Training Technology System:
A Method for Identifying and Solving
Training Problems in Industry and Business

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The Training Technology System (TTS) provides an orderly means of
separating training from non-training problems and a means of systematically
solving training problems in industry and business. The TTS was first
developed in 1978 (Swanson, 1980; Swanson & Sisson, 1980) in response to
a private sector need for a comprehensive training system for all levels in
the firm and for all training content. For example, the levels encompass cor-
porate, regional, or site training and the potential training content spans
management, motivational, or technical work behaviors.

More and more, training and development are becoming crucial elements
for industry and business as firms begin to realize that employees are
resources who must be maintained and developed; this investment in human
resources is just as important as the investment in physical resources; but,
like all good business decisions, it should be cost-effective (Mosier, 1986).

Norman Willard (1973) encouraged management to accept training as
a regular part of doing business while Springborn (1977) explained that it
does little good to invest in computers, numerically controlled machines, tools,
or other sophisticated devices if a skilled work force is not available to operate
and maintain them.

One of the most often quoted perceptions about the need for training in
the 1980s comes from Odiorne (1979). He predicted the following demands
for trainers: (a) induction (orientation/socialization) training for 26 million
new employees who will replace those leaving the workplace, (b) skills train-
ing for six million new workers and retraining for an undefined number of
current workers who need to learn new skills, and (c) upgrading for three
to four million managers, both those entering the managerial ranks for the
first time and those making upward or lateral moves that require new skills.

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If these views are not enough to underline the need for inventive, creative, cost-effective ways of training and development, the American Society for Training and Development recently estimated that U.S. firms are spending between $30 billion and $50 billion annually to train their employees ("Industry spending," 1985). In view of these facts, resourceful managers should settle for no less than useful tools.

System Overview

The TTS is one of several education-for-work training systems reported in the literature. Most systems begin with a curriculum theory base. The military's Instructional System Development (ISD) system is the most widely known (Campbell, 1984).

The TTS is firmly rooted in the fields of economics and psychology and the more applied fields of management and education. Underlying the economic/management foundation is an assumption that training can increase profits. The record of the impact of systematic training in industry and business substantiates such a claim (Swanson, 1982c). Underlying the psychological/educational foundation is an assumption that learning can be efficiently and effectively managed. In practice, this may not be true for every program, but it is a reasonable expectation when expertise from learning theory and learning technology is systematically applied to training problems.

Most training and learning systems are grounded first, and sometimes only, in psychology. The TTS is unique because it is grounded in economics and psychology. Furthermore, the economic foundation is considered as important, if not more important, to the TTS as the psychological foundation. Another way of explaining this is that, from the TTS perspective, trainers are business persons first and trainers second (Swanson, 1985); their decisions must first make economic sense before they make psychological sense.

The TTS program of research and development has been funded by several firms, including Control Data Corporation, Hutchinson Technology, Inc., Kellogg Company, Manville Corporation, Minnesota Mining and Manufacturing (3M), Medtronic Corporation, Northern States Power Company, and Onan Corporation. The TTS has been proven successful because these firms also have used it on a day-to-day basis.

Integration of the practical realities of industry and business operations and the university's demand for rigorous inquiry have become the hallmarks of this system. While the general form of the TTS has not changed since 1978, the specific methods for implementing it have been under continuous refinement. Most recently, a program to develop and validate a method for forecasting the financial benefits of training has been pursued and integrated into the TTS (Geroy & Swanson, 1984; Prifrel, Swanson, & Geroy, 1985; Sleezer, Swanson, & Geroy, 1985; Swanson & Geroy, 1984). This forecasting
research is a follow-up to earlier cost-benefit analysis studies (Cullen, Sisson, Sawzin, & Swanson, 1976, 1978).

**System Phases**

To identify and solve training problems in industry and business, the TTS embraces five phases: (a) analyze, (b) design, (c) develop, (d) implement, and (e) control (Figure 1).

