Method and Processes for Transit Training Metrics and Return on Investment

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CHAPTER 1: INTRODUCTION

Importance of Training and Quantifying Benefits

The need for training in public transportation cannot be overemphasized. Transit vehicles have become increasingly complex, driven primarily by advanced electronic and digital systems that improve vehicle efficiency, reduce emissions, and expand passenger amenities. These advancements are only effective if the equipment produced from that technology is properly operated and maintained. Skilled technicians are better equipped to keep advanced equipment functioning to its full potential. Likewise, operators can maximize the capabilities of technology when trained to do so.

Without question, today's transit technicians need new skills to keep pace with technology advancements. Each transit agency, therefore, needs to provide its workers with the kind of training that adequately prepares them for their jobs. Relying on applicants to have the necessary skills is simply not a viable expectation in today's labor market. Unfortunately, making the case for transit training is difficult. Instead of being praised for their work, training professionals are often asked to justify budgets and demonstrate value. This is ironic given that transit invests only a small amount in workforce training - between 0.66 to 0.88 percent of payroll compared to the national average of 2 percent. *(1)*

Unfortunately, most training professionals are just not prepared to justify their programs, which could very well result in essential training programs being cut or eliminated. The ability to document the positive effects of training thereby becomes essential. Doing so not only provides trainers with a tool to benchmark their program performance, but also offers tangible evidence to management and funding sources that training monies and resources are being directed in an effective and efficient manner.

Purpose and Organization

Knowing that metrics do matter for every training department struggling to justify the value of its work, the purpose of this paper is to present the essence of what the Transportation Learning Center has learned about training metrics to help transit agencies evaluate the worth and value-added of their training programs. This paper is adapted with the key elements of a more detailed guidebook developed by the Center. Following this introduction, Chapter 2 presents an overview of popular methods used to evaluate training and learning with an emphasis on the Kirkpatrick/Phillips model. Chapter 3 then presents guidance to assist agency personnel to use the Kirkpatrick/Phillips model to begin measuring their own training programs. Chapter 4 uses the Keystone Partnership in Pennsylvania as a representative example of the analysis that can be achieved through applying each of the five learning assessment levels.

Guidance offered here and in the guidebook will be of interest and value to any transit agency or training partnership seeking to raise technical skill levels, establish training benefits, and place qualitative and quantitative values on those training programs.

CHAPTER 2: OVERVIEW OF TRAINING/LEARNING METHODOLOGIES

A review of the literature shows that modern learning measurement is based on applying four basic levels of measurement first introduced by Donald Kirkpatrick in 1994. *(2)* A fifth level was added by Jack Phillips a few years later to address return on investment (ROI). *(3)* The five levels of what has become known as the "Kirkpatrick-Phillips Learning Measurement Model" serve as the basis for evaluating training effectiveness. Measurement and evaluation begins with level one, and then, as time and resources allows, agencies move sequentially through the other levels. Information from each prior level serves as a base for the next level's evaluation. Agencies can progress based on

available time and resources with the understanding that even basic assessments can provide useful information.

- **Level 1 - Reaction:** Measuring students' initial reaction to the training is the first and most basic level. It typically involves a post-training survey where students rate the quality of the class taken.
- **Level 2 - Learning:** Assessing at this level moves the evaluation beyond learner satisfaction and attempts to assess advancements students have achieved in skills, knowledge, or attitude. A popular tool used in this level involves students taking pre- and post-tests to determine the amount of learning that has occurred.
- **Level 3 – Application:** After student satisfaction and learning have been assessed, this level measures the transfer that has occurred in learners' performance and behavior resulting from the training received. The goal of this step is to assess whether behavior in performing job tasks changed after the training.
- **Level 4 - Business Impact:** Level four evaluations assess training in terms of business results. Frequently thought of as "the bottom line," this level measures the success of the program in terms that managers and executives can understand such as increased productivity, improved quality, decreased costs, and reduced frequency of accidents.
- **Level 5 - Costs and Benefits Assessment - ROI:** The Return on Investment or ROI phase is another way to express the business impact in concrete financial terms and taking into account the training program's cost.

Measurement Tools

Some of the more typical metrics used by the transit industry to gauge the effectiveness of training programs in support of the five-level model include:

- Supervisor and worker training satisfaction surveys.
- Promotion, retention and wage increases that resulted from training.
- Pre-test and post-test results and practical examination pass rates before and after training.
- Transit maintenance efficiency and quality improvements following training, including MDBF (mean distance between failures) and costs for maintenance related labor and spare parts consumption.
- Vehicle operator improvements resulting from training including enhanced customer service and satisfaction, more effective pre-trip vehicle inspections, driving practices that save fuel, improved vehicle handing in adverse conditions, etc.
- An assessment of the monetary benefits and costs of training program.

These metrics have proven value for assessing how well training programs meet their objectives. The Transportation Learning Center has published several metrics studies documenting the benefits of training. *(4)*

Benefits of Training Metrics and ROI Analysis

Results of training measurement can be used in several important ways that include determining if individuals are learning, if the entire class is learning, and whether certain instructors are more effective than others. Other key benefits that transit agencies can expect by implementing the five levels of the Kirkpatrick-Phillips Model include:

- Ability to revise training programs and resources to more accurately address the business and skills needs of the agency.
- Assessing the effectiveness of agency training both for individual learners and groups.

