

# Evaluation of Training Programs in Rail Transit: Its Role and Status

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The role and status of training evaluation in rail transit are reviewed. Three forms of evaluation—process, outcome, and utility—are considered. Training evaluation in a sample of commuter rail agencies is then examined. Findings indicate that reaction forms are ubiquitous. One rail agency is attempting to link training evaluation to performance appraisal for its nonunion employees. The most sophisticated use of evaluation was found in a large freight railroad. Barriers to the conduct of more thorough evaluations are the lack of training staff, nonexistent or outdated performance standards, and a perception that evaluation is a tool to justify decisions already made. Needs and job analyses are recommended for reducing the barriers. Techniques of training evaluation that could be used in the rail industry are described. Evaluation can be done at the employee, program, and organization levels. Evaluation is also discussed as it relates to management strategy. Advantages include its facilitating detailed feedback to management, its use for changing training, and its capacity to build commitment to training among managers. The relative benefits and drawbacks of educational technologies are considered.

A 1982 report (1) indicated that organizations in the United States were spending more than \$130 billion annually for training. Adjustment for inflation would set the figure today at more than \$170 billion. Such a remarkable expenditure reflects the cost of maintaining a work force that is up-to-date in its knowledge and skills. The question remains, Is the money well spent?

Technical training programs are generally initiated to enhance employee performance. Whether they meet this goal can only be ascertained through systematic evaluation. Considering the amounts spent on training, it is surprising that a review of programs in both the public and private sectors (2) indicates that little is known about the results of training.

## SCOPE AND FUNCTION OF TRAINING

The rail industry devotes a substantial amount of money to training at both the technical and managerial level (e.g., a major U.S. rail carrier reported a budget of \$4.6 million for technical training alone). However, a recent study (McKnight and Rotter, unpublished data) of commuter rail agencies in the New York–New Jersey metropolitan region indicated that several job categories still use on-the-job training that is unsystematic, fragmented, and unsupervised. To the extent that

rail agencies rely on such hit-or-miss tactics in their training, employees cannot be expected to acquire the understanding, job skills, and work attitudes that make for a productive work force. Systematic training becomes all the more important as jobs in the rail industry become more complex, with the increasing use of electronic and computerized controls in equipment.

## ROLE OF EVALUATION

Evaluation of training to assess its effectiveness and efficiency is critical. Effectiveness considers improvement in employee skill level, improvement of the training program, and feedback to managers, participants, and training professionals (3). Efficiency assesses cost-benefit ratios, which are derived by comparing the dollar value of improved job performance resulting from training with the costs of training.

Assessment of the effectiveness of training can disclose deficiencies that detract from its ability to achieve successful outcomes. Examples of deficiencies include inaccurate needs assessment, inappropriate selection of trainees, ineffective delivery of the programs, and inability or lack of opportunity to transfer acquired skills to the workplace (4). An assessment of the utility of the training program to the organization informs management of the strategic value of training. By attaching a dollar value to training, management permits training to be factored into longer-range plans for achieving organizational success.

Another benefit is that of conveying a message to management, other divisions, and the trainees that training is to be taken seriously (5). For example, the technical training unit of a large freight railroad demonstrated decreased costs through a fuel reduction training program. Consequently, upper management was convinced of training's value and moved the unit from a staff to a line division (McKnight and Rotter, unpublished data).

## TYPES OF EVALUATION

Comprehensive training evaluation incorporates assessment of both the process and the impact of training. Regardless of the type of evaluation, the evaluation process requires two activities: setting standards or criteria for measuring success and determining the extent to which the training contributes to achieving that standard (6).

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### Process Evaluation

The initial phase of evaluation focuses on issues such as identification of the type of training that would be most useful in ameliorating the problem and the group that should receive the training, whether the training is reaching that group, whether the course is adequately designed, and whether the training is being delivered as planned.

