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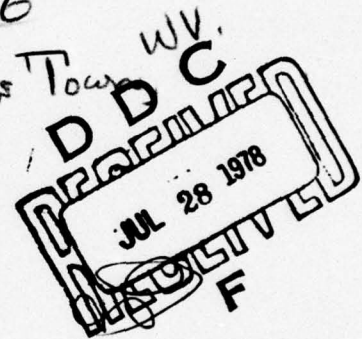
"MAINTENANCE OF PERFORMANCE EFFECTIVENESS"

February, 1978

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SUMMARY

The workshop to explore the practices of the civilian sector in developing and maintaining personnel effectiveness emphasized the following key points.

1. Performance problems must be dealt with at the level of specific problems. They are not amenable to general solutions.
2. Training is often not the only solution, or even a suitable solution to performance problems.
3. Solutions to performance problems must include the supervisors of the employees. The supervisor's performance is crucial to the maintenance of effectiveness.
4. While technology can provide valuable assistance to the supervisor in the development and maintenance of effectiveness, technological solutions, by themselves, do not work.
5. Normative models such as retention curves are not used by the civilian performance problem solvers to set individual training or practice schedules.

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MAINTENANCE OF PERFORMANCE EFFECTIVENESS

1. BACKGROUND:

The Army's primary peacetime mission is to maintain a state of readiness to engage in combat effectively on short notice. Many of the skills soldiers must use to achieve the mission may never be exercised or fully trained except in actual combat. Organizations in the civilian sector face an analogous problem in the event of natural or technological disasters such as forest fires, power failures and epidemics. As is the case for the Army, normal operations for these organizations do not exercise or maintain the requisite skills. On February 9 and 10, 1978 the US Army Research Institute for the Behavioral and Social Sciences conducted a workshop to explore whether the civilian sector uses some successful techniques which are applicable or adaptable to the Army.

The civilian sector workshop participants included representatives from two industrial firms, a power utility, and two government agencies. Army research and operational representatives interacted with them in addressing questions which included:

- a. What are the most efficient procedures for the acquisition and maintenance of proficiency?
- b. How often do tasks have to be performed, evaluated or trained to ensure perfect performance when required?
- c. If a task is performed infrequently and not evaluated in regular activities, how should the Army Supervisor or Commander intervene?

Position papers were prepared on the basis of interviews with the nonmilitary participants, (See Appendix 1). Problem case studies were prepared by the Army, (See Appendix 2). The workshop was conducted as a series of discussions based on the position papers and case studies.

2. WORKSHOP PARTICIPANTS:

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MAINTENANCE OF PERFORMANCE EFFECTIVENESS

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3. KEY POINTS OF DISCUSSION:

a. WHAT ARE THE MOST EFFICIENT PROCEDURES FOR THE ACQUISITION AND MAINTENANCE OF PROFICIENCY?

Much of the discussion focused on training as a means of acquiring and maintaining job competence. The civilian participants, however, regarded training as only one of a range of solutions, to be selected through use of a performance problem solving approach. While the specifics of practicing a performance problem solving approach differ among practitioners and circumstances, certain considerations are common:

- What are the indicators that make the manager say that there is a problem? These indicators relate to the accomplishment of organizational purposes or objectives. They must point to specific problems.

- What about performance contributes to the problem? Is there a failure to perform? What is its cause?

Does he know he should do it?

Does he know when to do it?

Can he tell the difference between correct and incorrect performance?

Can he do it if asked?

Can he do it in the real environment?

Does he have the resources -

time?
information?
material?
support?

Does he have conflicting priorities?

- What are the specifications and evaluation criteria for

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the specific task to be performed? These are determined through task analysis. For example, see the Soldier's Manual for the specific performer.

- What are the elements that contribute to the desired accomplishment and what is the quality of their contribution?

For example, "How often do tasks have to be performed to ensure perfect performance when required?" would be explored to find whether a specific task can be performed correctly when required. Contributing to "perfect performance in a specific task when required" are the elements of initial acquisition, practice (initially and over time), task assignment, supervision and evaluation, the conditions under which the performance is required, and who is the performer.