- Indicating the degree to which the agency is achieving its business goals relative to job performance.
- Providing a clear link between the vision, strategy and business goals and the appropriate measurement systems.
- Receiving greater support from upper management to finance ongoing agency training.

Metrics could allow a transit agency to benchmark its training to other agencies. To accomplish this, however, instruments used to make agency-to-agency evaluations need to be standardized, which currently is not the case. Unlike private sector companies that typically have nationally directed programs to monitor maintenance or operations performance, transit agencies lack a unified national approach and each agency must develop its own benchmarking approach. Developing this capability depends largely on an agency's commitment to measure itself and become more effective. The Federal Transit Administration (FTA) recognizes this and is addressing the issue through its state of good repair program. In its publication entitled "Transit State of Good Repair: Beginning the Dialogue," FTA admits that decision-makers at all levels cannot easily establish an operational policy of attaining a state of good repair nor determine what it will take to reach that objective without reliable measures. *(5)* FTA will work with the industry to help define what is meant by “state of good repair” and how best to measure it.

CHAPTER 3: GUIDANCE FOR MEASURING TRAINING PROGRAM PERFORMANCE

Overview

Measuring training performance can be a daunting task given the lack of resources and the multitude of activities needed to keep transit vehicles operating safely and on schedule. However, as described earlier in this paper, the future of the entire training program may be in jeopardy if agencies do not take steps to quantitatively justify their training efforts in the face of dwindling budgets.

Level 1: Reaction

A fundamental way to receive feedback on training is to give students a survey immediately following the training where they rate the quality of the course. Multiple choice questions classified under different heading groups are relatively easy to develop and administer. In fact, no training should be delivered without obtaining basic reactions from students. The detailed guidebook provides several sample surveys that instructors can easily customize to suit their needs.

Level 2: Learning

Level 2 assessments take training evaluations beyond gauging basic satisfaction of the learner and measures what has actually been learned. A typical tool used in this stage involves pre and post testing. As the terms suggest, a test is given to students before training begins. That same test is then given after the training, analyzing the results to determine exactly what the student has learned.

Test questions can be developed directly from the course materials used to provide the training. When administering the test, conditions for both tests need to be identical. If the pretest was given on paper the first time, it should also be given the same way for the posttest. Otherwise, any changes detected may be due to differences in how the tests were administered rather than changes in participants’ attitudes or learning. Participants should be given adequate time to complete each test, and tests should be collected immediately to ensure high completion rates.

Level 3: Application

This level measures transfer that has occurred in learners' behavior resulting from the training. A good indicator is the ability of a student to pass practical "hands-on" exams administered on the shop floor. Hands-on assessments are necessary to determine whether classroom learning can be translated effectively into the realities of the world of work. Some technicians can perform well in written tests but have trouble applying that knowledge in practice – particularly if hands-on practice is not built into the training program. Conversely, some technicians, despite strong practical capabilities, do not perform well with written testing. In developing a National Training and Qualification Program for rail car technicians, the Center is including a hands-on assessment component to determine qualification. Agencies could develop their own hands-on assessments by using the National Training Standards available from the Center as a guide.

Measuring an employee's ability to practice what they were taught can take place in classroom and mentoring settings. A Mentor Guidebook prepared by the Washington Metropolitan Area Transit Authority (WMATA) provides exceptional guidance. *(6)*

Level 4: Business Impact

The "bottom line" assessments of Level 4 measures training success in business terms that managers and executives understand -- increased productivity, improved quality, decreased costs, and reduced frequency of accidents. This level requires a monitoring program capable of measuring performance in several key areas. Measuring the business impact resulting from training without this capability is not possible.

Several areas exist where monitoring of maintenance activities are useful for assessing learning. While not all performance gains – or declines – can be attributed to training, establishing benchmarks allows instructors to more easily make determinations. Factors not related to the training function such as the acquisition of new vehicles, which are typically more reliable and require less maintenance attention, can be considered during the analysis.

Common measures for gauging the business impact of training in transit maintenance typically include:

- Promotions and wage increases that resulted from training
- Mean distance between failures/road calls
- Schedule adherence
- Bus spare ratio
- Maintenance cost per mile (labor and parts)
- Repeat and chronic mechanical failure/Part rework
- Percentage of unnecessary part replacements
- Ratio of scheduled versus unscheduled maintenance

Details regarding common measures are provided in the guidebook. An overview is provided below.

Promotions and Wage Increases

A big fear among trainers and managers alike is that investments made in training will result in employees taking their newly developed skills and going elsewhere for better opportunities and pay.

Creating a career ladder structure where workers are paid and promoted based on skills and ability provides employees with incentives to remain. Tracking promotions and wages gives managers a true indication of upward movement within the organization and allows them to more easily determine just how competitive wages are within other industries.

Mean Distance Between Failures
Arguably the most important performance measure in transit involves tracking of mean distance between failures (MDBF). Increasing the distance traveled between those failures is highly desirable and can easily be linked to skills acquired through training.

Percentage of Unnecessary Part Replacements
Monitoring the use of spare parts before and after training is another way to gauge the effectiveness of training. The task, however, needs to be done in a consistent manner with the understanding that agencies have different spare part replacement policies, and artificial parts usage spikes can occur during fleet-wide campaigns to address specific problems. While some prefer to wait until a part fails before replacing it, others are more proactive by predicting failures and replacing parts more aggressively as a preventive measure to reduce road calls and other unscheduled maintenance. Regardless of the approach, spare part usage will increase when technicians lack skills because a common diagnostic approach for them is to change parts believed to be at fault until the correct one is found.