One particularly useful technique at this stage is content evaluation (7). The first step requires that job elements (required knowledge, skills, and abilities) be identified through job analysis. Typically, subject-matter experts evaluate the extent to which the training course contents reflect the job or skill domain. As an example, the previously mentioned freight railroad, when designing a welding course, had it evaluated both by operating departments and by experts in welding.

Such evaluations help ensure that the course is job related. Results can demonstrate either training deficiencies or training excesses. Deficiencies result when high-priority training needs are omitted from the training program; excesses reflect unwarranted emphasis relative to the training need. Both require refinement of the course.

Process evaluation includes program monitoring to determine which group needs the training and follows through to see that the group in fact receives the training. The first objective requires employee diagnosis. This can be accomplished through employee testing, performance appraisal, or supervisory observation. The second objective requires goals for supervisors that tie their evaluations to their effectiveness in getting the requisite training for their employees.

### Outcome Evaluation

The second phase of evaluation assesses the impact of training. This aspect of evaluation seeks to determine whether learning took place. Do the trainees know more at the end of training than they did at the beginning? Another critical aspect of evaluation deals with changes in behavior. Is the newly acquired knowledge or skill used on the job?

The issues of learning and change in job behavior suggest the need to evaluate at various times during the training program and to follow through with evaluation when back on the job. Whereas learning can be readily assessed through conventional pre- and posttest measures, behavior changes are more of a challenge to assess. Failure to use the training back on the job could result from its being unrelated to the job or ineffective or from a lack of opportunity to practice newly acquired skills. All merit investigation. Those tactics frequently used (8) to evaluate changes in employee behavior include certification, licensing, and master job performance. Other tactics, discussed later, involve microsampling, control group comparison, critical incidents, and outlier assessment.

### Utility of Training

Whereas the immediate outcome to be assessed is some change in behavior, there is little justification for the costs of training unless it has increased productivity or reduced costs. This aspect of evaluation examines productivity and financial data.

## STATE OF EVALUATION IN A SAMPLE OF COMMUTER RAIL AGENCIES

### Reaction Sheets

A recent survey (McKnight and Rotter, unpublished data) of training at commuter rail agencies in the New York–New Jersey metropolitan area indicated the pervasive use of reaction forms to evaluate training. Although trainees are in a good position to answer questions about the presentation, too frequently reaction forms ask questions that trainees have little background to answer.

Dixon (9) details three problems that frequently result from the use of reaction forms: an increased focus on the entertainment value of the course, instructional design decisions based on inadequate information, and reinforcement of the notion of training as passive. To the extent that reaction forms focus on the instructor, instructors change their behavior to enhance their ratings. Because high ratings are linked to factors such as the instructor's being personable and the energy level in the class, the entertainment aspect of a course is amplified. Reaction forms that fail to ask critical questions or that ask questions that cannot be adequately answered by participants become deficient data bases for the construction of design decisions. Finally, the focus on the instructor reinforces the perception that learning is a passive rather than an active process. Despite the shortcomings of reaction forms, other systematic techniques were typically not contemplated by the training departments of the surveyed commuter rail agencies.

### Supervisory Observation

Most training departments had contact with management in the operating departments. This contact, though used informally and unsystematically, provided feedback to the training department on the training courses and suggestions about courses that would be needed in the future. However, supervisory observation as a source of evaluation falls short on many counts. It is not solicited in any systematic fashion and is subject to distortions and biases.

### Linkage to Performance Appraisal

Nonunionized employees at the commuter rail agencies were evaluated regularly with performance appraisals. These forms typically allowed for suggestions for performance improvement. One of the surveyed agencies designed its appraisal form so that suggested courses could be noted. This agency was experimenting with a plan to tie future appraisals to former notations of recommended courses. That is, when a supervisor suggested a specific course for the employee, the next appraisal would note whether the course had been taken and if improvement had been derived from the course. Other agencies, when asked about this practice, reported that it was not done and that there were no plans for linking performance appraisal to courses taken. Whereas this coupling of training and performance appraisal makes course evaluation more systematic, it is limited to nonunion employees. Moreover, with-

out feedback to the training department, the evaluation will not provide a corrective function.