It must be emphasized that a performance problem solving approach deals with specific problems. Once the cause has been established, alternative solutions become evident. In many cases, training is not the only solution, or even a solution at all. In most cases, supervisory practices are, at least, a contributing cause and a component of the solution. The range of solutions to performance problems includes:

(1) ENGINEERING:

Example: The Forest Service solved a problem of radio communication during wildfire suppression by providing people with radios that would only operate on a frequency assigned exclusively to their chain of command.

Example: Ford Motor Company managers may elect not to acquire equipment which they believe to be beyond the capability of their employees to operate or maintain. (Appendix 1, p. 11).

Army application: To compensate for lack of practice opportunity after initial training, engineer out the need for Morse Code proficiency by providing hardware coding/decoding in the radio-teletype equipment. (Appendix 2, I).

(2) REVISION OF POLICY:

Problems are the difference between what management wants and what it gets. In some cases the solution is to change expectations by changing policy.

Example: The performance of a meat and poultry inspector has significant effects on the productivity of the meat processing plant. The performance required must not impede production. When a specific

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inspection interferes with plant production the standards are reviewed. If the standard is found to be excessively stringent, policy is changed. (Appendix 1, p. 6).

Army application: The conflict, in the TOW case (Appendix 2, III), between "It is imperative that the section leader have the ability to coordinate the actions of the two squads at all times" and the probable loss of all communication, could be resolved by changing doctrine to require the necessary and sufficient decision capability in every man so that the two squads can become effectively autonomous when communication with the section leader is lost.

(3) JOB DESIGN:

Job aids are an important part of job design. They change the decision making requirements of the performer. They are used so extensively in the civilian industrial and consumer sectors to deal with performance problems that they are often taken for granted.

Example: Detailed specification of the job of the Meat and Poultry inspector, supported by check lists and other job aids, effectively has changed the job of both the inspector and his immediate supervisor. The supervisor now has a basis for checking whether certain inspections have been performed (by looking at the entry on the checklist) when there is no other visible evidence of whether or not they have been done. (Appendix 1, p. 5).

Army application: Use of fully proceduralized job aids for troubleshooting equipment changes the job of repairman. Troubleshooting without such aids is a cognitive, decision making task; with job aids it is a simpler, procedural task. The Army's Integrated Technical Documentation and Training (ITDT) Program provides the opportunity to change the job and training requirements of maintenance personnel.

(4) SUPERVISION:

Example: The performance is that of inexperienced people in wild-fire line crews. The supervisor is given support materials to enable him to evaluate performance and to conduct training. The performance is developed and maintained by paying attention to the supervision of the performance. (Appendix 1, p. 4).

Army application: The application is universal. All the civilian participants emphasized that it is not good to train people if their immediate supervisors do not supervise (make assignments, inspect quality of work and provide feedback) the specific performance. This requires training supervisors and providing them with the support materials to enable them to do the supervisory job.

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(5) PERSONNEL:

Example: Ford Motor Company is not able formally to evaluate qualified journeymen. When a journeyman is assigned a task and is found to be incompetent in that task, he is not assigned that task again. The judgment is an informal one made by the supervisor. There are enough different tasks to be performed to make selective assignment possible without loss of productivity. Selection tests are used for the selection of apprentices and performance is evaluated at every step in the apprenticeship program (see Appendix 1, p. 9).

Example: The Forest Service qualification and certification program for people involved in wildfire suppression regards training as both a development and a selection process. Those who don't qualify don't get the certificate and don't get the assignments. (Appendix 1, p. 2).

Army application: It is probable that some of the performance of soldiers such as the forward observer (Appendix 2) depends on personal qualities that must be selected - it is unlikely that competence can be developed in some people without the necessary entering qualities.

(6) TRAINING:

Training is, of course, one of the possible solutions to performance problems. The civilian participants demonstrated a wide variety of forms of training: centralized institutional; conventional classroom; self-instruction in classroom and decentralized; experiential learning; on-the-job training, both structured and informal. The common feature of all their training efforts is that they are based on analysis of specific performance problems and the resulting task specifications with criteria for evaluation.

Example: The job of the fire boss has been so redesigned that his training no longer involves a visual simulation of a forest fire, but does involve extensive simulation of the management decision making involved in controlling and directing a large fire fighting force. (Appendix 1, p. 1).

Army application: The decision-making aspects of Electronic Counter-Countermeasures could be partially simulated. Training and practice with simulated information flow and decision-making pressure are useful preparation for combat conditions as in wildfire command center simulation (Appendix 1), where no attempt judged necessary to simulate the fire.