Ratio of Scheduled versus Unscheduled Maintenance
The goal of every maintenance department is to conduct activities on a scheduled basis where events are organized and planned. Unscheduled maintenance occurs when vehicles breakdown and unanticipated resources must be allocated to facilitate repairs. Agencies with monitoring capabilities can track the ratio of scheduled and unscheduled maintenance and link improvements to training. Skilled personnel are better equipped to predict maintenance needs, prevent costly breakdowns, and thereby improve passenger satisfaction, business objectives all transit managers can relate to.

Level 5: ROI
The final return on investment (ROI) level expresses the cumulative business impact as a balance sheet that compares training program costs to financial benefits received. Many senior managers claim that people are the organization's greatest asset; yet training efforts put in to developing human capital often is seen as an expense, not an investment. Analyzing training programs as capital investments using ROI is an effective way to change senior management's attitude toward training by proving to them that financial benefits derived from training exceed the costs.

The ROI process is more involved than other levels but is made easier if broken down into manageable steps. The process is simplified with computer based monitoring and accounting systems that track expenses in various categories. The guidebook directs agency personnel to begin by first determining training cost followed by benefits. An overview of the various cost and benefit elements is provided below.

Calculating Training Costs
There are several factors associated with tabulating training cost, all of which must be considered when calculating ROI.

Design and Development Costs
Costs associated with design and development of the training program must take into account classroom events, courseware materials, mentoring and OJT, and others.

Promotional costs
Most agencies typically promote training activities. Although costs are minimal, they must take into consideration labor spent on promotional activity and other direct costs of promotion such as posters and brochures.

Administrative Costs
Allowances must be made for the time taken by the training department in administrating the training program. Typically a factor of the number of students, costs include hours of administration required per student, and costs associated with tracking training and results for each student.

Materials
The cost of materials must also be included, such as cost per student of developing training materials (books, manuals, consumables, etc.), cost to produce those materials, and to purchase off-the-shelf materials and training aids such as labs and equipment mock-ups.

Instructor Costs
The next category of costs relates to training delivery and accounts for instructor labor and any travel expenses.

Student Costs
A significant training cost relates to the students themselves. It necessary to charge a student's time spent in training against time that would otherwise be productive working.

Evaluation Costs
Finally, allowances must be made for the time spent evaluating the training, whether for ROI or any of the other four evaluation levels.

Calculating Cost Benefits Derived from Training
Determining the financial benefits from training essentially involves converting the benefit categories presented earlier in this chapter under Level 4 into cost savings. Unfortunately, there are no universally accepted procedures for conducting ROI. However, agencies can calculate savings resulting from training as long as their monitoring system is sufficient to detect differences in performance and costs are accurately established. Average per-hour labor costs, for example, should be established for each group of workers receiving the training (e.g., technicians, operators, etc). In cases where productivity has improved as a result of the training, the hourly rate can then be applied and extended over time. Where parts costs have been reduced because diagnostic skills have been improved and fewer perfectly good parts are sacrificed in the process, the savings are straightforward as each part has a cost associated with it. As discussed earlier, savings are easier to quantify when tied to specific training.

Agencies also calculate costs on a per mile basis, performing separate calculations for labor and parts, and them combining them to obtain a total cost per mile number. Many break down the categories into individual cost areas such as fuel, tires, brakes, etc. Establishing costs on a per-mile traveled basis makes savings due to training easier to determine and express. Managers readily understand the implication of buses that consume $0.25 per mile in parts after training compared to $0.27 per mile before the training. For a fleet of 100 buses averaging 45,000 miles per year the combined savings represent $90,000 in annual savings ($0.27 - $0.25 = $0.02 per mile savings per bus * 45,000 miles per year * 100 buses = $90,000).

The following sections provide general guidance and examples for estimating cost savings resulting from training. Additional detail is provided in the guidebook.

Parts and Labor Cost Savings in Repair Jobs

Savings from spare parts usage and labor represent one of the most significant benefits resulting from training. When it comes to labor, savings are best expressed as productivity improvements. Labor savings could result from several training events. Unscheduled service calls due to breakdowns require maintenance personnel to perform road calls, taking time away from scheduled duties to travel to the downed bus, make repairs on site, or tow the vehicle back. Based on a per-hour labor rate calculation, an agency could determine the average number of man hours required to perform a road call and apply the savings to the reduced number of calls needed within a year because of improved reliability resulting from training.

Electrical components tend to be the most vulnerable and expensive parts to replace on a transit vehicle. Training in the basic knowledge of electricity lays a foundation for technicians to perform proper diagnostics and repairs on electrical systems, leading to reduced costs in the replacement of these parts.

Savings from Lower Bus Spare Ratio

Transit agencies keep a number of spare buses in their fleets to account for out-of-service conditions such as accident damage and to have certain vehicles available for routine servicing and repairs. Except for small and rural agencies, FTA establishes a maximum number of spare buses agencies are allowed to operate. One indication of poor maintenance due to untrained workers is the need to have a larger ratio of spare buses. The extra buses are needed to account for vehicles that are less reliable and therefore more frequently in the depot, and for untrained workers who typically require more time to diagnose and repair faults. Dollar savings associated with reduction in bus spare ratio may be generated from the following cost categories: fleet procurement costs, inventory costs and non-beneficial maintenance costs for out-of-service buses. Each agency should be well aware of the capital and operating costs associated with each bus in its fleet. Evaluators can use those costs to calculate savings resulting from a smaller spare bus fleet made possible by more efficient and effective maintenance.