### **Behavioral Performance Measures**

In addition to commuter rail agencies, one large freight railroad was included in the survey. Its training department reported that it evaluated courses in several ways. It too used reaction forms for all courses, but new courses are evaluated for a number of months with pre- and posttests of knowledge and skills. Generally, these tests indicate a 50 to 60 percent improvement in knowledge and skills. New courses are also evaluated with follow-through interviews of supervisors and trainees about 6 months after trainees finish the course. After this initial phase, only reaction forms are used systematically, with occasional questionnaires sent to supervisors.

In two instances, this training department used behavioral indicators. One involved a training program (referred to previously) to reduce fuel consumption. This lent itself well to evaluation in terms of measurable changes and, in fact, fuel consumption was reduced more than 10 percent. In another instance, a needs analysis indicated that only 100 of 840 locomotive electricians were qualified as electricians. Moreover, locomotives had 28 mean days before failure. With the institution of the new training program for electricians, the mean time to failure increased to 78 days.

This technical training department is currently working on an intelligent system for troubleshooting on air brakes. Technicians will be trained to use this artificial intelligence system on lap-top computers. The director of training noted that, too frequently, wheels are changed when the real problem is in the brakes. By training mechanics to use this newly developed system, saving in parts should be realized. The value of performance indicators as a measure of training lies in the ease with which they can be transformed into measures of efficiency and in management's ready comprehension of the value of training.

## **BARRIERS TO EVALUATION**

### **Staff Size**

The training departments in the five commuter rail agencies consisted of a director and some support staff. Most of the technical training relied on staff from the operating departments. For example, operating examiners might be in charge of locomotive engineer training, and supervisory staff might be responsible for training in the maintenance departments. Because of the small size of the training departments, course development and implementation take the lion's share of time, leaving time only for reaction forms. The freight railroad was the only organization surveyed that had centralized technical training and a large training staff (35 people). Given this commitment to training, it is not surprising that this organization had the most sophisticated evaluation process.

### **Lack of Performance Standard**

Evaluation is based on the notion that measurable change takes place. Failure to specify a way to measure the change and how much change is needed renders evaluation impossible. A problem underlying failure to specify performance standards is lack of comprehensive, current job analyses. The data yielded from a job analysis would indicate not only the skills and knowledge needed to accomplish a task but also the mastery levels needed to accomplish the task effectively.

### **Evaluation as a Political Issue**

In some cases evaluation may be perceived as a political issue that is used either to further some department's agenda or to eliminate programs that are considered frivolous. This perception presupposes that a decision has already been made and that the evaluation is a way to justify the decision. This misuse of evaluation is more likely when evaluation is an afterthought and not an integral part of the training program. Another situation that lends itself to evaluation as justification occurs when pilot testing is neglected. Money and time are committed before the program has been evaluated on a small scale to ascertain whether objectives are being met. Commitment escalates with time and money spent so that pressures for justification become enormous. Situations like this can threaten the integrity of the evaluation process.

## **CLEARING THE HURDLES OF EVALUATION**

### **Evaluation and Needs Analysis**

Evaluation should be considered at the beginning of training development, and this should begin with periodic assessment of instructional needs. The needs assessment sets the plan for developing training programs that are useful to the organization rather than those that are the latest fad. In rail agencies, for example, organizational analysis would consider planned strategic changes that require new skills and knowledge in the work force. The changes may emanate from technology, regulatory legislation, or competitive demands in the environment. In some instances the change might better be met by revisions in the selection of personnel or by redesign of work.