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**Figure 1.** Training Technology System

**Analyze**

The analyze phase focuses on (a) separating training from nontraining problems in an organization and (b) defining precisely what people need to know and be able to do to perform at work. These two discrete steps are called needs assessment and analysis of work behavior. During a needs assessment, needs are identified, causes are determined, solutions are studied, and plans are proposed. The TTS model (Figure 2) for organizational needs assessment considers (a) types of needs assessment, (b) causes of performance, and (c) data collection methods (Swanson, 1982b).
The model is implemented through an eight-stage process that results in a specific proposal for management consideration and approval. One predisposition of the TTS is that the majority of problems in an organization cannot be solved by training alone. Therefore, management approval of training typically is coupled with a commitment for support that goes beyond the training program.

Analysis of work behavior begins after the approval of a training proposal. General work behavior analysis (Figure 1) includes job description and task inventory analysis work and can be completed in relatively short time periods if there is ready access to the workplace and the subject experts. Specific work behavior analysis (Figure 1) determines precisely the knowledge and skill required to perform the tasks that make up the job. This analysis work is detailed, time-consuming, and at times very difficult. Three specific methods available to the analyst are (a) procedure analysis, (b) process and troubleshooting, and (c) subject matter analysis. Procedure analysis works best for analyzing “people-thing” work behavior such as machine operation, tool usage, and materials handling (Swanson & Murphy, 1981; Swanson & Gradous, 1986). Process and troubleshooting analysis works when focusing on “people-system” work behavior including information and hardware...
systems (Swanson & Sisson, 1983). Subject matter analysis is for non-
observable work knowledge including “people-people/people-idea” work
behavior (Swanson, 1981; 1982a).

The use of this systematic program for analyzing work behavior is a ma-
jor element of the TTS (Swanson & Sisson, 1985; Swanson & Gradous, 1986).
This analysis provides the basis for confirming the original program proposed
in the needs assessment and is the behavioral anchor for the design, develop-
ment, and evaluation of a sound training program. The TTS analysis tools
go far beyond traditional job and task analysis because they are capable of
specifying knowledge work and systems work. In doing so, these methods
never lose touch with the actual performances required by successful workers.

Design

The design phase includes both program design (Figure 3) and lesson
design (Figure 4). Program design is focused on matching the training pro-
gram to organizational needs and constraints. The decision-making process
emphasizes the economic/management foundations of training. While pro-
gram design includes a breakdown of individual lessons that make up the
program, lesson design is more directly linked to the psychology/education
foundations of the training profession. Eight variables are used to focus on
the lesson design process (Swanson, Sisson, & Summers, 1985). They are
1. Trainee Readiness
2. Objectives
3. Content Structure
4. Instructional Sequence
5. Rate of Delivery
6. Repetition and Practice
7. Reinforcement and Rewards
8. Knowledge of Results

The lesson takes its initial form as a lesson outline based on the work behavior
analysis and the eight design variables. The lesson outline is further
developed into a lesson plan which orchestrates the instruction in terms of
content and method. It is a document that is shared and used by a number of
trainers. In contrast, the lesson outline is an intermediate document that
is cryptic in nature.

Development

Training practices in industry and business require initial program design
to occur at the program proposal stage and then to be confirmed and/or revised
following the work behavior analysis. Similarly, training lesson design revi-
sions are made as development takes place. Lesson designs result in lesson
plans for instructor-based training or story boards for media-based materials.
Figure 3. Program Design

In addition, peer review and pilot testing of training materials usually result in revisions of the materials, lesson design, and/or program design. It is typical for industry and business to use the first group of trainees as the pilot test group. It is important that they be treated as such and that follow-up evaluation and revisions take place.

Implementation

The implementation phase of the TTS contains the training program management plan and the delivery of training. In the training management plan, course schedule, promotion, and management are systematically considered. Included in the TTS are specific methods for organizing all tasks required to implement a training program, such as when the task must be completed, who completes the task, and what specifications are for the task.
Figure 4. Lesson Design

For managing the actual instruction, a method for incorporating media, notebook materials, and handouts into the formal lesson plan and into a training materials storage system is advocated. When these management considerations are overlooked, a training program can be undermined.

