A PLANNED TRAINING PROGRAM FOR
MAINTENANCE AND EQUIPMENT PERSONNEL

Charles T. Edson, New Jersey Department of Transportation

• IN LATE 1965, the division of maintenance and equipment compiled a list of training needs as submitted by members of the division. All operating managers and staff specialists were asked to suggest areas that they felt could be improved through training. Figure 1, the resulting compilation, lists training needs for eight groups of employees. Three broad fields of training were differentiated: administration and management; personnel; and methods, materials, and equipment. Every personnel classification within the division was included. The program was obviously long range. Several years would be required to accomplish all of the training in all of the categories.

The next decision made was to have the department training officer provide training programs applicable to many divisions in the department and the division training officer would provide programs for the need of the respective division. Examples of programs that would be accomplished by the department officer are typing, shorthand, basic management, advanced management, performance evaluation, statistics, speed reading, and general administration. The division officer would provide programs as outlined in this paper.

ADMINISTRATION AND MANAGEMENT TRAINING

A look at the outline revealed that the supervisors and foremen had the greatest number of distinct training needs, and these needs were prevalent in just about all categories. This was a good starting point for major program development. Two programs in supervision and management were developed, one for foremen and assistant foremen and one for supervisors. They were called the foreman’s academy and the supervisor’s academy. Ten days of in-residence training were given with classes given from 9 to 4. Four evenings were also used for discussion in the area of civil service rules and regulations, personnel relationships, legal obligations, and organization relationships and procedures. The class was limited to 40 students divided into two groups of 20 each. Instruction was by consultant teachers, complemented and supplemented by instructors from the department. Figure 2 shows a sample agenda. The consensus is that this program did improve the overall management of the maintenance operation at the level of the first-line supervisor and it did help to prepare him for promotion to a middle-management position.

This conclusion resulted from comprehensively testing three control groups of 20 employees before and after the course for aptitude and attitude. They were divided into similar groups by a random statistical method on the basis of education, experience, and ability to learn. One group did not attend the course. Analysis of the results of the tests revealed that the two groups attending the program had changed their attitudes considerably. The group that did not attend the foreman’s academy did not appreciably change their outlook toward the department or its management.

Figure 3 shows attitude test results of the first foreman’s academy. These test results served as a guide in the further development of the training program for foremen. A total of 160 foremen and assistant foremen have attended the foreman’s academy to date.

The supervisor’s academy was held after the first foreman’s academy, since the foreman’s academy was a proving ground for the training procedure to be used. The supervisors’ program was similar to that for the foremen, but aimed at a higher level

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<table>
<thead>
<tr>
<th>ADMINISTRATION AND MANAGEMENT</th>
<th>Division Heads</th>
<th>Bureau Heads</th>
<th>District Heads</th>
<th>Supervisors</th>
<th>Foremen</th>
<th>Equipment Operators</th>
<th>Mechanics</th>
<th>Maintenance Men</th>
<th>Engineers</th>
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X indicates training required  
Blank indicates training not needed

Figure 1. Training needs of division of maintenance and equipment.
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<thead>
<tr>
<th>Time</th>
<th>Monday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Tuesday</th>
<th>Wednesday</th>
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<td>8:30 a.m.</td>
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<td>9 - 10 a.m.</td>
<td>9 - 10 a.m.</td>
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<td>Pre Test, Attitude</td>
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<td>2:30 p.m.</td>
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</table>

Three reinforcement classes were held at two month intervals to try and maintain the level of retention at the maximum.

Figure 2. Foreman's academy agenda.
The three dimensional sketches show a relative improvement in attitude after completion of the course.

Figure 3. Foreman's academy attitude survey.
of management and supervision. Supervisors were taught the techniques of managing
supervisory rather than nonsupervisory personnel.

There was a wide range of reaction from supervisors. Some rejected the idea of
attending such a program, while others were eager to learn. The testing both before
and after the supervisor's academy showed that a great majority increased their apti-
tude and changed their attitude to coincide with department goals.

One of the by-products of both foreman's and supervisor's academies resulted from
the association of the individuals attending the school. Although of the same title, many
had met only on rare occasions prior to the training program. At the academy they
discussed their particular problems in their geographical area of the state. Using their
common language they came to know each other and each other's problems better than
before. It is felt that as a result of the academies there is a much closer relationship
between people in supervisory positions.