Savings from Operator Training

Many untrained bus operators tend to consume more fuel and brakes, two major cost drivers. The tendency is to accelerate quickly and brake late, requiring a much harder brake effort to stop the vehicle which generates more brake heat, increases stopping distances, and decreases brake lining life. Properly trained operators accelerate in a more gradual fashion, which significantly improves fuel economy, brake life and passenger comfort. Operator training is also important to maximize the benefits of hybrid-electric propulsion where greater fuel economy gains are possible when drivers use strategic brake and accelerator actions to maximize battery propulsion and regenerative braking to recharge batteries.

Calculating Training ROI

The resulting savings from training are compared against the training program costs to produce estimates of return on investment rate. Many times evaluators may generate high and low estimates of savings and a range of ROI rates based on different discount rates to account for factors other than training that may have contributed to the cost savings. The next chapter shows application of Level 5 ROI to the Pennsylvania Keystone Training Program where an initial training investment of $2.6 million yielded a stable annual ROI rate increase of five to 12 times the investment over a four year period. *(4)*

CHAPTER 4: APPLYING THE KIRKPATRICK-PHILLIPS MODEL: PENNSYLVANIA'S KEYSTONE TRANSIT PARTNERSHIP EXAMPLE

Background

The Transportation Learning Center has assessed training benefits at two major locations: Keystone Transit Partnership formed in the Philadelphia area between the Southeastern Pennsylvania Transportation Authority (SEPTA) and the Transport Workers Union (TWU) Local 234; and Project Empire Transit Career Ladder Partnership consisting of members of Amalgamated Transit Union (ATU) Locals 1321 and 580 employed at the Capital District Transportation Authority (CDTA) in Albany, NY, and Central New York Regional Transportation Authority (CENTRO) in Syracuse, NY. In each case the Center facilitated technical training of skilled maintenance personnel and conducted follow-up assessments to measure the benefits of the training provided.

Results of the Keystone Partnership are presented here and in the guidebook as representative examples of applying the five-level process outlined in the Kirkpatrick-Phillips Learning Measurement Model. Results of the Albany training assessments are available in another Center publication entitled Smart Investment Partnership: New York State's Transit Workforce Training Proves its Worth. *(4)* Additionally, while the guidebook makes extensive use of figures to provide illustrative examples in each of the five levels, due to the length limit this paper only includes some of them.

Keystone Training Program

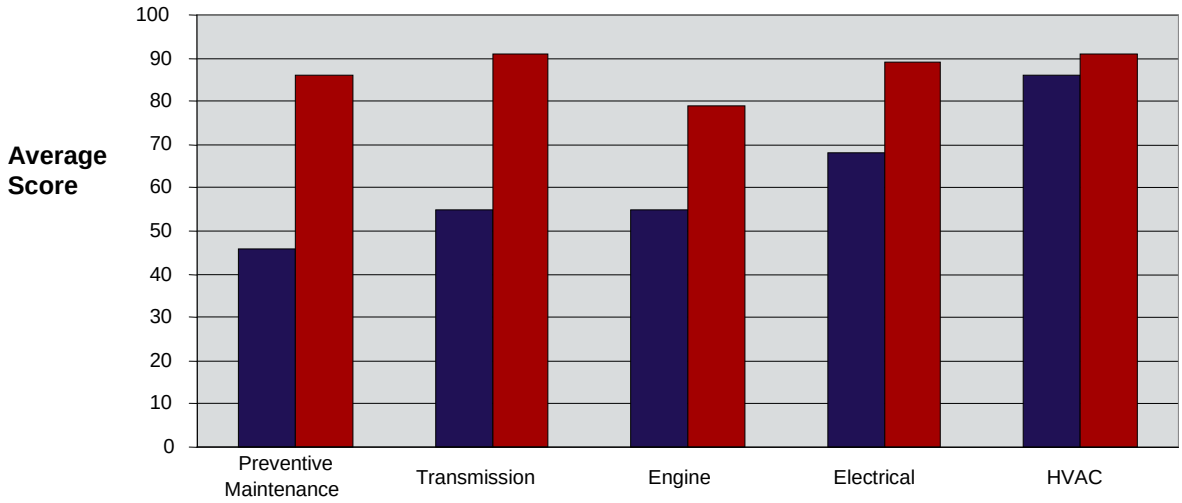
The Keystone Transit Career Ladder Partnership (Keystone) represents the longest operating, largest, and so far, the most successful of the statewide joint labor-management transit training partnerships supported by the Transportation Learning Center. The Keystone program was initiated ten years ago to address the growing skills crisis in the transit maintenance workforce. Since 2001 the Keystone Partnership has provided some 12,000 new training opportunities to more than 2,000 transit workers in approximately 34 Pennsylvania transit agencies. The Center has published a series of reports documenting the benefits of the partnership training through improved skills, more efficient maintenance activities and increased vehicle reliability. *(4)*

Level 1: Reaction

This first level measures initial reaction to the training and involves a post-training survey assessing the quality of the class. The survey conducted at 24 Pennsylvania transit agencies indicates that Keystone has generated broad support from supervisors and workers. Sample survey results are presented in the detailed guidebook.

