Training Effectiveness Evaluation

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Introduction

The gap between evaluation theory and practice is a serious problem for training in industry and business[1]. A recent literature review of the summative evaluation on training noted:

> The general consensus of the authors is that most summative evaluation of training and development programs is not conducted effectively at the present time. It may be concluded that more attention needs to be given to the components of summative evaluation used as a basis for this review and to upgrade the evaluation competencies of training specialists[2].

A paradox facing most practising managers of training is that their non-training bosses typically neither ask for nor require formal evaluations. And, when these managers do evaluate, it is usually in response to a crisis and invariably comes too late. A typical work-place scenario consists of the busy training practitioner doing what the company wants, feeling successful, and not being regularly required to prove the added value that results from training. With a full agenda of important training development and delivery tasks, the busy trainer finds it difficult to evaluate training. However, most important organisational functions regularly evaluate their progress and bottom-line contributions to the enterprise. In addition, it has been clearly established that training effectiveness evaluation data, particularly bottom-line performance results, are the key to gaining support for the training function from non-training managers[3]. It is clearly irrational not to evaluate training effectiveness.

The purpose of this study was to develop and pilot test a *practical* Training Effectiveness Evaluation (TEE) system that could be applied to any training programme in industry. Training personnel from Control Data Corporation and researchers from the University of Minnesota Training and Development Research Center worked together to achieve this purpose.

Both Parker's review of literature[2] and Kusy's study of management support of training evaluation[3] established the need for this study. In addition, the TEE is the heart of the control phase of the comprehensive training technology system developed by Swanson and Sisson[4]. The other four phases of the system are analysis, design, development and implementation.

*The authors wish to acknowledge Robert J. Prifrel and Control Data Corporation of Minneapolis, Minnesota, for supporting this research and ... also wish to thank Scott D. Johnson and Brian

The TEE consists of three major elements:

(1) an effectiveness evaluation *plan;*
(2) *tools* for measuring training effectiveness, and
(3) the evaluation *report.*

Evaluation Plan

In TEE, planning decisions are made about which tools will be used to assess whether the training programme produced the desired results. The effectiveness planning sheet presents both evaluation tools and effectiveness questions. The four questions represent levels of training effectiveness and should be asked of every training programme. They are:

(1) Was the training delivered professionally?
(2) Were the learning objectives met?
(3) Was the original training need met?
(4) Was the training valuable?

The evaluation tools, labelled A-F on the effectiveness planning sheet, are used in gathering the information needed to answer the evaluation questions. These tools measure the satisfaction, learning and performance that result from training and, in the case of Figure 1, focus on basic supervisory training.

An "x" in a cell on the planning sheet indicates that this evaluation tool is required for *all* training programmes. The open cells represent reasonable evaluation options with choices needing to be made in the learning and performance columns. For the knowledge area, the choice of using a knowledge test (2C), an in-training performance test (2D), or both, must be made. For performance, the choices focus on either cost-benefit analysis or performance comparisons. The completed plan *requires* a minimum of four evaluation tools; two for satisfaction, one for learning and one for performance. The tools that are selected also address the four effectiveness questions.

The completed *plan* specifies the tools that will be used to assess whether the training has produced the desired results. Figure 1 is a *plan* for a basic supervisory training course. The sample plan shows that the effectiveness of this course will be evaluated using the following measures: trainee satisfaction, trainee/supervisor satisfaction, knowledge test, performance comparisons and cost-benefit analysis.

Tools for Measuring Training Effectiveness

The three categories of evaluation *tools* — satisfaction, learning and performance — can be presented as three scores, one for each category. The satisfaction score is an indicator of how pleased trainees and their supervisors were with the training; the learning score is an indicator of the amount of knowledge acquired by the trainees during the training course, and the performance score is an indicator of the effects that result from the training. Although there are many options available to professional trainers for constructing evaluation tools, the TEE focuses on a limited number of reasonable options, not every option.

The TEE requires that trainee satisfaction be measured for every training course. Trainee satisfaction is measured by

Figure 1. Basic Supervisory Training Programme Effectiveness Plan

This planning sheet helps to specify the evaluation tools that will be used to answer the four questions about the training effectiveness of each training programme. The questions represent four levels of training effectiveness. The xs in the planning sheet cells indicate the evaluation tools that are required of all training programmes. The open cells represent reasonable effectiveness evaluation options with two choices needing to be made. In terms of learning, the choice of using a knowledge test (2C), a performance test (2D), or both, needs to be made. For performance, the choice is within cells 3E, 3F, 4E and/or 4F.