(7) DO NOTHING:

The civilian participants recognize that some performance problems

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cannot be solved or are not worth solving. For example, an engineering solution is available for starting up combustion generating equipment, but it is not cost effective. Once a performance problem is considered formally and a decision made to do nothing, this is a solution to the problem!

b. HOW SHOULD THE ARMY SUPERVISOR OR COMMANDER INTERVENE?

All the civilian participants emphasized the crucial role of the supervisor in the development and maintenance of competence. They all have had experience with developmental programs which produce competent people but because of supervisory practices their competencies are not used. Any program for developing and maintaining competence must build managers and supervisors into the system.

Example: The supervisors of meat and poultry inspectors are given job aids for evaluating the performance of inspectors. On the basis of these job aids, supervisors routinely evaluate performance and report on deficiencies. These reports form the basis of need identification for initiating performance problem solving activity. (Appendix 1, p. 6).

Example: The supervisors of Forest Service line crews are given materials for conducting "tailgate sessions" for the purpose of evaluating employee knowledge and skill and for conducting instruction to remedy any deficiencies that they detect.

Example: The evaluation of the developing competence of apprentices in Ford Motor Company is done by the apprentice's immediate supervisor on the basis of the task specifications in the Apprentice Training Guide. (Appendix 1, p. 9).

Example: Pennsylvania Power and Light Company builds supervisors into its training and evaluation programs. Many ongoing training programs are implemented by supervisors using prepared support materials. (Appendix 1, p. 14).

The key to the acquisition and maintenance of competence in the Army is the role of Officers and NCOs as supervisors. NCOs must have opportunities to evaluate and correct the performance of their subordinates. The organization of such opportunities involves decision making, specific knowledge of the performance expected of each subordinate, and often complicated scheduling. To do the job effectively, the NCO needs delegated decision making capability. This in turn requires a framework for delegation and monitoring the discharge of delegated authority. If one examines the Soldier's Manual for an NCO one finds little mention of the tasks of the NCO as a supervisor. For example, Soldier's Manual FM 9-45K 3 TANK TURRET REPAIRMAN, SKILL

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LEVEL THREE, page 4-IX-21 is entitled "PERFORM INSPECTION AND SUPERVISE ORGANIZATIONAL MAINTENANCE OF" but the task description has nothing to do with inspection and supervision. The task description deals with doing the job - not with supervising others who are assigned to do the job. In fact, the description is that of a super technician. This has the effect of putting the NCO in the position of competing with his subordinates for opportunities to demonstrate competence instead of developing their competence and concentrating on his competence as a supervisor. The Soldier's Manual 11B40 - Infantryman, Skill Level 4, also confuses the performance of a task or operation with supervising the performance. Page 2-I-B-18, "SUPERVISE USE OF UNIT RADIAC EQUIPMENT" provides an extensive theoretical treatment of the subject. It is not task oriented and provides no direct treatment of the tasks of the supervisor and criteria for evaluating supervisory performance.

The differentiation of rank based on technical expertise and rank based on management or supervisory responsibility is an old problem in both the civilian and service sectors. Failure to make the separation leads senior managers to assume they have a hierarchical management system when, in fact, they have no lower level or first line management.

Page 4-IX-22 of the Soldier's Manual 45K 3, Skill Level 3, describes the task of the NCO as supervisor. In this task he has one subordinate. The four performance measures begin with either "Instruct repairman to.." or "Direct repairman to ..". The NCO is explicitly told that his job is to "tell his subordinates what to do" -- step-by-step. Supervision and management are not "telling people what to do" but the more significant jobs of getting people to deliver the expected accomplishment. The NCO must be held "accountable" for the competence of his subordinates. "Accountability" as used in the management philosophy of the civilian sector is the responsibility for paying attention to results and accounting for, or correcting, any difference from the expected results.

Making managers and supervisors accountable for the performance of their subordinates is an essential element of a system to develop and maintain the competence of the subordinates. This does not mean supervisors are to blame for any lack of competence of subordinates. It means they are responsible for paying attention to the competence of their subordinates, for detecting any deficiencies and either doing something about it or arranging for something to be done. Implicit in the interrelationship is the necessity for the supervisor to be accountable for the competence of the subordinate and to be capable of inspecting the subordinate's performance.

c. HOW OFTEN DO TASKS HAVE TO BE PERFORMED, EVALUATED OR TRAINED TO INSURE PERFECT PERFORMANCE WHEN REQUIRED?

