

Managerial and Human Resource Experiences with Preconstruction Engineering Management Systems—Washington State Perspective

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Washington has had more experience with a preconstruction engineering management system (PCEMS) than most other states. This paper deals not so much with details of this system but rather with recommended developmental criteria that, based on Washington's experience, should be considered. Although the reasons for developing a PCEMS and the use it will receive will vary significantly from state to state, some fundamental questions exist that must be asked and evaluated to help ensure successful implementation.

Based on Washington's experience with a preconstruction engineering management system (PCEMS) package (one of the earliest in the nation) this paper gives guidance for those who are contemplating or have recently begun the development of a PCEMS package in their jurisdiction. Details of Washington's PCEMS can be found elsewhere (1).

BACKGROUND

Washington's system, called Manpower Management Information System (MMIS) was conceived in 1972 but was not fully operational until 1978. At the heart of MMIS are a computerized critical path scheduler and 85 work standards. These work standards represent each of the significant steps performed during the preconstruction process, which work unit performs the step, its duration, and the manpower necessary. The summation of the work standards necessary for one project gives not only the necessary project duration but also the personnel required, by month, to complete the work.

The resulting schedules and personnel demands by project can then be totaled by work unit, state route, district or statewide, and project engineer. As a planning tool, both short-term and long-range reviews are possible. The only limitation is the knowledge of future work. During this planning process, program adjustments may be necessary to balance work loads, or the need for staff increases or decreases can be foreseen.

Soon after the budgeted plan is established, two events begin. First is the continual program adjustments to correspond to revenue changes and priority changes. Continual system updating is necessary. Second is the collection of expenditure data. Because each work standard has a corresponding accounting charge number, collection of these expenditures and monitoring of progress of a project compared with its plan is generally easy. Management decisions can be and are made during each of the steps in this process.

The description just given is very brief, but for anyone seriously contemplating a PCEMS, the elements are certainly familiar. A fair question to ask is, "With the extensive development work on MMIS, has it met its goals and is it worth the expense?" The answer is that all the goals have not yet been met in making the cost justification borderline. But, the system operation and subsequent feedback have yielded invaluable experience and the direction for improvement. I hope that this experience, often painful and expensive, can be passed on to others to minimize their developmental problems.

PCEMS CRITERIA

Following is a list of considerations and criteria that should be addressed before proceeding with the development of PCEMS in a jurisdiction. The list is in order of priority. The order of priority will undoubtedly vary from state to state but all items merit evaluation.

1. System use--Determine how the system output will be used in your management process. The intended use of this output will determine the type and complexity of the system.

2. PCEMS is a tool--PCEMS, as with any other resource management system, is a tool for program managers. Remember that all results produced must be analyzed by managers before the computer data can be used. People carry the responsibilities of decisions; systems are but one of their management tools.

3. Support of top management--No management system can succeed without the total endorsement and support of top management. This support must include actual use of certain reports generated and insistence that the system is used and updated. In some states this support should include legislative support, and if applicable, commission or gubernatorial support.

4. Schedule control--The heart of any program management process is the schedules. All project managers keep schedules for the projects under their control. These schedules are often kept mentally, on hand written lists or computer listings. It is critical for an effective PCEMS that one and only one schedule be used and updated by everyone. The bridge designer, soils engineer, and financial manager must all be aware of the current plans and necessary revisions. Only in this way can individual units be held responsible for the timely completion of their activities within the total project.

5. Coordinated system--The usefulness of PCEMS is proportional to the number of users who benefit from its existence. For maximum usefulness, it must be made compatible with your jurisdiction's accounting, revenue, and projected cash-expenditure systems. By such coordinated files, which use a common data base, expenditure data can be compared with initial plans, projected cash flow can be updated automatically as schedules change, and the program can be adjusted to projected revenue.