At *minimum,* there should be one evaluation tool each for satisfaction, learning and performance. Additionally, the selected tools must *minimally* address the four questions.

Programme title Basic Supervisory Training

Prepared by John Mart

Approved by Sara Jameson

Date 3/27/86

EFFECTIVENESS QUESTIONS	EVALUATION TOOLS: Satisfaction — A. Trainee satisfaction	B. Trainee supervisor satisfaction	Learning — C. Knowledge test	D. In-training performance test	E. Job behaviour/ performance	F. Cost-benefit analysis
1. Delivery. Was the training *delivered* professionally?	X					
2. Objectives. Were the learning *objectives* met?	X		2.C ○	2.D		
3. Need. Was the original *need* met?	X	X			3.E ○	3.F
4. Value. Was the training *valuable*?	X	X			4.E ○	4.F ○
	Required		Choice no. 1		Choice no. 2	

x = Required of all training programmes.
o = Choices for this programme.

having each trainee complete the Training Programme Evaluation Form (Figure 2). The trainee satisfaction score is calculated by tallying all the trainees' responses to questions 1 to 7. Ordinal values are then assigned to the following descriptors: Very good (4), good (3), fair (2) and poor (1). The overall trainee satisfaction score is obtained by averaging the scores and determining the mean satisfaction score which will fall within the 1-4 range. Sub-scores on the individual questions can also be computed this way.

The comments written by the trainees on the trainee satisfaction form are not included in the trainee satisfaction score, but instead provide immediate, open-ended feedback for the instructor.

Trainee supervisor satisfaction is measured by using the Management Evaluation Form (Figure 3), which is completed by each trainee's supervisor. After the responses are gathered, the average supervisor satisfaction score for the training programme is computed in the same manner that average trainee satisfaction score and sub-scores are determined. Again, the written comments provide the trainer with immediate, open-ended feedback.

The total satisfaction score for the training is computed by averaging the trainee satisfaction score and the trainee supervisor score and dividing this number by two. This process weights the opinions of both trainees and the supervisors equally. The trainer can report the raw satisfaction score on the 4-point scale or use basic mathematic formulas to express the score as a ratio or percentage[a].

Using standard trainee and supervisor satisfaction forms for all training courses allows for the comparisons of training courses with each other and across time, making it

Figure 2. Training Programme Evaluation Form (Training Technology System)

Programme Title _____ Date _____

Instructor(s) _____

_____

Please answer the following questions to help us improve future training programmes.

		Very Good	Good	Fair	Poor
1.	Quality of instructor's presentations	_____	_____	_____	_____
2.	Quality of the information presented	_____	_____	_____	_____
3.	Amount of time to practise new material	_____	_____	_____	_____
4.	Quality of feedback on your performance during training	_____	_____	_____	_____
5.	Quality of training environment	_____	_____	_____	_____
6.	Usefulness of the course content to your job	_____	_____	_____	_____
7.	Was attending this training programme a good use of your time?	_____	_____	_____	_____

What was the most valuable part of this course for you? _____

_____

_____

What was the least valuable part of this course for you? _____

_____

_____

If you rated any item "poor", please provide some additional explanation _____

_____

_____

Additional comments would be appreciated _____

_____

_____

_____

_____

Trainee Name (optional)

Figure 3. Management Evaluation of Training (Training Technology System)

Programme Title _____

Dates of Training _____

Trainee(s): _____

Trainee Supervisor: _____ Date: _____

Please answer the following questions to help us improve future training programmes.

Now that your employee has completed training and is back on the job, what is your impression of the effectiveness of the training programme?

	Strongly agree	Agree	Disagree	Strongly disagree
1. Employees have performed better at their old job or have been able to perform a new job following training	_____	_____	_____	_____
2. Attending the training was a good use of the employee's time	_____	_____	_____	_____

Additional comments would be appreciated _____

_____

_____

_____

_____

_____

Learning in training is measured by knowledge tests, performance tests, or both. Knowledge tests measure the cognitive information learned by trainees. Two types of knowledge test items — multiple choice and matching — are encouraged because they can be scored objectively and are not as susceptible to guessing. In constructing knowledge tests, care must be taken to ensure that the tests produce valid and reliable results. A test is valid when it measures what it is supposed to measure and it is reliable when it produces consistent results. The job aid for constructing knowledge tests (Figure 4) includes sample test items, validity and reliability criteria, and helpful test construction references.

