

The Application of Industrial Engineering to Maintenance Operations in New Jersey

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New Jersey established a Bureau of Industrial Engineering in October 1964. A staff of seven industrial engineers and technicians was recruited from outside state service. The designated mission and function of the Bureau was and is "... to plan, direct, and supervise industrial engineering practices in the analysis of work, the development of methods improvements, the establishment and application of work standards, the standardization of methods and procedures, and the development and implementation of cost control techniques, to insure the optimum utilization of the manpower, facilities and equipment of the various divisions and bureaus of the State Highway Department."

The Bureau's initial project was to develop work planning and scheduling systems for both roadway maintenance and equipment supervision. Better manpower and equipment utilization were the objectives.

You cannot plan and schedule without having standards of work performance, because planning can only go on when you know how long it takes to do a job. The industrial engineers, early in the planning and scheduling project, set up a companion project to develop work standards for both equipment and road maintenance.

A third project was to design and install an equipment preventive maintenance program which is mainly a complex scheduling project.

These planning, scheduling, and work measurement projects are long range and will continue to be developed. There have also been special study projects concerned with equipment replacement needs, chemical ice control, and specialty crew organization.

The great strength of bringing trained industrial engineers in is that they bring a methodology. If we can bring from industry men who have been trained in analysis of work, the setting up of work standards, techniques of production and waste control, cost analysis and control, training, these men can bring us skills and activities we need at this time and in the immediate future. It seems that we shall have to move into these activities just as industry did when it became time and cost conscious.

Another strength in bringing industrial engineers into highway activities is the freshness of their viewpoint. Industrial engineers are usually enthusiastic individuals with zest for improving methods, systems, cutting costs, and training. Coming into a world of highways, they find much to challenge them. Tough old problems to the highway engineer are new challenges to the industrial engineer. He has no mental roadblock induced by traditions, worn out policies, governmental budget processes, and politics.

A trained ability to question any going system is another useful characteristic of industrial engineers. Whereas highway engineers are often brought up in a school of the status quo, industrial engineers are willing to challenge the status quo and reprocess it.

What are the weaknesses of traditional industrial engineering when applied to highway maintenance? Obviously, the industrial engineer entering the highway field meets a technology, environment and organization new to him. In any one industrial plant where an industrial engineer works he meets a more limited technology than the full spectrum of materials, equipment, and methods he finds in a statewide highway maintenance operation. He can learn this technology over the years, given time. Theoretically, he should have no problem with organization, because organization and people are basically similar in all organizations. But, there is an important difference when one enters government, namely the governmental or bureaucratic way of doing things. We are circumscribed by law in many of our operations, we carry out our work in constant contact with the public, we have the political factors, and we have the bureaucracy

of state departments exercising control over each other through jurisdictional budgetary or personnel prerogatives.

Governmental operations have more inertia to overcome in changing directions and it may take some time for the industrial engineer to appreciate this. This can result in his taking more time to accomplish his objectives because he may fail to dot all the "i's" and cross all the "t's" in setting the stage for his work. He may fail to appreciate from the start that the line organization may be more restricted in its authority than its counterpart in industry. Failing to appreciate this, the industrial engineer may become impatient and sometimes overbearing with the people with whom he is working. I think he has to nurse the situation and personnel more in governmental work. If he fails to do this, it is unlikely that the line organization has the incentive or the pressure against it to keep pushing the innovations industrial engineering is supposed to be bringing about. His lack of knowledge of the system may cause him to lack seasoned judgment in how he furthers his projects.

Still another disadvantage of the traditional industrial engineering approach, and particularly of hiring people from the outside, is the suspicion among government employees as to what the new personnel and the new system is going to do to them and their entrenched organization. Actually, this problem is not much different than what the industrial engineer finds in industry when he initiates an industrial engineering program in a plant which has not had one before. But, operating in the extended geographical scope of a maintenance organization, he finds it difficult to get close to the entire maintenance organization. Suspicions can be kindled and resistance can be created before an industrial engineer even appears in a maintenance district.