Level 2: Learning

Level 2 accelerates the evaluation beyond learner satisfaction and attempts to assess the extent students have advanced in skills, knowledge, or attitude by typically using pre and post training testing to determine the amount of learning that has occurred. Figure 1 on the following page gives an overview of pretest and post-test results from selected Keystone Philadelphia courses where learning improvements of up to 87 percent indicate significant knowledge gains.



	Preventive Maintenance	Transmission	Engine	Electrical	HVAC
Pre-training	46	55	55	68	86
Post-training	86	91	79	89	91
Percent Improvement	**87%**	**65%**	**44%**	**31%**	**6%**

FIGURE 1 Keystone Philadelphia pretest and post test results.

Level 3: Application

In Level 3, which measures the transfer that has occurred in learners' behavior due to the training program, the goal is to assess whether on-the-job (OJT) behavior changed after the training. In the Keystone example, one indicator of skills gained over time is success in passing the practical "hands-on" exams administered on the shop floor after classroom and OJT training. Prior to Keystone training only 53 percent of the employees completing the classroom training passed the performance test. Two years after the beginning of Keystone, 84 percent passed and earned promotions.

Level 4: Business Impact

Bottom line measurements in Level 4 assesses training in terms of business results - increased productivity, improved quality, decreased costs, and reduced frequency of accidents. A summary of some Level 4 examples taken from the guidebook is provided below.

Promotions and Wage Increases

Figure 2 on page 12 illustrates examples of bus maintenance worker career ladder promotions through Keystone Philadelphia and corresponding wage increases. The 116 promotions achieved in the first four program years helped to alleviate SEPTA's skills gap caused by emerging new technologies and an exodus of senior maintenance workers due to retirement. Wage increases resulting from promotions served to keep SEPTA competitive with other transportation sectors seeking to "steal away" skilled, but often underpaid transit workers to their camp.

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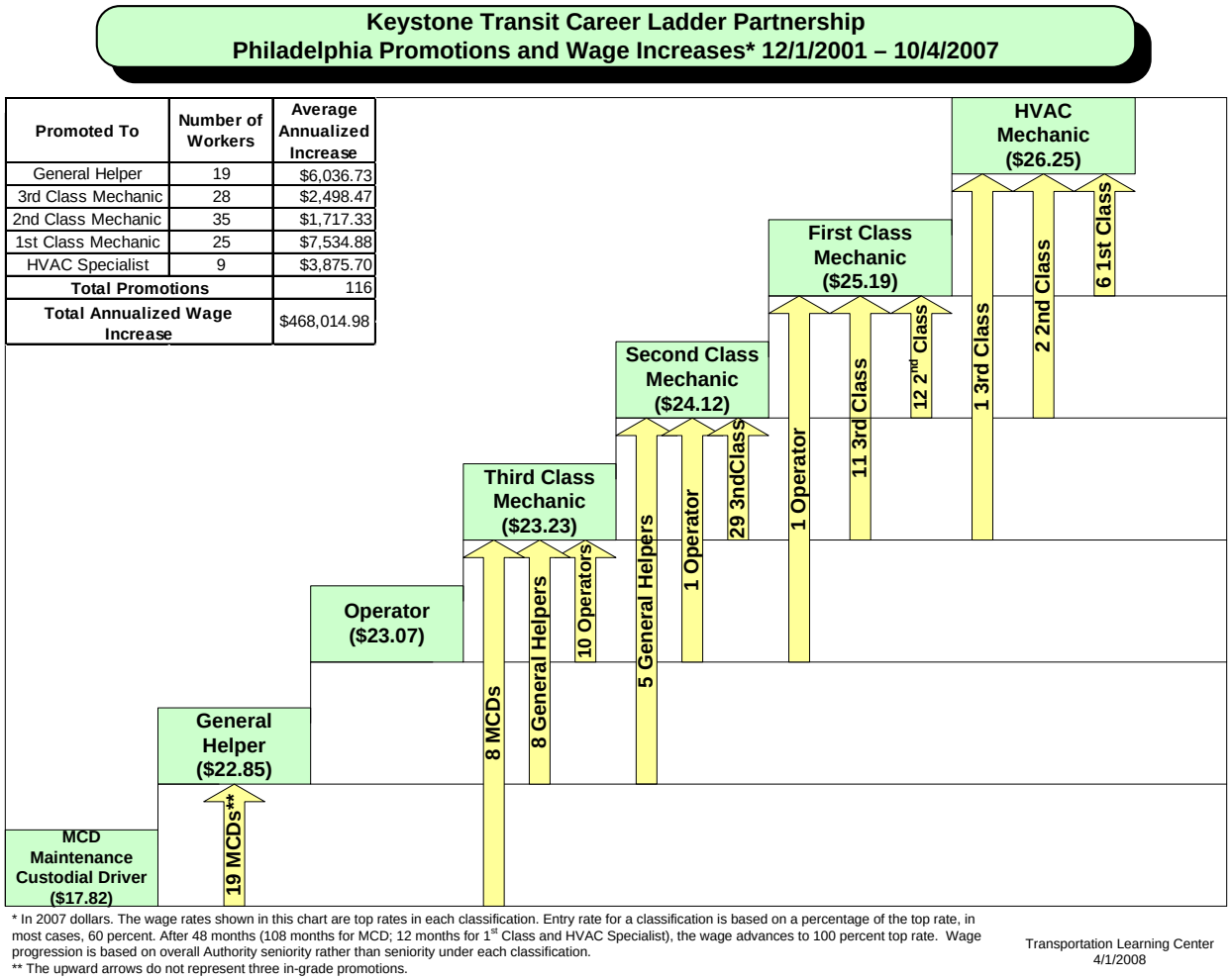