In-training performance tests measure what the trainees can do by examining either the products that the trainees produce or the processes used by the trainees to exhibit learning. An in-training performance test must also be valid and reliable. The job aid for constructing in-training performance tests (Figure 5) provides examples, criteria for validity and reliability, and helpful performance test references.

The scores obtained with the knowledge test, the in-training performance test, or both, are used in calculating the total learning score. When learning information is collected using a single tool, that score becomes the total learning score. When both tools are used, the learning score is calculated by computing the percentage correct score for each test and then adding these scores together and dividing by two. The trainer can either report the raw learning score or express it as a ratio or percentage (see[a]).

In TEE, the tools for measuring the performance that results from training are performance comparisons and cost-benefit analysis. Performance comparisons contrast the productivity of either the organisation or the employee after training with the productivity before training or against a goal. Figure 6 is the job aid for performance comparisons.

Cost-benefit analysis is used to determine the economic value of the training programme, the benefit of which is determined by subtracting the cost of the programme from the performance value resulting from the programme. Figure 7 is the TEE job aid for conducting

Figure 4. Knowledge Test

TYPES OF ITEMS:

1. Multiple choice (sample):

To speed up nut turning on tasks where space is limited or where bolts with long threads prevent the use of sockets, use the _____ wrench.

(a) crescent
(b) combination
(c) ratchet
(d) allen

Indicate the best answer by circling the number.

The most important property of an objective test is:

(1) Ease of marking.
(2) Accuracy of scoring.
(3) Its reliability.
(4) Its validity.
(5) Complete sampling of the syllabus.

2. Matching (sample):

For each item, write a number to indicate that the statement applies to:

(1) Norm-referenced assessment
(2) Criterion-referenced assessment
(3) Both norm- and criterion-referenced assessment
(4) Neither norm nor criterion-referenced assessment

_____Assessment is mastery-based
_____Some people must fail; otherwise assessment is too easy
_____Assessment is useful for making predictions

Directions: Column A contains a list of advantages of varied shopping outlets. Choose from column B the outlet which best fits each advantage in column A and insert the identifying letter in the space provided. Responses in column B may be used more than once.

Column A	Column B
___(1) "One-stop" shopping	(a) Mail order
___(2) Offers 24-hour service	(b) Door-to-door
___(3) Armchair shopping	(c) Vending machine
___(4) All prices may be lower	(d) Department store
___(5) Product demonstrated at home	(e) Speciality
___(6) Open counter display	(f) Used clothing

CONTENT VALIDITY:

(. . . does the test measure what it is supposed to measure?)

1. Make sure that the test matches the content taught and its relative emphasis

2. Use a matrix with content breakdown on one axis. Use low- and high-level thinking on the other axis. Weight the distribution of items according to trainee time-on-task or importance

Content \ Level	Low	High	TOTALS Test items No.	%
Unit No. 1	6	6	12	30
Unit No. 2	4	2	6	15
Unit No. 3	3	5	8	20
Unit No. 4	7	7	14	35
TOTALS (No. and % of test items)	20 50%	20 50%	40	100

RELIABILITY:

(. . . does the test yield consistent results?)

1. Use at least 25 test items for any one test.

2. Use as many items as possible, being careful that the test time does not become unreasonable.

References: Gronlund, N. E.[6]; Parker, B.[2].

Figure 5. In-training Performance Test

TYPES:

1. *Process Checksheet (samples):*

Course: Basic Tools and Hardware

Performance Check list

Terminal Performance Objective:

Given: a torque screwdriver, Phillips head tip, no. 10-32 x ½ Philips panhead screw, no. 10 flat washer, no. 10 hex nut, subassembly work place
Performance: fasten the hardware to the subassembly work place
Standard: per the following torque specification of 58 inch/pounds