The upper levels of management and administration were not of the numbers that
could be efficiently trained within the department; therefore, it was decided that an
out-service facility would be used wherever possible. The New Jersey Department of
Civil Service offers executive training in the form of lectures by outstanding manage-
ment people. Most of our division executives have attended the "management of man-
gers" training program at the University of Michigan, selected American Management
Association courses in New York, and courses given by Rutgers University. Executives
within the department were trained in one executive training program provided by the
department's training officer consisting of a series of monthly meetings and book-
reading assignments.

The division of personnel's bureau of training and development is planning a manage-
ment development program for middle managers so they can be developed and trained
as they are promoted into executive positions. The level of training will be aimed at
the position the person occupies and the next position that he would be expected to fill.
A study is currently under way to determine what these training needs are, following
which the bureau of training and development will provide the appropriate training
session as an in-service training program to help the employee develop his adminis-
trative skills as he can put them to use.

METHODS, MATERIALS, AND EQUIPMENT

Our training outline really did not indicate the magnitude of training needs of non-
supervisory personnel. Here the number of people needing training and the variety of
skills, equipment, and technology that can be taught grows to a vast list. We have set
up courses for equipment operation, equipment maintenance, and maintenance methods
and skills, and courses on how to teach these courses.

New Equipment Training

During the winter of 1963, a study had been made of the winter maintenance opera-
tion; as a result, new spreader trucks were designed. As the development engineers
began working on these trucks and placing them in the field, it became evident that the
operation was so different from operation of equipment previously used that time was
being lost, materials wasted, and equipment was being abused, causing breakdowns
and many minor repairs. As a result, a comprehensive training program was devel-
oped for the winter maintenance materials spreader operation.

A complete training manual was written for this operation, of the type that did not
allow the instructor very much leeway in what he had to say. There were two columns
in the manual, one for the visual aid to be used, and the other for the material the in-
structor was to present.

After a training program for instructors was held on how to use this training manual
and what to stress in the training classes, the instructor went back to his normal work-
ing area and trained his fellow employees in the operation and maintenance of this new
equipment. He was supplied with drawings showing how the controls and hydraulic sys-
tem worked, slides of the machine parts, and mock-ups of the spreader assembly so
that certain adjustments could be demonstrated in the classroom. The instructor
proceeded to follow the outline book as it was written, interjecting a few points of interest from his own personal background. After the class training session they moved out of the classroom into the maintenance yard where the proper use of the equipment was demonstrated. After this demonstration, the class was broken into small groups and a group leader (previously trained for this task) pointed out the equipment's operating and maintenance features and then let each student operate under his guidance. Students were then allowed to practice on their own with the instructors watching from a distance. The maintenance personnel then returned to their respective headquarters and performed the duties as outlined in the training program.

After the training program, it was evident that the efficiency of material usage was higher and that the equipment downtime was much less. This result led to expansion of the training manual to include all types of winter-material spreaders currently owned by the department. This expanded program was then presented on the same basis as the original program.

Along with the operation training manual, a manual was developed by the bureau of equipment outlining spreader maintenance procedures with equipment diagrams showing lubrication points, operating controls, and maintenance requirements. Each crew was furnished with several copies of this manual, and each member of the crew was furnished the portion of the manual pertaining to his particular phase of the operation. While training the maintenance personnel in the operation and maintenance of the equipment, it was apparent that equipment personnel also needed training in repair of the winter material-spreading equipment.

A similar program was devised and mechanics, along with their supervisors, were trained in the methods of repair of these spreaders. Results of this initial confrontation with the operation, maintenance, and repair of equipment indicated that programs of this type on other pieces of equipment could also reduce the downtime of that equipment. Subsequently, there has been training on sweepers, vacuum-type inlet cleaners, graders, and front-end loaders.

Skills Training

As a result of the success in the initial training for winter equipment operation, it was decided that long-range programs would be beneficial in the area of equipment operation and maintenance as well as in highway maintenance techniques.

About this time, it was noted that there was a large turnover in new personnel at the entrance maintenance positions (maintenance man II). A study by a committee representing the field and staff forces resulted in a continuing program for the entrance-level employee and a 5-year program for maintenance and specialized-equipment operation. The committee decided what types of equipment were to be taught in each of the three training phases, and that the instructors should be selected from the ranks so that they could communicate more effectively with the trainees. These instructors were selected on the basis of their knowledge of the equipment and their potential training ability. After the careful selection of these instructors, a training program in teaching methods (job instructor training) was held for the instructors who were then assigned to particular phases of the training program.