6. Formatted for users--The success of a PCEMS is also related to whether or not it fills the information needs of the users. The system must be geared to function like your department. For instance, if project advertising or letting dates are the one critical element, then the system should use these dates as the key factor and gear all else to them. However, if predictable cash flow or balanced personnel are the most important elements, then the PCEMS must be designed accordingly. Do not expect people to change. If possible, tailor the system to the users rather than force users to become acquainted with whole new procedures and data format.

This will produce less resistance and enhance chances for success.

7. Design in flexibility--As the state or federal revenue picture changes, program adjustments are necessary. If the weather is unexpectedly good or bad, project schedules are affected accordingly. As environmental or permit procedures are altered, complete dates may be postponed. For these and innumerable other reasons, adjustments to your PCEMS may be necessary. Therefore, your PCEMS must be easily updated with an affordable computer cost.

8. Timeliness of data--All system elements should be kept current at all times. However, careful weighing must be done between this timeliness versus the personnel effort to keep it current and the data-processing charges in an interactive system.

9. Desired accuracy--Your PCEMS will not be totally accurate. You can design in the level of accuracy you require. In general, the cost and complexity of your PCEMS will increase with greater accuracy, as will the need for a more frequent and accurate manual input. An attempt to be too accurate is probably more detrimental than the recognition that a 5-10 percent deviation is tolerable.

10. Input simplicity--Tied in closely with system accuracy, but in direct opposition, is input simplicity. Let the computer do as much of the work as possible (e.g., use of files in other systems, use of screen data input). Also, do not require any more details than are absolutely necessary. Whether by forms, keyboard, or cards, make sure that all input is easily codable and requires a minimum of training.

11. Initial system data requirements--Whether based on manpower standards or data retrieval from other systems, extensive base data must be collected, analyzed, and put into usable form. Do not overlook this sizable system development cost.

12. Interactive processing--Computer technology now allows users to inquire, update, or delete system elements immediately as the data are available. Careful review of your computer system capabilities is necessary before adopting this option. Although highly desirable, this prime-time use is often expensive, ties up the system when many others are using it, and may degrade response times. Often a mix of interactive and overnight processing results in optimum system performance.

13. Degree of computerization--The increasing predominance of computers in our lives may lead us to believe that they are a cure-all of our information needs. This is not necessarily so. If your processing needs are small, a portion of the work could be done manually. Remember, you will have not only the system development costs but also the re-

sulting ongoing system operation and maintenance costs.

14. System maintenance--Carefully evaluate the system development procedures to minimize future maintenance problems. As in highway construction, often a slightly higher initial cost may result in substantial savings in ultimate maintenance costs.

15. Adaptability--New system uses will be developed, management personnel will change, funding changes will take place, and your transportation program will change significantly in size and complexity. Your PCEMS must be able to adapt to this changing environment and still fulfill its requirements. Recognize this need and plan for it.

16. Learn from others--Many others have advice and observations on existing systems from which you can learn. If possible, use developed systems from others (e.g., the Federal Highway Administration PCEMS) if they meet the criteria discussed above for you.

17. Involvement in development--In the process of developing a PCEMS, solicit and use input from as many individuals as practical. Their involvement during the development process not only provides extremely valuable input but also helps to ensure their support during implementation.

18. Do not oversell--Those who have recognized the need for a PCEMS and have or will actively work for its development in their jurisdiction will undoubtedly be enthusiastic about its promise of success. A word of warning is needed. Do not oversell the capabilities of the system. A PCEMS will be most vulnerable to criticism during the first few months after implementation. If it was oversold and cannot deliver all that was promised, the credibility gap generated may never be closed. Be enthusiastic, be salespersons, but also be cautious when dealing with people's expectations.

OVERVIEW

The criteria described are general in nature and cannot be much more specific until applied to each individual location. However, if you obtain top management support, ensure that the system works for you (not you for it), and learn as much as possible from others, your chances of successfully implementing a PCEMS are excellent.

REFERENCE

1. D.L. Lund. Preconstruction Engineering in Washington: Manpower Management Information System. TRB, Transportation Research Record 742, 1980, pp. 34-36.