Critical Item	Procedural Steps	Satis-factory	Unsatis-factory	Criteria
	1. Determine torque specification	1	0	specification will be 58 inch/pounds
	2. Locate the adjustment knob	1	0	at the butt end of torque screwdriver handle
	3. Locate torque indicator line	1	0	transparent plastic collar at mid-point of torque screwdriver
	4. Turn adjustment knob	1	0	clockwise/counter clockwise to 50 inch/pounds
	5. Line up torque indicator line	1	0	at the 58 inch/pounds setting
	6. Lock the adjustment knob	1	0	adjustment knob locked in place
	7. Insert Phillips head tip into position	1	0	at the end of torque screwdriver opposite adjustment knob
	8. Position screw	1	0	into no. 10 predrilled hole in subassembly workpiece
	9. Position flat washer	1	0	over shank of prepositioned screw in step 8
	10. Position hex nut	1	0	over shank of prepositioned screw in step 8
	11. Fasten hardware in place	1	0	finger tightened
	12. Position torque screwdriver	1	0	tip of torque screwdriver securely seated in screw head
	13. Tighten screw	1	0	until locking sound occurs
	14.	1	0	

Total score _____

Total score = 13
Minimum mastery level score = 13

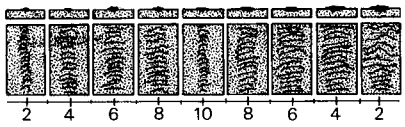
Management Delegating Responsibility

Perf. rating
Good = 3
OK = 2
Poor = 1
No = 0

1. Explains the new responsibility to the employee and tells why it is important.
2. Tells the employee the performance standards that are expected for the tasks.
3. Asks the employee if there are questions or suggestions and responds to the concerns that are expressed.
4. Asks the employee to make a commitment to the responsibility.
5. Tells the employee that you have confidence in their ability to carry out the responsibility.

Total_____

2. *Product Specifications (samples):*



Product rating scale for assessing the appropriateness of the amperage setting for welds made by students. Ten points are awarded to welds made at the appropriate amperage (heat) setting and proportionately fewer points are awarded to welds that are judged either too "hot" or too "cold".

Directions: Rate the instrument according to the following criteria by placing a "X" in the appropriate blank.

Criterion	*Description*	*Yes*	*No*
Quality	Does it measure quality of the performance?		
	— Skill	_____	_____
	— Attitude	_____	_____
Efficiency	Does it measure efficiency of the operation	_____	_____
Ease of use	Does the language, design, length and degree of detail promote ease of use?	_____	_____
Achievement of goals	Does it achieve the goals of measuring student progress, diagnosing, certifying and evaluating instructions?	_____	_____
Adaptability	Does it serve, with little revision, for self-evaluation, poor evaluation and instructor/supervisor evaluation?	_____	_____
Validity	Does it measure what it was designed to measure?	_____	_____
Reliability	Does it provide trustworthy or essential measures?	_____	_____

Recommendations for change

CONTENT VALIDITY

(. . .does the test measure what it is supposed to measure?)

1. Make sure that the process checksheet contains all the critical steps specified by the work behaviour analysis.
2. Make sure that all the product specifications, quality and quantity, are included in the evaluation criteria.

RELIABILITY

(. . .does the test yield consistent results?)

1. Have trainee exhibit the process at least twice and produce at least two products.
2. If No. 1 is not possible, have trainee talk through the process while doing it or describe the specifications to ensure correct rating.

References: Richards, B.[7]; Wentling, T. L. and Lawson, T. E.[8].

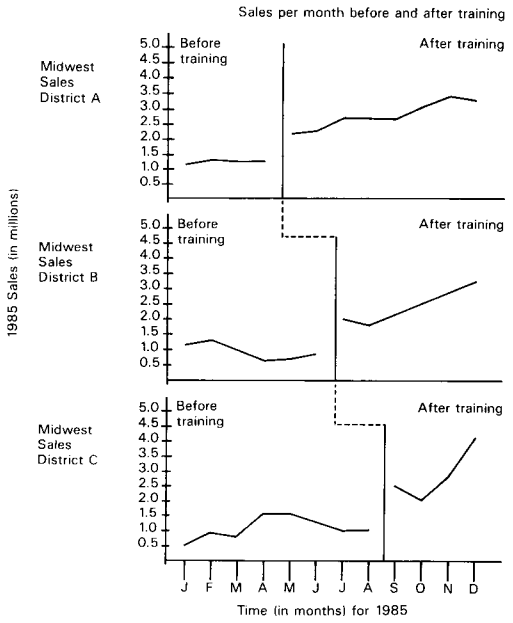
Figure 6. Performance Comparison Job Aid

TYPES:

1. *Employee Job Performance (samples):*
   . . . (same information as presented on the Performance Test)

2. *Organisation Performance (samples):*

The training staff decided to evaluate the effectiveness of the needs discovery training programme by considering whether training made an impact on 1985 sales. To conduct this evaluation, they utilised a design which examined sales volume per month across each sales district before training and after training. The length of the before and after training phases was contingent on the sales district of which the sales representative was a member. The staggered line represents the actual training programme which occurred over a two-day period. The following figure illustrates this method.