The maintenance equipment program and the specialized equipment program were scheduled on a 5-year basis and the continuing maintenance man II (entrance level) program would train all new employees. The first program to be initiated was the maintenance man II program which was scheduled over a 17-day period with each class limited to 12 students.

Instructors were provided with a basic outline of what they were expected to teach and then prepared their own lesson plans. There were nine training teams in the state for this program which were monitored by the division training officer to control uniformity of training. Instructors were to provide the division training officer with their outlines and their evaluations of each day's training. From these outlines and evaluations it was confirmed that the 17-day period was the right length and it became the standard time for the program.

The division training office then reviewed all of the instructors' evaluations and their outlines and prepared a general outline to be used by all instructors. This general out-
line was then used by the instructors throughout the state for a series of training programs and again the division training office reviewed the evaluation of the program and came up with a standard program for this maintenance man II training. There were several checks built into this program so that the instructor could see if each trainee first observed and then used each hand tool or piece of equipment, as well as to make sure he did participate in using the correct maintenance technique. A follow-up report by the student's supervisor was made for two months to show what work the student actually performed in his permanently assigned position. From the form, calculations were made to show hours he spent either using hand tools or operating equipment for each maintenance procedure. An analysis of this helped to evaluate both the program and how effectively new employees were being used. The maintenance man II program included methods of pavement patching, joint-crack maintenance, drainage, mowing, guardrail replacement, and winter maintenance; operation of truck, mower, loader, small roller, compressor, two-way radio, and joint pouring machine; and proper use of shovel, rake, sledge hammer, and various small tools such as broom, pick, grub hoe, and posthole digger.

This same method was employed in developing the maintenance equipment training program. In both cases, the instructors eventually were provided with a defined outline of what they were to teach and visual aids that complemented this outline. Those visual aids encompassed things such as operation and maintenance of the small roller, operation of the front-end loader, and operation of dump truck unit (this includes the truck, winter-materials spreader, dump body, and snowplow). Safe operation of equipment was stressed in all classes.

The maintenance equipment program included operation and care of the dump truck, front-end loader, tractor, mower, compressor, light grader, and small tandem roller. The maintenance methods utilized in this training program were pavement patching, replacement of steel guardrail, grass mowing, and grading.

In the maintenance man and maintenance equipment programs, time was set aside for staff personnel to come and talk with the students for one-half day each on safety, employee benefits, and personnel procedures. This included such topics as the pension plan, blood bank, credit union, how to get a promotion, organization and structure of the department, how to handle a grievance, how to protect themselves and the motoring public while working on the highway, and what other training programs are available to the employee.

The specialized equipment training program was not handled in the same way as the previous programs, but was developed in a manner similar to the way the winter maintenance training program was developed, where manuals were written for the instructors prior to the training. Each instructor was trained in the use of the manual, in job instructor techniques, and in the operation and maintenance of the piece of equipment that he was assigned to as an instructor. The teachers in this particular program only participate in classes where they are already competent operators as chosen by the subcommittee formed for this purpose. A single instructor may teach classes on three or four pieces of equipment; however, there are approximately 15 pieces of equipment in this particular program. The equipment in this program included the large grader, backhoe, bulldozer, rollers, paving machine, oil distributor, crane, mudjack, tractor-trailer, and sweeper. The program is divided into four phases: phase 1—classroom training; phase 2—field training; phase 3—equipment operation under guidance; phase 4—equipment operation under only general supervision.

At the end of classroom training, the student is given a test to determine whether he is ready to operate the subject equipment for field training purposes. At the end of the field training class he is given a certificate saying that he has passed the formal part of his training and is authorized by the department to operate a particular type of equipment under guidance of a qualified operator. After his term with the qualified operator is complete, his competence is reviewed by a subcommittee and, if he passes, he is then allowed to operate the equipment himself, checked periodically by a supervisor. At the end of phase 4 of the training, his performance is again reviewed by the appropriate subcommittee and, if found competent, he is issued a certificate saying that he is authorized by the department to operate that type of equipment
TABLE 1
TRI ANING DURATION IN HOURS

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Phase I, Classroom</th>
<th>Phase II, Field Class</th>
<th>Phase III, Equipment Operation Under Guidance</th>
<th>Phase IV, Equipment Operation Only General Supervision</th>
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<td>Crane</td>
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<td>Tailgate paver</td>
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<td>Concrete saw</td>
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<tr>
<td>Pulvi-mixer</td>
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without supervision and to train other employees in the operation of that equipment. Table 1 gives the training time for each phase of the specialized equipment training program.