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None of the civilian participants use normative models such as fixed schedules, learning curves or retention curves for timing individual training or practice. The participants feel that such models are insensitive to individual differences and lead to expensive and inefficient solutions to performance problems. The detection and correction of loss of competence is an ongoing supervisory function that deals with the priorities of specific tasks, and adapts to differences among individuals.

Example: The California Division of Forestry reports that 80% of those who were given a pass/fail performance test of Cardio/Pulmonary Resuscitation (CPR) 90 days after training failed the test (incorrect rate or volume as indicated by the mannequin used for the test). Follow-up on the 20% who passed the later test showed that their supervisors gave high priority to practicing CPR and maintaining performance levels. (Appendix 1, p. 1).

Example: The Meat and Poultry Inspection Service uses self-instructional guides as performance aides to counteract skill loss. The guides use a format where each inspection procedure is broken down into a sequential series of questions subject to a yes or no response. Each question and answer step is supplemented with detailed drawings depicting the key elements of the procedure. (Appendix 1, p. 5).

Example: In the Ford Motor Company Apprenticeship Program competence is not evaluated except when performance of a task is required. When a lack of competence is evidenced management responses vary. (Appendix 1, p. 8).

Example: On the basis of experience the linemen in the Pennsylvania Power and Light Company say they need refresher instruction and practice in Cardio-Pulmonary Resuscitation (CPR) and hand-line lowering on a six-month cycle. (Appendix 1, p. 15).

The civilian practice, with respect to evaluation of individual competence, differs markedly from the Army practice of a super-imposed evaluation system. In the Army, Skill Qualification Tests (SQT) are conducted every two years by teams of evaluators. A near relation of the Army system of SQT evaluation by external evaluators is used by AT&T. The results of the external evaluation are fed back to the immediate managers and supervisors and produce intense evaluative and corrective action by the immediate supervisors. The results of the external evaluation are used as an index of the performance of the managers! The use of the Army evaluation data varies locally by battalion, but, on a national scale, the data are used in making individual personnel decisions, including promotion and retention.

d. HOW DO YOU APPLY PERFORMANCE TECHNOLOGY:

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The discipline that provides solutions to performance problems and leads to developing expertise in the problem solvers, is a pragmatic one. The discipline is applied to correcting the cause and solving the problem:

Describe the intent of further work - what you are trying to accomplish.

Specify how you will tell if you have accomplished your intent - the measures or indicators you will use to evaluate the accomplishment.

Do whatever you think best, given the state of your knowledge of "useful tactics" and of the problem.

Evaluate the outcome of what you did - pay attention to the measures or indicators to see how much you accomplished.

Do what is necessary to improve the accomplishment until you accomplish acceptably close to what you had intended.

This exploratory, or trial-and-test approach is remarkably efficient if carried out as a discipline. It accounts for much human accomplishment and virtually all the development of expertise in performance problem solving. The most difficult part is in identifying the measures or indicators that will be used to evaluate accomplishment. These are usually derived during the problem identification phase. This is one area in which experts can be useful to the developing performance problem solver.

It is strongly suggested that this discipline, applied by officers and NCOs with the support of some experts in performance problem solving, will do much to solve the Army's problems related to the acquisition and maintenance of competence. The "useful tactics" are in existence, waiting to be exploited - what is needed is a coherent system for exploiting them.

4. RECOMMENDATIONS:

a. Effective performance problem solving requires that one deal with specific problems for which there are specific indicators or evidence.

This has two implications:

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- (1) Before considering training as a solution to problems of acquisition and maintenance of competence, apply the performance problem solving approach and identify specific performance problems.
- (2) Once a specific performance problem has been identified, consider the full range of possible causes - not just the possible "inadequacy" of the performer - and the full range of possible solutions (discussed on pages 5 to 7).

b. ASSIGN ACCOUNTABILITY FOR COMPETENCE:

Make Officers and NCOs accountable for the competence of their subordinates. This means that they will be responsible for paying attention to the performance of their subordinates, detecting any deficiencies from expected performance and doing something about it. If they don't have the knowledge or resources needed to correct the deficiency, their responsibility is to take steps to secure the necessary expertise or resources or report the performance problem as a specific performance problem solving need.

c. REVISE SOLDIER'S MANUALS FOR SUPERVISORY LEVELS:

The inadequacies of the Soldier's Manuals for supervisory levels are discussed on pages 10 and 11.

