

Building a Preconstruction Management System: Effect on Human and Fiscal Resources

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This paper addresses some of the psychological and emotional issues involved in employee response to the implementation of a preconstruction management system. The material included is based on experience with the design and implementation of the Manpower and Project Scheduling System for the New Mexico State Highway Department. Some of the technical features have been included to provide a basis of reference for these human factors. The paper recommends that the level of reporting into the system and output from the system should be kept to a minimum. It also points out that the people who operate and manage the system are more important than the system itself. The personality profile of these managers and the style of management is related to employee acceptance and response. Several other peripheral issues regarding the successful operation of a scheduling system and its effect on employee morale have been included.

The first step in developing a preconstruction management system is to analyze existing management practices within the transportation agency. Problem areas as well as successful practices must be identified. An effective management system is then designed to correct the problems and incorporate areas of sound management.

New Mexico, like the other states contacted prior to the development of its system, designed the system to address known and perceived problem areas. Each state had developed its own special problems. Typical examples of problems are

1. Poor financial management;
2. Inadequate funding sources;
3. Manpower problems; i.e., too many or not enough employees, lack of proper training, improper use of consultants, or deficient compensation plans;
4. Incomplete or inaccurate scheduling systems;
5. Poor communication and coordination between work centers;
6. Poorly defined work responsibilities; and
7. Poor planning processes, including political control of the planning process.

The top management of the New Mexico State Highway Department was aware of many of its own management problems. These included the following:

1. Inadequate state revenues;
2. Poorly defined work responsibility;
3. Poor financial management; i.e., inability to predict expenditures or revenues accurately, inability to predict cash flow, and incomplete understanding of federal-aid highway funding;
4. Only a fraction of the work scheduled by a formal central path method (CPM) process;
5. Time estimates for work generally inaccurate and not kept current throughout the development process;
6. Work not monitored in all areas to ensure orderly development and timely completion;
7. People who operate the scheduling system unfamiliar with the work they were attempting to schedule and not knowledgeable in financial matters related to the projects and programs; and
8. People in charge of operating the scheduling system lacked the personality traits necessary for the successful operation of a management system.

SOLVING THE PROBLEM

The people in charge of the operation of a pre-

construction management system are more important than the system itself. Even a system that has the best computer programming and that accurately embraces all technical aspects of project development is certain to fail if the people who operate the system fail to create an atmosphere of cooperation with the employees who interact with it. They must see the system as a useful, helpful tool. If the system is used as a club to make employees perform or as a monitoring system to report their failures, the employees will undermine the system and thereby guarantee its demise. The system cannot and must not appear to be responsible for their work; the managers are responsible for their work.

One should not get the impression that a scheduling system does not monitor work progress; it must. However, the way in which work is monitored is crucial. A system reports incomplete or late work, but it must not be used as a basis for reprimanding employees responsible. Rather, the goal should be to find out why the work is behind. Is there something management can do to avoid this problem on other projects or to bring the project back on schedule? The emphasis must be on what corrective action can be undertaken now, not on disciplinary actions. Certainly, poor performance cannot be allowed to continue. A scheduling system will highlight poor performance as well as exceptional or exemplary performance. Rewarding outstanding performance is a much better management practice than the singling out of poor performers for disciplinary actions; nevertheless, sometimes disciplinary action is necessary.

DEVELOPING THE SYSTEM

The system must have the essential technical elements that have proven to be successful. These are as follows:

1. Well-defined work activities,
2. Flow chart that defines developmental sequence and work interrelations,
3. Planning values that predict the amount of work hours and workdays for each activity for each project type,
4. Computerized scheduling system that schedules all work simultaneously against identified resources,
5. Computer reports that inform managers of scheduled work and personnel requirements,
6. Monitoring system that identifies and reports incomplete work,
7. Computer reports that serve as the basis of a management information system for all projects, and
8. Computerized cash-flow system to aid in proper financial management.