Comparative Manufacturing Productivity

Supervisor A		Supervisor B		Supervisor C	
Employee no.	Hrly. prod.	Employee no.	Hrly prod.	Employee no.	Hrly. prod.
1	163	11	194	21	172
2	149	12	138	22	137
3	118	13	137	23	136
4	108	14	131	24	135
5	106	15	110	25	127
6	93	16	89	26	100
7	60	17	61	27	56
8	57	18	49	28	52
9	42	19	48	29	41
10	30	20	41	30	28
Average	92.6	Average	99.8	Average	98.4

CONTENT VALIDITY:

(. . . does the test measure what it is supposed to measure?)

1. Determine if the organisation regularly collects data on the performance of the work group in the area under investigation.
2. Make sure that unit of performance selected is the same or a good approximation of the performance need specified in the original needs assessment.

RELIABILITY:

(. . . does the test yield consistent results?)

1. If using organisational records, enquire about the reliability of the data-collection methods.
2. Use controls such as comparison of group performance during earlier time periods before and after the programme.

References: Gilbert, T. F.[9]; Kusy, M. E.[3].

Figure 7. Cost-benefit Analysis Job Aid

TYPES:

1. *Cost Analysis*

Cost Analysis Worksheet

Forecaster _____ Date _____

1. Needs analysis/planning
   - Staff _____
   - External consultant costs _____
   - Materials _____
   - _____ _____
   - _____ _____
   - Sub-total $_____

2. Work behaviour analysis
   - Staff _____
   - External consultant costs _____
   - Materials _____
   - Sub-total $_____

3. Design
   - Staff _____
   - External consultant costs _____
   - Materials _____
   - External support costs _____
   - Sub-total $_____

4. Development
   - Staff _____
   - External consultant costs _____
   - Materials _____
   - _____ _____
   - Sub-total $_____

5. Implementation
   - Trainee _____
   - Facilities _____
   - Tuition/fees _____
   - Staff _____
   - Materials _____
   - _____ _____
   - Sub-total $_____

6. Evaluation
   - Staff _____
   - External consultant costs _____
   - _____ _____
   - _____ _____
   - Sub-total $_____

7. Total costs (sum of all sub-totals) Total $_____

2. *Performance Valuing*

Net Performance Value Calculation Worksheet

A. *Data Required for Calculations*

(a) What unit of measure was used to describe the performance? _____ (units)

(b) What was the level of performance per worker[2] at the conclusion of training? _____ (no.) _____ (units) per _____ (time)

(c) What was the level of performance per worker before training? _____ (no.) _____ (units) per _____ (time)

(d) What dollar value was assigned to each unit? $ _____ per unit (dollar value)

(e) How long was the training time to reach the goal (b)? _____ (no.) _____ (unit of time)

(f) How long was the evaluation period? (At a minimum this is the longest time of all options that were considered.) _____ (no.) _____ (unit of time)

(g) How many workers participated in the training? _____ workers (no.)

B. *Calculations to Determine Net Performance Value*

(h) Did trainees produce during training?
____ No = 0 ____ Yes = $\frac{b+c}{2}$ _____ (value of h)

(i) The number of units produced per worker during training = $e \times h$ _____ (value of i)

(j) The number of units produced by a worker during the evaluation period = $[(f-e) \times b] + i$ _____ (value of j)

(k) The dollar value of a worker's performance during the evaluation period = $d \times j$ $ _____ (value of k)

(l) The net performance value gained per worker = $k - (c \times d \times f)$ $ _____ (value of l)

(m) Do you want to calculate the total net performance value of all trainees?
_____ Yes = $1 \times g$ _____ No = 1 $ _____ (value of m)

3. *Cost-Benefit Model*

$$\frac{\text{Performance Value} - \text{Cost}}{\text{Benefit}}$$

CONTENT VALIDITY:
(. . . does the test measure what it is supposed to measure?)

