are many signs throughout VDOT that changes in the current process are needed. The cash balance is larger than VDOT's top managers want it to be, and the road building industry

depends on a stable and vibrant construction program. Since as many projects miss their advertisement dates now as when this study began, fundamental changes are needed to improve the rate of on-time project advertisement. Many of VDOT's most experienced employees retired in 1991 and 1995; errors and omissions are more likely with many remaining employees learning new jobs that are part of a complex process. The "crisis mode" seems to prevail much of the time in the preconstruction functions. All of these factors can contribute to low employee morale. Performance can suffer when morale is low, and this needs to be addressed.

*Recommendation 15: Although none of these recommendations will provide an instant fix for the problems discussed in this report, concerted efforts to improve communication, establish more accountability, and develop a versatile information system that employees will view as a help, rather than a burden, are vitally important for improving VDOT's ability to advertise projects on time.*

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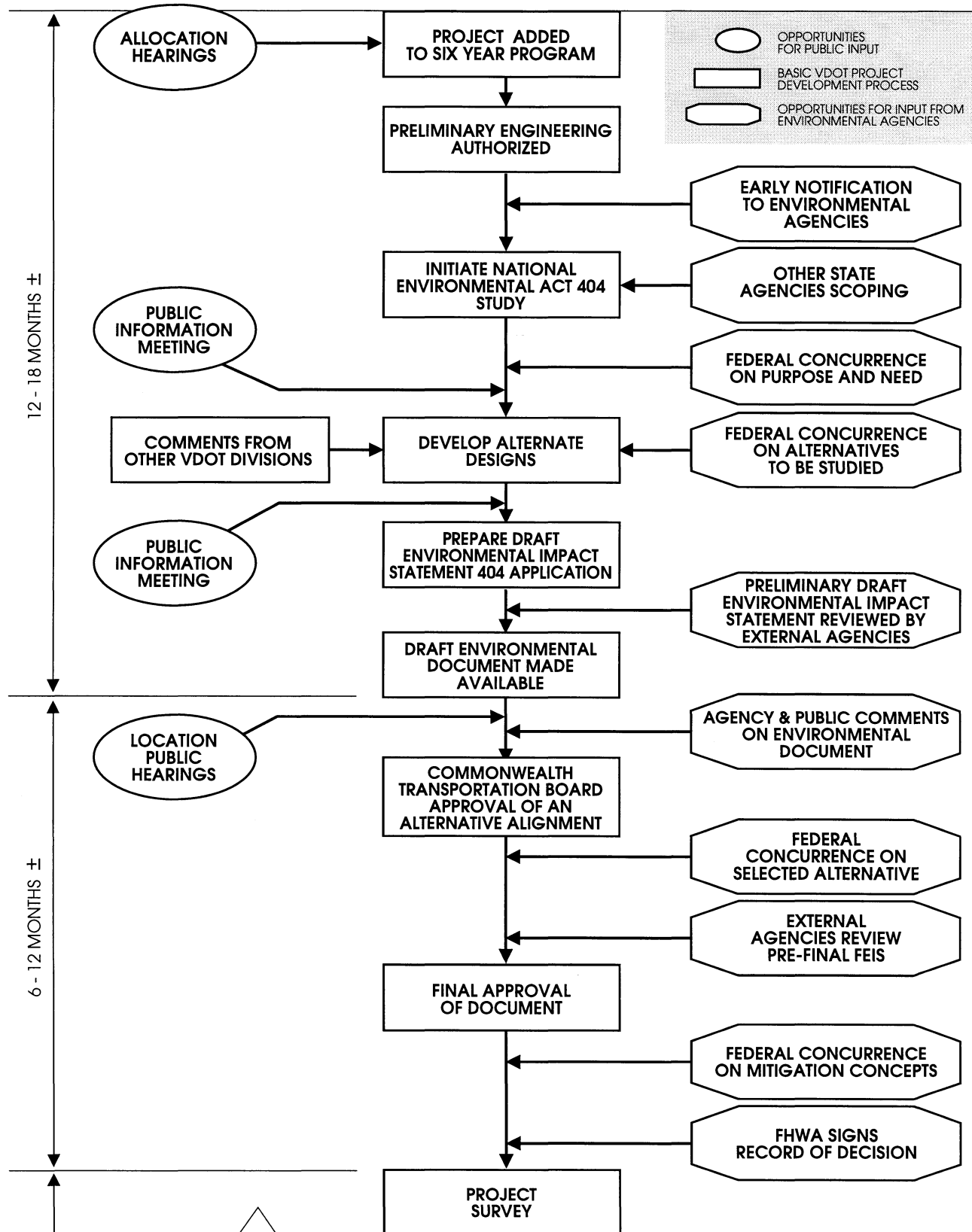
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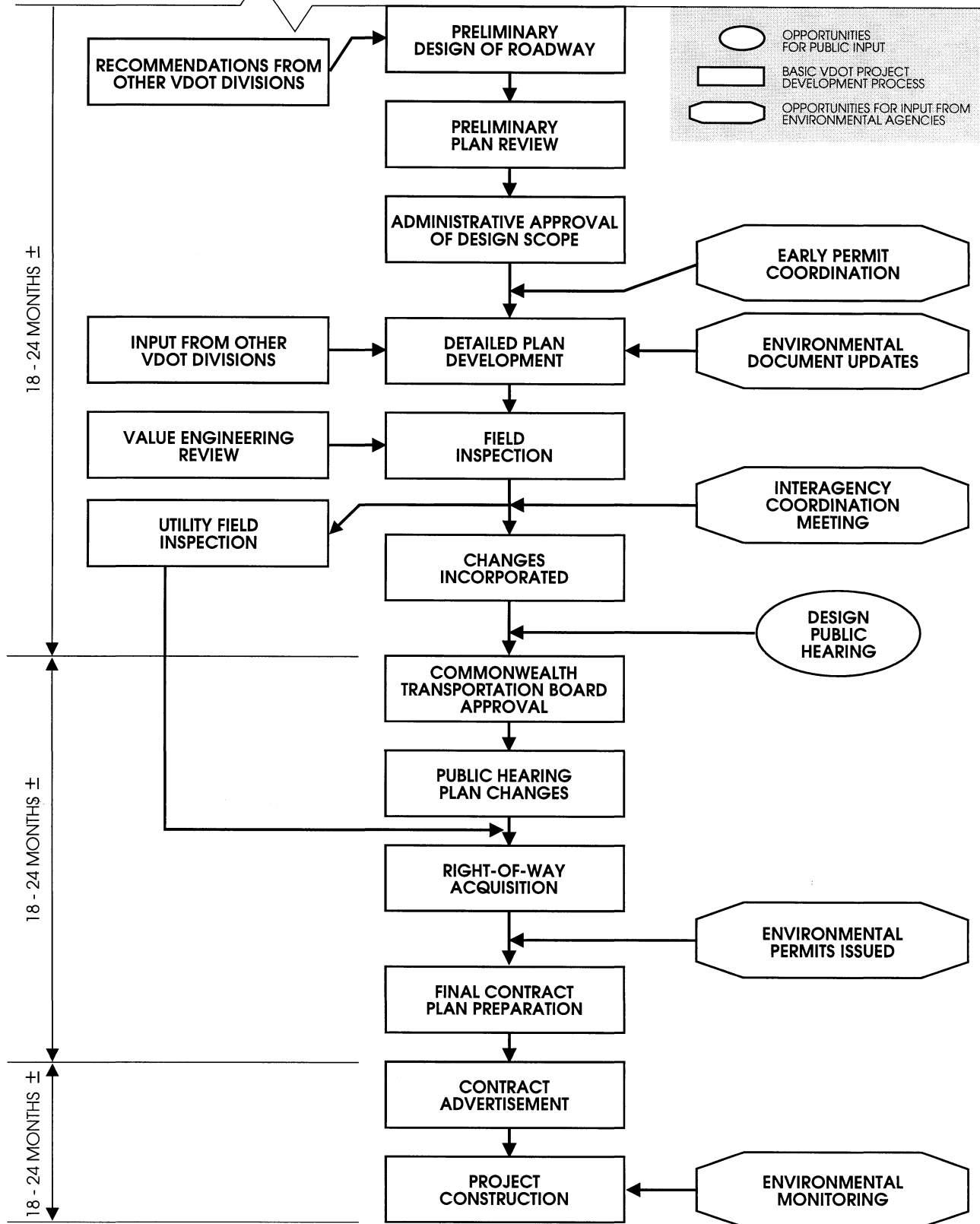
## **APPENDIX A**





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## APPENDIX B

# VIRGINIA DEPARTMENT OF TRANSPORTATION