Job Instructor Training

Various skill training programs were taught by people from different organizational levels and it was found that the best instructor was one who was a peer or nearly a peer of the student and talked the same language. Trial and error methods were used to determine effectiveness of various types of instructors. The professional instructor, without particular knowledge of all details of the job, was tuned out because of his inability to answer small detailed questions asked by the students. A technically competent instructor who did not talk the student's language was also tuned out because of the language barrier. The results of these and other tests were that the instructor should talk the intimate language of the student and be highly competent in the field of endeavor vis-a-vis a peer who was technically competent with instructor potential. Since personnel qualified in the skills were readily available, it was only necessary to instruct them in the correct teaching techniques.

A job instructor training program was prepared to meet this need. This program was basically the same one developed by the federal government during World War II. It included a job analysis, an operational analysis, and a manning table. This was basically accomplished in eight 2-hour sessions; however, a ninth practice session was added to give the instructor confidence and for the training committee to evaluate the instructor's competence. These instructors are used in the skills training programs as a team at the present time. Eventually all foremen will be trained in this technique so the training of skilled personnel will be done by the local foreman rather than a team of instructors.

Equipment Repair

During initial phases of the training program development, it became evident that training the operators was not going to solve the complete need for the equipment program. Therefore, it was also necessary to train mechanics and supervisors in modern methods and techniques of equipment repair, particularly with the newer equipment. The first equipment training program for mechanics held was the winter maintenance materials spreader program which was developed and presented by the division training staff.

Subsequent to that program, many of our vendors and manufacturers became interested and were quite willing to present training programs on their equipment for our
mechanics and supervisors. Currently, the dependence is primarily on manufacturers
and vendors' training programs for training mechanics and their supervisors in the re-
pair, preventive maintenance, and rehabilitation of equipment. The division does, how-
ever, present training programs that cover multiple pieces of equipment on a general
topic, such as fluid power and its applications. Mechanics are also scheduled in the
maintenance and equipment training programs so they can become more familiar with
methods of operation used by maintenance forces. This gives the mechanic a great in-
sight as to how equipment will be used and enables him to repair and strengthen it so
that it is more applicable to the job that it is being used for.

The department also has a program for training personnel for positions that are
hard to fill due to the lack of available trained personnel in those particular skills. The
department has such programs for a mechanic apprentice. The mechanic program is
one in which the person is hired as a mechanic trainee and serves an apprenticeship
period while attending school at night and working during the day. At the end of this
period the mechanic trainee then becomes a full mechanic. In this manner people are
actually being hired to fill vacancies they are not equipped for at the time of hiring;
they are then trained for these positions and the need fulfilled by this means.

Maintenance Technology Skills

Each year the department depends more and more on contract maintenance for the
larger maintenance tasks such as resurfacing, bridge painting, traffic striping, instal-
lation of chain link fence, and grass mowing. As each of these jobs becomes more
complex and the reporting system improves, it is necessary to train department per-
sonnel to inspect the contractor's work and report on his performance. For this in-
spection work, it was decided that there should be some form of technical training for
division personnel. In 1965 and 1967, the division personnel were sent to a construction
inspector's school where they were taught what to look for on a construction project.
The school was divided into sections, such as drainage, paving, earthwork, surface
treatment, and landscape. At these schools they were taught the methods by which the
construction division inspects projects. This came to a close in 1967. During 1968,
a review class was held for the people already trained to oversee these contracts to
update them on reporting techniques and to maintain their inspection skills. The divi-
sion is now accomplishing this training in a two-fold manner: (a) by having the inspec-
tors come in and talk with a staff specialist for approximately one day concerning the
inspection of that particular specialty; and (b) a special class for maintenance personnel
on the inspection of the type of work being undertaken by the division of maintenance
and equipment. This was handled in five half-day classes, taught by a maintenance
manager well versed in contract administration and construction techniques and sup-
plemented and complemented by staff specialists.