Are not all of these problems those which would be encountered if a highway department undertook to improve maintenance management by training its own people and having them introduce the work improvements, standards, and cost controls that the industrial engineer is trying to bring about? My guess is that the same problems of innovation face the long-time highway-oriented individual who would bring about a methods improvement. However, the methods man trained from within is likely to know more of the technology and the ways the organization works, so that he holds an advantage over the outside industrial engineer. On the other hand, the inside man has to be trained in methods and standards work. So, there are compensating values which ever approach one takes.

There is, of course, the important question of engineer availability for this work. In New Jersey, there were just not any engineers around who might have been singled out in sufficient numbers for this. Once we had gained agreement that a Bureau of Industrial Engineering should be established and that people should be recruited from outside, we did benefit by the addition of these new people to our total staff.

What is the total value of this operation and its prospect for the future? The chief accomplishment of our industrial engineering staff has been to give our foremen and supervisors a good course in planning and scheduling. In doing this, much paperwork was generated which built up resentment among our foremen against the industrial engineering approach. In the equipment area where we have moved on to scheduling work operations through the computer, this resentment is breaking down and prospects of future improvements and relationships are good. We hopefully expect that in the area of road maintenance the same will prevail as we move into computer scheduling.

In equipment, we have benefited by institution of a preventive maintenance program that seems to be working with increasing assurance and less friction as we move along in time. Progress might have been faster in all projects had we been able to establish better coordination between industrial engineers and the line maintenance organization. Our industrial engineers too often took things on their own and went off on their projects without appreciating that it requires the line supervision to make the projects work. The line supervision, on the other hand, lacked sufficient farsightedness to take warmly to the new approaches without being cultivated.

To do justice to both groups though, we could have made faster progress had we been further along with our computer organization which has been developing concurrently with industrial engineering. This meant that the computer center could not take on the work needed to develop our planning and scheduling and work order programs.

Another problem has been the diversion of the industrial engineering group to other departmental divisions and problems. Initially, industrial engineering confined itself to maintenance projects, but very soon their skills were applied to other projects around the department, lessening their availability for maintenance. They have carried out industrial engineering training programs, prepared office-space layouts, initiated program budgeting, made cost-effectiveness analyses. The very fact that these industrial engineers can be used on so many projects in itself speaks well for recruiting industrial engineers from outside the highway industry.

In my opinion the strengths overcome the weaknesses. One of the weaknesses in our setup has, in my opinion, been the placement of industrial engineering in respect to maintenance outside the Division of Maintenance and Equipment. This has resulted in a sense of competition where cooperation would have been the better motivator.

We are finding that if we do maintain a separate Bureau of Industrial Engineering, it is important to have on the maintenance staff at least one engineer to work in liaison with the industrial engineers. We did this early in equipment projects and we seemed to make more progress there. More recently we have done this in roadway maintenance.

I believe industrial engineers find themselves more at home in our equipment shops which are more akin to the four walls of an industrial plant. Garage repair operations are more identifiable with those found in industry. Road maintenance, with its far-flung activities, its uncertainties with the weather, and its interruptions for emergencies is a production scheduler's nightmare. Anyone working in this field, whether the most experienced industrial engineer or a young highway engineer trained for this work, is handling a complex problem.

There is one final word which should be said for the industrial engineer who comes from industry and tries to work in the field of highway maintenance. In manufacturing industry the 50 years or more over which industrial engineering has developed has been mainly confined to production. For many years industrial engineers did not venture into plant maintenance because it was long felt plant maintenance could not be standardized and controlled as production could. While progress has been made in applying industrial engineering to plant maintenance, this is still considered a more nebulous field for industrial engineering.

Therefore, to ask the industrial engineer to come out from industry where maintenance engineering within the walls of one plant seems to be a special problem and operate in the wide spectrum of highway maintenance with its variety of operations, geographical spread and governmental problems, is to ask a great deal of the man trained in a particular tradition. He needs time to get acquainted and adapt himself. An ideal setup would be to place him with matching numbers of men who have grown up in a highway department and who have the aptitude for learning and adapting themselves to new ideas. This combination of experience brought together on a maintenance team which includes the line supervision, should produce the kind of results that maintenance must have in the future.