1. Make sure the cost categories are the same as those regularly used in the organisation. Have someone in accounting and T&D department verify categories.
2. Make sure the unit of performance and its worth is reasonable and acceptable to the decision makers in the organisation.

RELIABILITY:
(. . . does the text yield consistent results?)

1. Double-check the individual numbers and their manipulation in the formula.
2. Have a second analyst prepare a cost-benefit analysis.

References: Geroy, G. D. and Swanson, R. A.[10]; Head, G. E. and Buchanan, C. C.[11]; Kearsley, G. and Compton, T.[12].

Figure 8. Effectiveness Evaluation Report

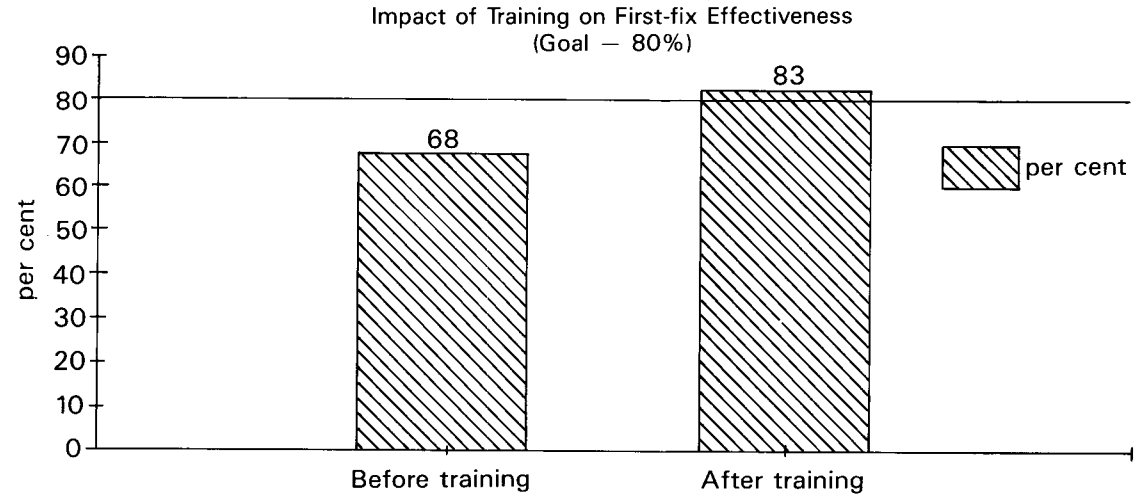
Programme Title: Circuit Troubleshooting
Programme Date(s): 20/2/86
Department: Technical Training Department
Prepared By: Mark Baber
Distributed To: James Birt, Mark Olser, Rob Drew