Individually, each managerial task of the implementation stage is easy to complete, but just as easy to put off. The benefits derived from these tasks
are long-lasting returns in the form of time savings whenever a training program is repeated.

Delivery of training in the TTS is addressed at two levels. On the surface, all instructional content and method, including the management of minute-by-minute trainee and trainer activities, are specified, and the trainer is expected to execute the lesson plans. On a long-term basis the evaluation step of the control phase determines discrepancies between what was intended, what happened, and what needs to be done to improve the program. During the instruction, a traditional four-step job-instruction training method is used to guide trainer-trainee interactions:

1. Trainer prepares the learner
2. Trainer presents the material
3. Trainee practices the materials
4. Trainee is tested for understanding

Beyond these general steps, the TTS identifies 31 specific training methods. Each method requires instructor skills that can best be described as an artistic smorgasbord of human interaction skills.

Control

The control phase of the TTS includes (a) evaluating and reporting the effectiveness of training, (b) revising training, and (c) maintaining trainee behavior once trainees are back on the job. Evaluation, the major step in the control phase, consists of an effectiveness evaluation plan, tools for measuring training effectiveness, and the evaluation report.

In effectiveness evaluation, planning decisions are made about which tools will be used to assess whether the training program produced the desired results. Four questions represent levels of training effectiveness and are asked of every training program:

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

Three categories of evaluation tools are considered for gathering the information needed to answer the evaluation questions. These tools measure (a) satisfaction, (b) learning, and (c) performance that result from the training. The satisfaction score is an indicator of how pleased trainees and their supervisors are 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 organizational or economic accomplishment resulting from the training program. The economic evaluation compares financial costs and benefits of training.

Effectiveness evaluation includes reporting the results of the training program to management. The report contains summative information that
managers need to make good decisions. It provides a decision maker with the necessary information for understanding the impact of a training program in satisfaction, learning, and performance.

One major purpose of evaluation information is to provide a sound basis for training program revisions. Program revisions need to be made in an orderly and timely manner and should be based on reliable and valid evaluation data.

Maintenance of trainee work behavior back on the job can range from a follow-up memo highlighting training content to a formal follow-up assessment of trainee/worker work behavior to determine if additional or refresher training is needed. This latter case can take the form of a new needs assessment and proposal for follow-up training. Reporting back to management for continued approval of training programs causes top management to reassess continually and recommit to training; it also causes the trainer to reassess and commit to a viable set of priorities.

A Critique of the System

The TTS creates one-of-a-kind products with each training program being built to individual specifications. The TTS assures that the correct tasks are performed in the appropriate order. Process control techniques are used to insure that all training programs are constructed to predetermined standards. Work is reviewed during construction so that errors can be identified and corrected before they adversely affect the next step of the program. Using process control at the TTS phase and step levels increases the odds that the training program will be effective.

The TTS is broader than most training systems because it covers areas ranging from organizational needs assessment and the economic impact of the training. Many rival systems begin with the assumption that training is needed and will solve a problem; the TTS does not. Others start further down the line by assuming that not only is training needed, but the person organizing the training program is a subject expert; the TTS does not. Other systems eliminate needs assessment and analysis of work behavior which are vital to the TTS. Evaluation in many systems is restricted to measuring learning objectives; evaluation in the TTS is not. The TTS assesses both learning objectives and ways the training program supports the organization’s business and financial goals.

Many of the curriculum theory models are fixed on evaluation “proxies,” such as learning objectives rather than organizational performance or work behaviors. Additionally, some systems dissect learning behaviors into domains (e.g., cognitive, psychomotor, and affective) in a manner that does not parallel the wholistic work performance actually required on the job.

Beyond the noted differences, the greatest strength of the TTS is also the greatest strength of several other training systems available to industry and
business. That is the systematic approach they take to the complex work of identifying and solving training problems. Without such a system, employee training is likely to be inefficient and ineffective.

References


Industry spending billions to reeducate labor force (1985, March 25). Minneapolis Star and Tribune, pp. 7B, 14B.