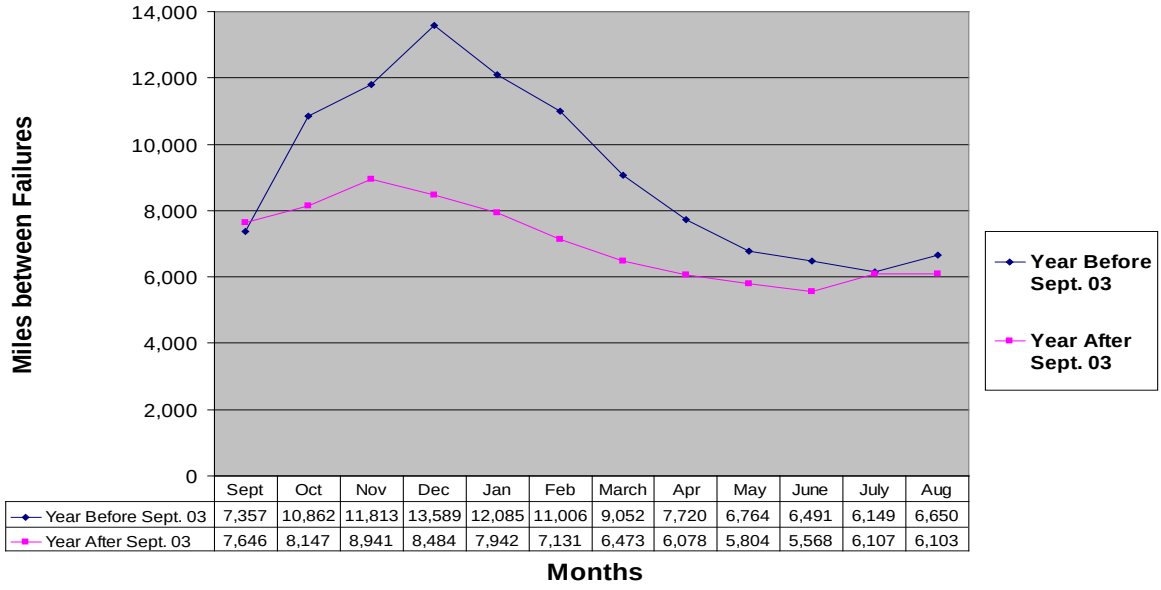
FIGURE 2 Keystone Philadelphia promotions and wage increases.

Mean Distance Between Failures

Figures 3 and 4 on page 13 compare trends in MDBF between SEPTA's bus garages that did not receive any preventive maintenance (PM) training and those garages that did receive Keystone PM training.

Figure 3 shows declining MDBF over a two year period for SEPTA city bus garages that did not receive Keystone PM training. As an ordinary development, MDBF worsened in the second year because of equipment aging and other factors.

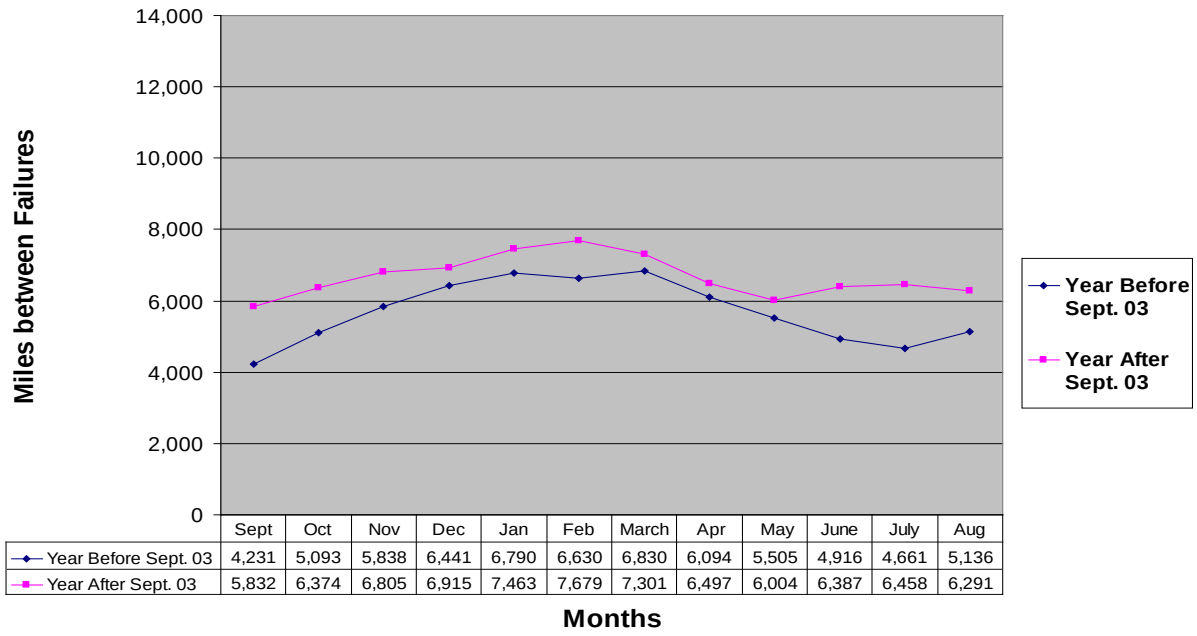
Figure 4 illustrates MDBF over time for SEPTA city garages that received hands-on Keystone PM training. From September 2003 (the first month after training), MDBF improved for each month in the entire year, with improvements of up to 1,797 more miles traveled between failures, or 39 percent improvement in miles driven between failures. This improvement in vehicle reliability may be attributed to a larger base of mechanical knowledge and skills dispersed among trainees at all seniority levels following the training.