Several other key elements must exist. Among these are a financial system that can accurately predict available revenues for the required work program. Another is a stable, long-range work program, consisting of specific projects developed in conjunction with available or forecast revenues and required project development time (this is determined from the scheduling system). A stable program will have relatively few political projects that

preempt scheduled work. Logically, new projects are added to the program at the end of the queue rather than at the head. (Of course, a successful scheduling system must consider and be flexible enough to handle emergency projects.)

Finally, top management must not only support the system but also understand it. This is necessary to ensure that decisions are not made that undermine the system. For example, managers must not promise completion dates that are unrealistic nor should they promise more projects than can be funded.

Several other factors must be considered to ensure the success of a preconstruction system. These elements are the ones most-often forgotten. The system must provide managers at all levels with the information they need to manage their work. The system should not provide too little, or worse, too much information. Too much information inundates the user. If information is provided about everyone else's work to each manager, an environment is created where managers are checking on other manager's work instead of their own.

The system must be tailor-made to the needs of the individual transportation agency. It must consider work procedures and the people who will use it. If it is too sophisticated at the user level, employees will not understand it. Employees will be suspicious of a system that they do not understand. They must believe that it is their system. It is best if they help to create it. It does not matter whether they really do create it as long as they think they did.

The use of technical panels comprised of agency employees works very well to accomplish three main objectives:

1. The system is developed specifically for the agency that will use it;
2. Employees help design the system; they have input into the process and develop a sense of authorship; and
3. Employees begin learning about scheduling systems and preconstruction management long before the system is implemented.

Pilot reporting is a term used to describe a reporting process used to collect statistical data regarding how long it takes to perform work activities for various types of projects. New Mexico did pilot reporting for six months. It was not well received by the employees, who saw it as additional paperwork and a watch-dog feature that would be used to check up on them. In reality, the useful data obtained were small compared with the time and effort expended on data collection, computer processing, and output reports. The real value of pilot reporting was in giving employees the perception that the data were used to establish planning values, that their work times were accurately reflected in the scheduling process, and that the system was tailor-made to people and practices of our agency.

Two key features of a scheduling system are project overrides and activity reporting.

Project overrides give employees an opportunity to use their judgment to change computer values generated for project schedules. It lets employees feel like they are controlling the work and the computer rather than the computer controlling them. This is an extremely important psychological factor that must be properly integrated into the system. It must achieve a proper balance; i.e., employees must not be given carte blanche to input whatever values they want; and, on the other hand, the computer-generated values cannot be used without employee review and revision.

To properly monitor project development, employees must report the completion of scheduled work. If the reporting process is complicated, time-consuming, or cumbersome, employees will not report accurately. In New Mexico payroll reporting was rejected at the activity level. It appeared to be much like pilot reporting--too much data collection for the benefits derived. It may be added at some point in the future, but only when people who use the system clearly understand the objectives and are willing to expend the necessary reporting time. Instead of payroll reporting, employees fill out a card that contains five items:

1. The unit performing the work (a four-digit number assigned to each management unit or work center);
2. The project's control number (a four-digit number assigned uniquely to each project; it appears on all computer documents and is readily available to the unit manager);
3. The activity being completed (a three-digit number for the specific work activity being completed; management units quickly become familiar with the half-dozen or so activities that relate to their work);
4. The date the work was finished; and
5. The initials of the reporting employee.

It typically requires about 15 s to complete a card and most managers are required to submit fewer than 15 cards/week. Psychologically, employees do not feel antagonistic when reports show that they failed to complete an activity since they had responsibility in helping to determine both the value and completion date. Managers welcome the opportunity to report that they have completed the assigned work.

USE OF THE SYSTEM

The scheduling system should be used to schedule all required developmental work against available resources. It should provide all the information managers need to plan, organize, direct, and control their work. It should be a monitoring system to report late work. It should provide information regarding cash flow for projects. It should be used to build long-range programs. It should be used as a stabilizing force to ward off advancing projects arbitrarily. It should be used to predict personnel requirements, both short-term and long-term.