### **Using Needs Analysis To Build Commitment**

If one of the barriers to evaluation is a suspicion that it is a tool for justification, commitment to evaluation can be built during the needs assessment. By incorporating the critical groups into the needs analysis, would-be critics can become stakeholders. Thus, unions that might be opposed to the assessment process should be brought in early. The survey of training and operating departments described here indicated that unions were generally supportive of training programs but less supportive of testing. Collaboration with unions to define instructional needs and establishment of criteria for evaluation can avoid resistance later in the process. Similarly,

top management can increase commitment to the training program if it is involved in the setting of broad strategic needs.

### Development of Criteria

The criteria should derive from the instructional needs assessment. Mager (10) proposes that the criteria describe behaviors that demonstrate the desired skill, conditions under which the trainee will perform, and the lowest limit of acceptable performance. Evaluation should be done at various points in a training program: at the end of classroom instruction, at the end of the on-the-job component, and later on the job itself. Obviously, different standards appropriate to the various stages must be formulated.

The criteria themselves should be evaluated to ensure that they meet tests of reliability and validity. Typically, they are selected on the basis of relevance, completeness, and lack of contamination. Relevance means that the criterion consists of components that are similar to those required to succeed in the job. Completeness considers the extent to which the criterion lacks components found in the job. Contamination deals with elements in the criterion that are unrelated to performance in the job.

Two major groupings of criteria should be considered in designing evaluation: criterion-referenced and norm-referenced measures. Criterion-referenced measures compare an individual's performance with a standard of achievement. Industry standards provide criterion-referenced measures. According to Goldstein (6), these are less commonly used in industrial training settings. Norm-referenced measures compare the performance of one trainee with that of others or to norms that have been developed on broader samples, but they say little about the level of skill.

### MANAGEMENT AND TRAINING CONCERNS

Goldstein (6) describes three complaints that reflect concerns from those involved in training. The trainee's complaint concerns trainees who complete a training program and whose scores on pre- and posttests indicate improvement but who lose their jobs because of inability to perform the work. The trainer's complaint concerns a well-planned, well-implemented training program whose trainees are not permitted to perform their jobs as they were trained. Management's complaint concerns money spent on a training program that worked well for the competition but fails to work for the organization in question.

Each of these complaints reflects problems with the manner in which the criterion was selected. From management's perspective, the ultimate measure of success is dollars resulting from savings or increased productivity. However, a training program that saves money for the competition may not meet the needs of a particular organization because of differences in the work force, work design, methods, or delivery of the program. Though basic skills can be taught with generic programs, technical skills likely to be needed in rail transportation require more tailored instruction.

The trainee and trainer complaints also suggest criterion problems. If trainees complete a training program but still

cannot do the job, it is time to look at the job. Has the job changed since the initiation of the program? Has the work force changed substantially since the inception of the training program? Are jobs now held by groups who are deficient in areas required for success on the job? From the trainer's perspective, an additional problem is suggested. If trainees are trained in a method that is not used on the job, then "going by the book" and actual practice must be examined. The problem certainly points to the need for more current job and person analyses.

### EVALUATION TACTICS

Kirkpatrick (11) has suggested four levels of evaluation: reaction, learning, behavior, and results. Each assesses different aspects of the training process and outcomes. Reaction is mostly related to the training process and gauges the receptivity of trainees to the program and the atmosphere in which the training was delivered. Learning, too, can be a process measure in which the course itself is assessed with an eye toward revising it to establish more effective training. Learning, however, can be an outcome measure in which the trainee is tested on the knowledge and skills acquired. Behavior refers to a measurement of job performance. Kirkpatrick (11) notes that just as a good rating on reaction forms does not guarantee that learning takes place, excellent performance on the training tasks does not ensure that the training will affect the way the job is performed. Finally, results relate to the way the training programs affect overall organizational objectives. These utility measures allow translation of outcomes to figures that permit comparisons between ways of training, between formal and informal training, and so forth.

### Employee-Centered Evaluation

This level of evaluation examines the impact of training on the individual. Learning can be assessed by comparing knowledge and skills before and after training. Though an experimental design using control groups yields the most convincing data on the effects of training, situations in industry often preclude use of such controls. A more flexible approach to evaluation is a quasi-experimental design that depends on several pretest measures before introduction of the training program. Commuter rail training programs that had apprenticeships regularly tested the trainees on knowledge. Furthermore, FRA-mandated testing could also serve as an evaluation check by linking performance on FRA tests with training performance.