	Sept	Oct	Nov	Dec	Jan	Feb	March	Apr	May	June	July	Aug
Year Before Sept. 03	7,357	10,862	11,813	13,589	12,085	11,006	9,052	7,720	6,764	6,491	6,149	6,650
Year After Sept. 03	7,646	8,147	8,941	8,484	7,942	7,131	6,473	6,078	5,804	5,568	6,107	6,103

* Three-month moving average MDBF (average of the month shown, 1 month before and 1 month after).

FIGURE 3 MDBF comparison for garages that <u>did not</u> receive training.



	Sept	Oct	Nov	Dec	Jan	Feb	March	Apr	May	June	July	Aug
Year Before Sept. 03	4,231	5,093	5,838	6,441	6,790	6,630	6,830	6,094	5,505	4,916	4,661	5,136
Year After Sept. 03	5,832	6,374	6,805	6,915	7,463	7,679	7,301	6,497	6,004	6,387	6,458	6,291

* Three-month moving average MDBF (average of the month shown, 1 month before and 1 month after).

FIGURE 4 MDBF comparison for garages that <u>did</u> receive training.

Ratio of Scheduled versus Unscheduled Maintenance

As mentioned in Chapter 3, another key measurement in bus maintenance is the ratio between scheduled maintenance events where activities are accomplished within planned service intervals, and unscheduled maintenance where repair jobs are reactive in nature and usually the result of breakdowns. It is more advantageous to accomplish repairs while the vehicle is receiving scheduled

maintenance than having to chase unscheduled repairs where vehicle downtime is not anticipated. Within five years, unscheduled maintenance activities dropped from 51 percent to 42 percent of total maintenance activities at SEPTA. The reduction of unscheduled maintenance is a strong indicator of improved equipment performance as a result of more effective overall maintenance performance, including preventive and predictive maintenance, resulting from improved training.

Moving maintenance into the scheduled category gives the maintenance department greater control, improves the structure of the operations, and generates cost savings from the reduction of disruptive and costly breakdowns and unscheduled overtime.

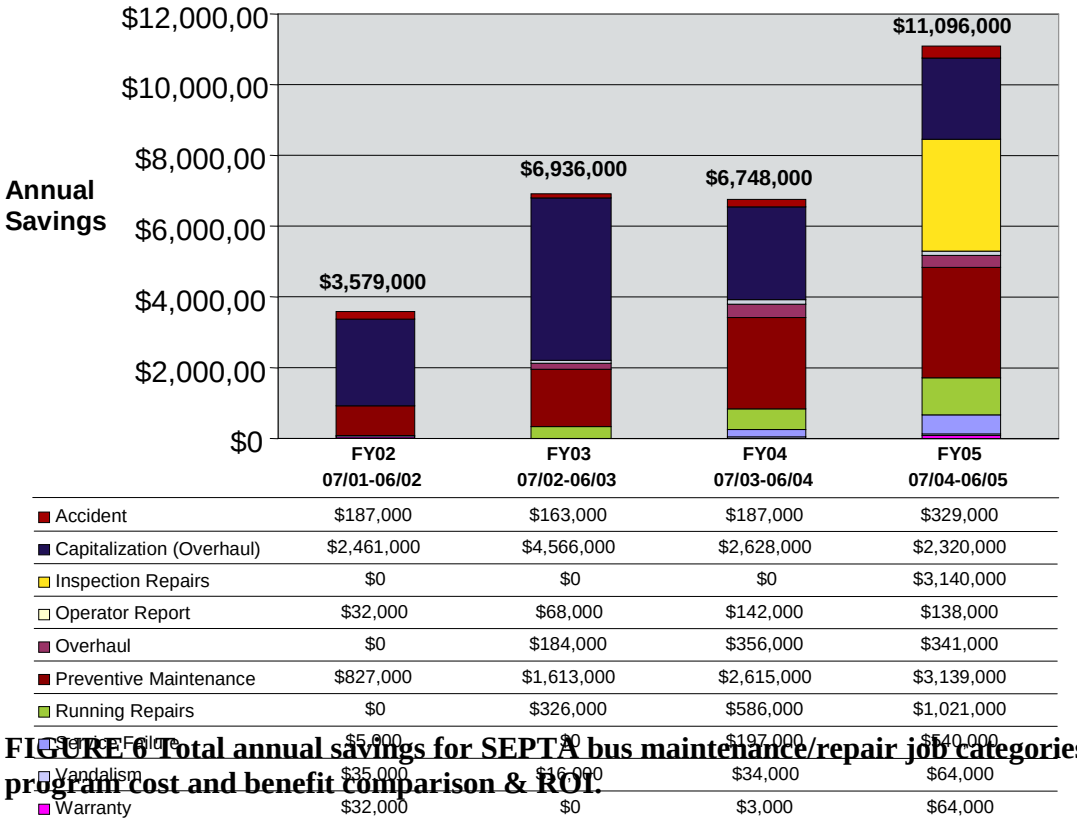
Level 5: Costs and Benefits Assessment

This costs and benefits assessment level highlights a practical approach that can be applied by agencies to assess monetary benefits and compare them with training program costs. One transit ROI component is to calculate the savings from reduction of unnecessary part replacements regardless of the agency's policy to replace parts before they fail as a preventive measure. In a smaller transit property in Pennsylvania, technicians were better equipped to understand the overall electrical system and take care of minor maintenance problems following basic electric training. This led to a sharp reduction in charging system related work orders requiring the replacement of batteries where the average work order battery cost was reduced by $54 or 26.5 percent after training.