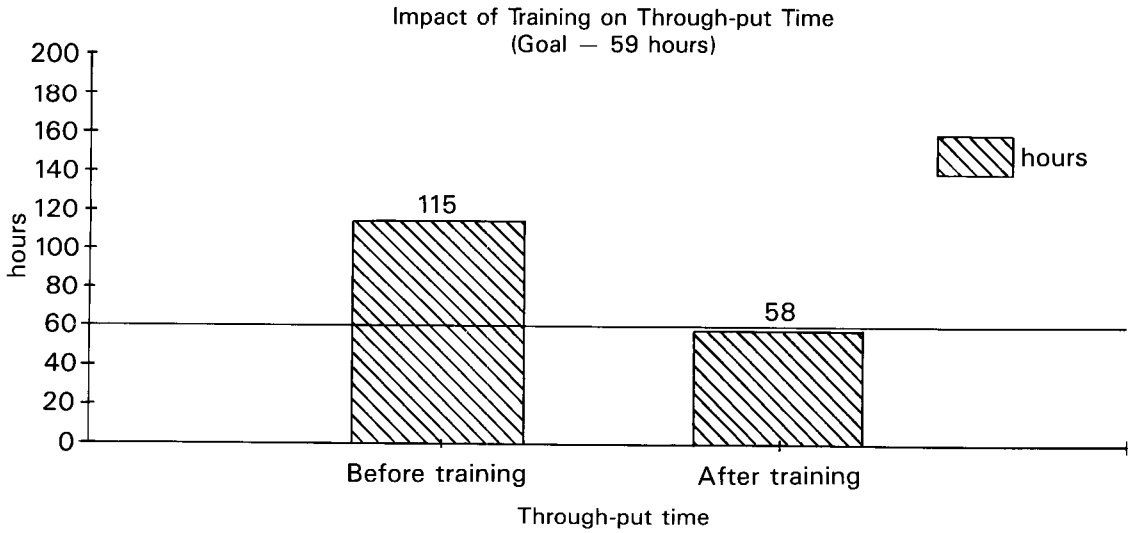
1. Original Employee/Organisation Performance Need
   The timeliness of repairs in the circuit areas was not sufficient to meet the schedule demands: average through-put time was 115 hours. The first-fix repair rate was 68% and the additional repair process resulted in equipment being unnecessarily damaged.
2. Employee/Organisation Performance Goal
   Training goals were a first-fix rate of 80% and an average through-put time of 59 hours. Availability of CE-4 insertion tools was expected to improve the through-put time by 4 hours and the revised part ordering system was expected to improve through-put time by 2 hours.
3. Approved Solution (Training and Non-Training Components)
   Peters approved circuit troubleshooting training for the 61 test technicians and indicated that CE-4 insertion tools would be available for all trainees. She also approved the implementation of the revised system for part ordering (Memo 1/86).
4. Effectiveness of Training
   The effectiveness of the Circuit Troubleshooting Training was measured from the perspectives of satisfaction, learning and performance.

   Satisfaction measurements were obtained from the trainees and from their supervisors. The trainees' mean rating for delivery effectiveness was 62%, the quality of information presented rating was 50%, and the usefulness of this training to their jobs rating was 90%. The overall management rating of this course was 70.5%.

   Learning during training was measured by a knowledge test and by performance in-training. The comparison of the pre- and post-test of knowledge showed an increase of 57.6% for the group. The in-training performance was measured with lab tests. The average trainee score was 96%.

   Performance measurements showed a 15% improvement for first-fix efficiency and a 57-hour improvement on through-put time. Cost-benefit analysis showed a training benefit of $715,365.
5. Evaluation Summary





The data represented in the graphs was obtained from the SQC records of the test department. The time period for the "before-training" data is 30 days and the time period for the "after-training" data is 45 days.

6. Improvement Proposal
   (i) Trainees indicated that they want more feedback on their performance during training. Instructors will respond to this suggestion.
   (ii) CE-4 insertion tools are still needed for approximately 10 test technicians.

In situations where there is one measure of performance, that measure becomes the performance score. In situations where both measures of performance are used and a composite score is needed, the total scores for both measures can be translated into like terms, or standard scores, added together and divided by two. Performance scores can be expressed in a variety of ways, including ratios, percentages, dollars and units produced. It is important to express performance measures in terms that have meaning to the organisation.

> The completed Effectiveness Evaluation Report...is a powerful tool for communicating the results of a training programme

Effectiveness Evaluation Report

TEE also includes systematic reporting of training programme evaluations. The report contains the categories of information that training and non-training managers must know in order to make sound decisions. The contents include the original employee/organisation performance need (described in 25-75 words), the employee/organisation performance goal (summarised in 25-50 words), the approved solution with both training and non-training components (described in 25-50 words), narrative summarising the effectiveness of the training (25-50-word descriptions each for the measures of satisfaction, learning and performance), an evaluation summary with visual presentation and/or comparison to performance goal, and an improvement proposal.

The completed Effectiveness Evaluation Report, as illustrated in the circuit troubleshooting training sample (Figure 8), is a powerful tool for communicating the results of a training programme. It provides the management decision maker with the necessary information for understanding the impact of a training programme.

Summary

The TEE provides tools for planning evaluations, gathering the effectiveness information and reporting the information. Through systematic analysis and reporting of effectiveness evaluations, training managers can ensure that their programmes contribute to their organisation's bottom line.

Notes

(a) It should be noted, however, that a composite score is questionable unless the individual test scores that comprise it come from tests with similar score units, standard deviations and levels of difficulty for test items. The composite score for two dissimilar tests is computed by determining the z-score for each test, combining the scores, and dividing by two. Additional discussion of z-scores, including the methods for computing them, can be found in Roscoe[5].

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