Besides evaluating performance at the end of training, an on-the-job evaluation is essential to gauge whether the acquired skills have been transferred to the job. The difficulty is that most jobs covered by unions do not have systematic performance appraisal. As a surrogate measure, an observation form might be developed for supervisors to complete, or employees themselves might be trained to track ways that training has been used in their jobs through the critical incident technique.

The most promising method, however, of checking on the transfer of skills is by using simulators. Long used in aviation,

simulators are just beginning to work their way into locomotive engineer training. They give detailed performance indicators in varied simulated work situations. Simulated work situations are also being created for dispatchers' jobs. The use of models is related to simulations. The technical training department of the surveyed freight railroad has replicated portions of its line to scale. This allows it to simulate various types of signal failure and observe trainees' troubleshooting skills. As more skills are moved from on-the-job training to systematic training, it will become possible to evaluate training performance in greater detail. Underlying all attempts to assess performance is the development of clear-cut performance standards for the job in question.

### Focus on Course and Program

To evaluate the effectiveness of a training course or program, one needs to shift the focus from the individual to the group level. Some evaluations will be aggregated individual scores that indicate how the group is doing on the average; others may be organizational indicators that consider time to complete tasks and quality of the work done or that compare this course or program with alternative training.

An intriguing technique for evaluating training that can be applied from medical evaluation is microsampling. In medical microsampling, two doctors review a sample of patient charts to identify problems in patient care. This technique could be applied to car repair and inspection units, in which a sample of repaired or maintained cars or engines could be inspected for problems. If problems are identified, procedures for solutions can be determined, and later reaudits would determine whether the problem has been eliminated.

Another technique from the medical profession is outlier analysis. Outliers are patients whose hospital stays deviate from the norm for that diagnosis. This technique presupposes a good data base that provides normative data. With the proliferation of computers in every area, building such data bases is not unreasonable.

Outlier analysis lends itself to comparisons between and within rail organizations. For use within an organization to evaluate car repair and maintenance, time to failure would be a good index. Use of maintenance information systems for equipment would permit analysis of stock with longer or shorter than the average time to failure. If information is available from other rail lines, between-organization comparisons could be made. Though differences in age of equipment, amount and type of use, and environmental factors detract from direct comparison, they could be taken into consideration and handled through statistical control.

Outlier analysis can be applied to other areas of rail operation as well. It is useful for analysis of customer complaints, accidents, on-time performance, ridership, fuel consumption, and so forth.

### Focus on Organization

In most areas of organizations, requests for new equipment or an increase in personnel are accompanied by projections of increased productivity or decreased costs. In human re-

sources, however, the translation of program benefits into dollars is a new phenomenon. Utility analysis concerns detailing the cost of all the factors in training and comparing it with the cost of on-the-job training. To accomplish this, the organization must know the amount of time it takes both trained and untrained workers to reach a standard of performance, the difference in performance between the average trained and untrained worker, and the costs of training for the trainee, the trainer, and the facilities. Cascio (12) has worked out formulas that transform this information into monetary factors. Though it is difficult to assign monetary values, failure to do so, Cascio warns, will cause training to be seen only in terms of costs.

## EVALUATION AS MANAGEMENT STRATEGY

Despite the increased availability of decision support systems and intelligent systems to aid in decision making, decisions concerning training continue to be based more often on intuition, hunches, and tributes. Money is spent on courses because they have good marketing rather than good content. Questions concerning demonstrated payback are rarely asked.

### Detailed Feedback

One advantage of evaluation derives from the development of performance measures, which, in turn, derive from job analysis. Development of these documents will require close attention to the nature of the jobs, how they have changed, and how they can be assessed. The availability of performance measures will give management a keener sense of how job behaviors relate to unit performance. The ability to evaluate performance should permit managers to identify problems early and recommend specific training or remediation for those with substandard performance.