MANAGEMENT TRAINING

At the present time, there is in the planning phase a training program for three
levels of management—the first level being the administrative management of the regions
or districts, the second being the area supervisors, and the third level being the fore-
men and assistant foremen. The top administrative managers will be taught how to use
the planning and scheduling reports as a tool in control and supervision. The middle
managers will be taught how to prepare the annual plan and to schedule the equipment
and manpower assigned to them to implement the plans. They will also be taught to
go over the work load of each foreman and assign priorities based on availability of man-
power, equipment, and materials. The first-line supervisor will be thoroughly in-
doctrinated into the procedures of scheduling and planning. He will be trained in how
to make a yearly schedule of routine maintenance work. It is expected that this training
program will give all levels of management a chance to see how a scheduling and
planning process can help them. It will also be made apparent how the reports of the
schedules and plans affect the work of the organization.
<table>
<thead>
<tr>
<th>ADMINISTRATION AND MANAGEMENT</th>
<th>Division Heads</th>
<th>Bureau Heads</th>
<th>District Heads</th>
<th>Supervisors</th>
<th>Foremen</th>
<th>Equipment Operators</th>
<th>Mechanics</th>
<th>Maintenance Men</th>
<th>Engineers</th>
<th>Administrative Clerical</th>
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<tbody>
<tr>
<td>Administrative Policies and Procedures</td>
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<td>Management Principles</td>
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<td>Fundamentals of Supervision</td>
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</table>

**PERSONNEL**

| Personnel Procedures | x, y | x, y | x, y | x, y | x, y | x, y |
| Employees Relations | x, y | x, y | x, y | x, y | x, y | x, y |
| Job Training | x, y | x, y | x, y | x, y | x, y | x, y |
| Safety | x, y | x, y | x, y | x, y |
| Introduction to Supervision | x, y | x, y | x, y | x, y |
| How do I fit in? | x, y | x, y | x, y | x, y |
| Information Only | x, y | x, y | x, y | x, y | x, y | x, y |

**METHODS, MATERIALS, EQUIPMENT**

| Fundamentals of Equipment Usage | x, y | x, y | x, y | x, y | x, y | x, y | x, y |
| Fundamentals of Material Usage | x, y | x, y | x, y | x, y | x, y | x, y | x, y |
| Materials | x, y | x, y | x, y | x, y | x, y | x, y | x, y | x, y |
| Equipment Operation and Maintenance | x, y | x, y | x, y | x, y | x, y | x, y | x, y | x, y |
| Methods | x, y | x, y | x, y | x, y | x, y | x, y | x, y | x, y |

- **x** indicates training required
- **y** indicates training accomplished or in progress
- **Blank** indicates training not needed

**Figure 4. Training accomplishment of division of maintenance and equipment.**
TRAINING METHODS

In the opening paragraph it was mentioned that a training goal was set by collecting the ideas of people in many different positions throughout the division. As the training programs were developed it was quite apparent that the initial goals set in this rather unscientific manner were quite realistic in the long run. A copy of the initial planning chart, Figure 4, shows both the training needs and the training accomplishment.

The training programs presented to people in the division of maintenance and equipment have included various types of training procedures: the lecture, discussion group, role playing, on-the-job training, programmed instruction, and the vocational apprentice program. The lecture was used in the majority of the training programs by using either a formalized training guide with visual aids and the actual spoken words written out, or the outline where the instructor provided his own words to meet the ends desired and put forth in the outline. The on-the-job training method was used in the skilled training programs quite successfully and is rather important to the operation, maintenance, and repair of the equipment training. The discussion group aspect has been used quite successfully in the management training programs and even unintentionally in many of our supervisors' meetings. At these meetings supervisors present different topics, which are discussed by other members of the management team. As a result of this discussion many new points are brought out and a better understanding of the problem achieved. Role playing is used very successfully in the job instructor training program. Programmed instruction was used in the remedial math training program and was used in both the supervisor's and foreman's academies.

Experience gained in developing and presenting the earlier training programs indicated that the type of training procedure used should be compatible with the program being presented and the personality of the student. The basic methods employed in devising the total training program eventually provided the division with a comprehensive training program to upgrade skills in operations, supervision, and management.