The time and effort spent on bus maintenance training at all skill levels has produced impressive improvements in parts and labor cost reduction in many of SEPTA's major maintenance/repair categories. Figure 5 below showcases an example of such savings. A preventive maintenance job that once cost $114 in labor and materials now cost only $82 after four years of Keystone training. SEPTA has saved a total of $8,194,000 on bus preventive maintenance jobs because of training initiatives.

FIGURE 5 Average labor & parts cost and annual savings – SEPTA bus preventive maintenance jobs.

Figure 6 summarizes the total savings at SEPTA analyzed to date by the Center. The annual savings for all bus maintenance/repair categories rose rapidly from $3,579,000 in the first year of Keystone to $11,096,000 in the fourth year.



	FY02 07/01-06/02	FY03 07/02-06/03	FY04 07/03-06/04	FY05 07/04-06/05
Accident	$187,000	$163,000	$187,000	$329,000
Capitalization (Overhaul)	$2,461,000	$4,566,000	$2,628,000	$2,320,000
Inspection Repairs	$0	$0	$0	$3,140,000
Operator Report	$32,000	$68,000	$142,000	$138,000
Overhaul	$0	$184,000	$356,000	$341,000
Preventive Maintenance	$827,000	$1,613,000	$2,615,000	$3,139,000
Running Repairs	$0	$326,000	$586,000	$1,021,000
Service Failure	$5,000	$0	$197,000	$540,000
Vandalism	$35,000	$16,000	$34,000	$64,000
Warranty	$32,000	$0	$3,000	$64,000

FIGURE 6 Total annual savings for SEPTA bus maintenance/repair job categories program cost and benefit comparison & ROI.

The Center has had access to sufficient data on program costs and outcome metrics from the Keystone training at SEPTA to analyze costs vs. benefits and return on investment. SEPTA's incremental program costs totaled $2,625,127 in training SEPTA's bus maintenance workforce over the four years studied. In the four years after the startup of the Keystone Training Partnership, training and other factors led to a combined cost savings of between $10 million and $22 million in vehicle maintenance and repair and bus capital costs due to a reduction in the bus spare ratio from 24.7 to 17.1 percent. Table 1 on the following page compares the monetary benefits accounted so far with the annual program costs (actual grant dollars plus an estimate of SEPTA's match).

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TABLE 1 Keystone Training Benefits and Total Cost Comparison

	Year 1&2 (18 months) 12/01-06/03	Year 3 07/03-06/04	Year 4 07/04-06/05	**Total**
Savings from Reduced Labor and Part Costs	$10,515,000	$6,748,000	$11,096,000	$28,359,000
Savings from Reduced Spare Ratio (from 24.7 percent to 17.1 percent)	$11,277,102	$17,792,572	$19,041,130	$48,110,804
Total Savings	$21,792,102	$24,540,572	$30,137,130	$76,469,804
High Estimate of Savings from Training (30 percent contribution)	**$6,295,585**	**$7,131,541**	**$8,754,808**	**$22,181,934**
Low Estimate of Savings from Training (15 percent contribution)	**$2,903,995**	**$3,329,008**	**$4,080,654**	**$10,313,657**
ROI = (Training Benefits – Costs)/Costs * 100 percent				
Internal Training Investment	$803,855	$341,271	$402,257	$1,547,383
Grant Investment	$640,448	$197,362	$239,934	$1,077,744
Total Training Investment	**$1,444,303**	**$538,633**	**$642,191**	**$2,625,127**
High Estimate of ROI	***336%***	***1224%***	***1263%***	***745%***
Low Estimate of ROI	***101%***	***518%***	***535%***	***293%***

CONCLUSIONS

When decisions are being made to cut or even eliminate training for vehicle operators and technicians, training departments are finding it necessary to justify their purpose and existence. The Kirkpatrick four level learning evaluation model, coupled with the more recent cost benefits and training ROI (fifth level) analysis have been widely utilized evaluation methods among trainers in many industries. However, very little has been written on transit's application of these evaluation methods and the specific measurements and outcomes, and their strengths and constraints in the context of transit operations and maintenance. Building on years of research focusing on transit specific training metrics and ROI analysis, this paper provides a scalable analytical framework, practical research methods, and valuable tools and resources to transit training practitioners who are interested to bring their metrics analysis to the next level. Applying a five-level assessment methodology, the paper illustrates the training benefits derived from over 12,000 training opportunities provided to technical occupations by the Keystone Transit Training Partnership formed in Pennsylvania. Results, which include a return of five to 12 times the training investment, serve as an example of what other agencies could demonstrate in terms of quantifiable training benefits using these methods. The five-level procedure presented in this paper and detailed in the guidebook is progressive, beginning with rather easy steps agencies can take to prove the value of training and building from there depending on available resources.

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