### Change Training

Whereas training is increasing across industries and rail is no exception, an irony emerges in that training is becoming bureaucratized (13). It is most often administered separately from line operations. Among the five commuter rail agencies surveyed (McKnight and Rotter, unpublished data), the most common location is in the personnel or human resources division. In several agencies, technical and managerial training are housed in separate units. In the large freight rail line, technical training is part of the operations department, and managerial training is part of the human resources department. Technical training had been moved into the operations department after its value had been demonstrated in a program designed to reduce fuel consumption. Separation from operating divisions has obvious advantages: it fosters consideration of long-range training goals and promotes an atmosphere that is different from the daily pressures of work on the line. However, separation makes training vulnerable to the risk that it will not be responsive to operations needs.

## Educational Technologies

The professionalization of training is leading to an increase in computer-based instruction, particularly interactive videodisc, in which a videodisc player is interfaced with a computer. The courseware combines text and graphics on a floppy disk with high-quality visual and audio on the videodisc. The presentation is controlled by the program and by the student, who enters responses (input) through the computer keyboard. Touch-sensitive screens provide another source of input.

### Advantages and Disadvantages of Videodisc Technology

Interactive videodisc technology incorporates the best features of computer-based instruction, such as individualized pace of instruction, active learning mode, and immediate feedback. Students can see the outcomes of various decisions and, through the flow of the presentation, understand the consequences of their choices. It further incorporates evaluation into the learning process, because the computer keeps track of the students' choices and provides a record both to the students and the trainer.

Professionalization of training could lead to a proliferation of packaged training programs. Such packaged programs may meet the need for basic skills in various technical areas, but they do not meet the need for training on specialized equipment. Large railroads can afford to develop custom-crafted training programs using the latest in education technology, but smaller railroads face greater difficulties. Once educational developers have generated programs for larger railroads, they may promote these programs to smaller railroads. Use of interactive videodisc could be especially appealing to smaller railroads, because it would permit fairly sophisticated technical training programs without maintenance of a large training staff. However, if such training programs do not meet specific needs, they will not result in the expected improvements in performance. Systematic evaluation programs aid in avoiding such mistakes.

### Building Commitment to Training

Systematic evaluation can build and enhance managers' commitment to training by including them in the process of evaluation (14). Managers have a stake in both the outcome and the development of training. If training is to be needs- or user-driven, so must evaluation. Consequently, managers should participate in all phases of training, from needs assessment to course development to evaluation. If the starting point for change in a training program is evaluation, managers should be part of the groups that produce the objectives and criteria against which training will be evaluated. Their other major role is that of evaluators who assess the extent to which training has improved job performance.

The evaluation should be sensitive to the questions managers have concerning training and should be presented in a

usable time frame and manner. Presentation of evaluation findings in a timely and intelligible way will enhance their use by managers in making decisions concerning the place of training in long-range plans for the agency.

## SUMMARY

The role and status of training evaluation in rail transit were reviewed. Three forms of evaluation—process, outcome, and utility—were considered. Training evaluation in a sample of commuter rail agencies was examined. Findings indicate that reaction forms are ubiquitous. One rail agency is attempting to link training evaluation to performance appraisal for its nonunion employees. The most sophisticated use of evaluation was found in a large freight railroad.

Barriers to the conduct of more thorough evaluations are the lack of training staff, nonexistent or outdated performance standards, and a perception that evaluation is a tool to justify decisions already made. Needs and job analyses were recommended for reducing the barriers.

Techniques of training evaluation that could be used in the rail industry were described. Evaluation can be done at the employee, program, and organization levels. Evaluation was also discussed as it relates to management strategy. Advantages include facilitation of detailed feedback to management, its use for changing training, and its capacity to build commitment to training among managers. The relative benefits and drawbacks of educational technologies were considered.

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