It should not be used as a whip to make people do work. One of the initial fears unit supervisors had was that this system and the people who operate it would attempt to issue daily orders on which work should be done. These fears arose because they did not understand the mechanics of a scheduling system or its real purpose. Their fears were reinforced during pilot reporting when each employee had to fill out time sheets of exactly what they had done all day long. Employees did not see this as an attempt to establish reliable planning values but rather, as an attempt by the computer system to keep tabs on them.

In reality, the computer system does provide schedules for work and does report failure to complete the work as scheduled. This is done without recrimination, however. Employees know when they are late and why. Their concern is that other people will not understand why the activity is late. This concern is addressed by contacting managers responsible for the late activities and noting their comments on the late report. This is done before it is distributed. Complete reports are distributed to their supervisors (usually section heads) and to

bureau chiefs. A copy of just the unit's manager's late activities is sent to each unit manager. This process has worked very well. In fact, unit supervisors have expressed their appreciation for being reminded of overlooked activities as well as being given the opportunity to let everyone know why a particular activity was late. These opportunities for human intervention in the scheduling and monitoring process are crucial and cannot be overemphasized.

In the development of the New Mexico system, some top managers expressed the opinion that projects should be scheduled solely on the basis of computer-stored planning values. They also stated that employees would accept the system or they would be subject to disciplinary action. The best way to ensure acceptance, however, was to allow employees to help create the system and have checkpoints where they could at least express their opinions. Employees are sure to reject a system they do not understand if it is being forced on them. It was necessary that I (as project team leader) act as a buffer between employees and top management. The project team leader had to win the confidence of both sides.

CONCLUSION

The single-project CPM scheduling system we had before worked, but it did not work well. It did not address manhours nor the multiproject scheduling environment in which the work occurs. It did not monitor project progress and was poorly supervised and managed. No system could have worked well because at that time we had poor financial management and were unable to accurately predict future revenues and expenses.

Acceptance of the system has filtered down. The agency head initiated development of the new system and assistant agency heads endorsed this action. Division heads were initially reluctant to admit they had problems that a new scheduling system could solve. During development they recognized the potential and began to support the system. Now, section heads support the system and use it more and more. Acceptance by unit managers has been steadily increasing. Some areas are still lagging, but these holdouts will become more supportive as time goes on and as exposure to the system increases. Right now, most employees do not love the system or hate it; they see it as part of the job, part of the routine. We expected to have at least a full year of implementation and an additional year after that to build confidence and gain user acceptance. We are right on schedule.

Stable funding is a key factor. We have made a lot of progress in this area in conjunction with the scheduling system. Obviously, we cannot have a

stable letting schedule if we have sudden funding cuts or sudden large increases. Our program is really only as good as our ability to predict revenues.

One area in which the system has helped a lot is in the area of consultant contract negotiations. The system identifies areas of needed consultant work. It provides manhour estimates and contract-completion dates. It provides an excellent basis for negotiating consultant contracts. It is easier to keep track of consultants since they must submit completion cards just like everyone else. Progress payments to consultants have been greatly simplified since the cards document how much work has been completed.

We have a lot fewer crises now. We have an improved credibility with the legislature because of our stability. We are actually operating with fewer personnel than before and accomplishing a larger program. The proof of this is reflected in their approval of our requests for additional funds.

The scheduling system has provided a sound basis for effective management. New programs can be analyzed and evaluated prior to implementation to determine their effects on human and fiscal resources. In the summer of 1980 we were involved in a lawsuit with the Federal Highway Administration (FHWA) because obligational authority was withdrawn after New Mexico had obligated only 16 percent of its authority through the first two quarters. A year later we had obligated 80 percent of our authority before the end of the third quarter. In addition, we had three times the anticipated 20 percent remainder in authorization requests submitted to FHWA in July.

New Mexico received \$12 million in authority beyond that anticipated. The scheduling system has been in operation since July 1980. It was the single-most-important factor in bringing about the complete, one-year turnaround. This additional release has had a very positive impact on morale. Employees feel like they really accomplished something, and they did. Although they perceive additional reasons for the stability and improved financial situation, they recognize that the system has orchestrated our efforts and given them a powerful tool for managing their program.

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