As an immediately practical and widely beneficial step, revise the Soldier's Manuals for supervisory levels to define the inspection and supervision tasks of the NCO. It is highly probable that doing this for a comparatively small number of Soldier's Manuals (ten or twelve) will reveal a pattern that will enable the remainder to be done without further input from experts in performance and management technology.

d. INVOLVE OFFICERS AND NCOs IN PERFORMANCE PROBLEM SOLVING:

When dealing with performance problems, assign those with experience and responsibility in the problem area to the problem solving team. Provide experts in performance problem solving as a resource to the team.

Superimposed technological approaches to solving performance problems do not have a record of success. When you get down to it, the continuing commitment of line managers and supervisors to developing and maintaining the competence of their subordinates is crucial to success.

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e. USE TECHNOLOGY TO PROVIDE SUPPORT TO OFFICERS AND NCOs:

Use technology to:

- (1) Define the role of Officers and NCOs as managers and supervisors - with criteria that will permit both self appraisal and evaluation by supervisors.**
- (2) Define the performance of subordinates in a way that will facilitate the evaluation of performance by immediate supervisors.**
- (3) Provide technological support for organizing and monitoring the ongoing evaluation of performance, the necessary training and practice, and for identifying needs for performance problem solving activity.**
- (4) Provide the technological support that will enable Officers and NCOs to be effective in the training aspects of their role - for example, by providing lesson plans, visuals and other materials.**

BRIEF DESCRIPTIONS OF TRAINING METHODS AND EXPERIENCE

1. U.S. FOREST SERVICE
2. USDA MEAT AND POULTRY INSPECTION
3. FORD MOTOR COMPANY
4. PENNSYLVANIA POWER AND LIGHT COMPANY
5. A CASE STUDY IN THE USE OF JOB AIDS

U.S. FOREST SERVICE
NATIONAL WILDFIRE COORDINATING GROUP

Michael Bowman

THE PERFORMANCE SITUATION

Wildfires may require the deployment of as many as 25,000 people brought to the scene from all over the country for a period of up to 20 days. The total task force on an individual fire is managed by six person teams - the Fire Boss and five immediate subordinates. This six person team is trained together and assigned together. The organization is indicated by the attached organization chart. Other members of the organization will be drawn from available resources and may not have previously worked together.

The six person team is responsible for acquiring and assessing intelligence, evaluating the relative value of resources that may be destroyed and will be required to conserve them, deciding upon and planning courses of action. The implementation of the courses of action then is assigned to the next level of (middle) management.

There are currently about 50 such six person teams and assignments to wild-fire suppression may occur at intervals of two years or more.

METHODS USED

The National Wildfire Coordinating Group is made up of representatives of the US Forest Service, the Bureau of Land Management, the National Parks Service, the Bureau of Indian Affairs, the US Fish and Wildlife Service, and the National Association of State Foresters. This group has established a single qualification and certification system for those who will be involved in wildfire suppression. These certified must meet specified standards with respect to Training, Physical Capability, Demonstrated Performance and Experience.

The training curriculum is about 1,000 hours from entry level to Fire Boss. It is based on specifications of job performance requirements from which are derived task specifications, instructional objectives and evaluation criteria. A variety of instructional methods are used, each supported by detailed instructor's guides and student workbooks.

Six man teams who have reached the qualifying requirements attend the National Fire Training Center in Arizona for two weeks. A significant part of the program uses simulation to achieve designed purposes related to gaining skill and experience and to the evaluation of competence. There is no simulation of wildfires (this is used for middle managers) but extensive

simulation, in real time, of the information flow, decision making pressure and developments that are experienced in a wildfire command center. It should be noted that training is regarded as both a developmental and a selection process. Those who fail to meet performance criteria do not get certificates. While the deficiencies are specified, in many cases candidates are not given further instructional and experiential opportunities to remedy the deficiencies.

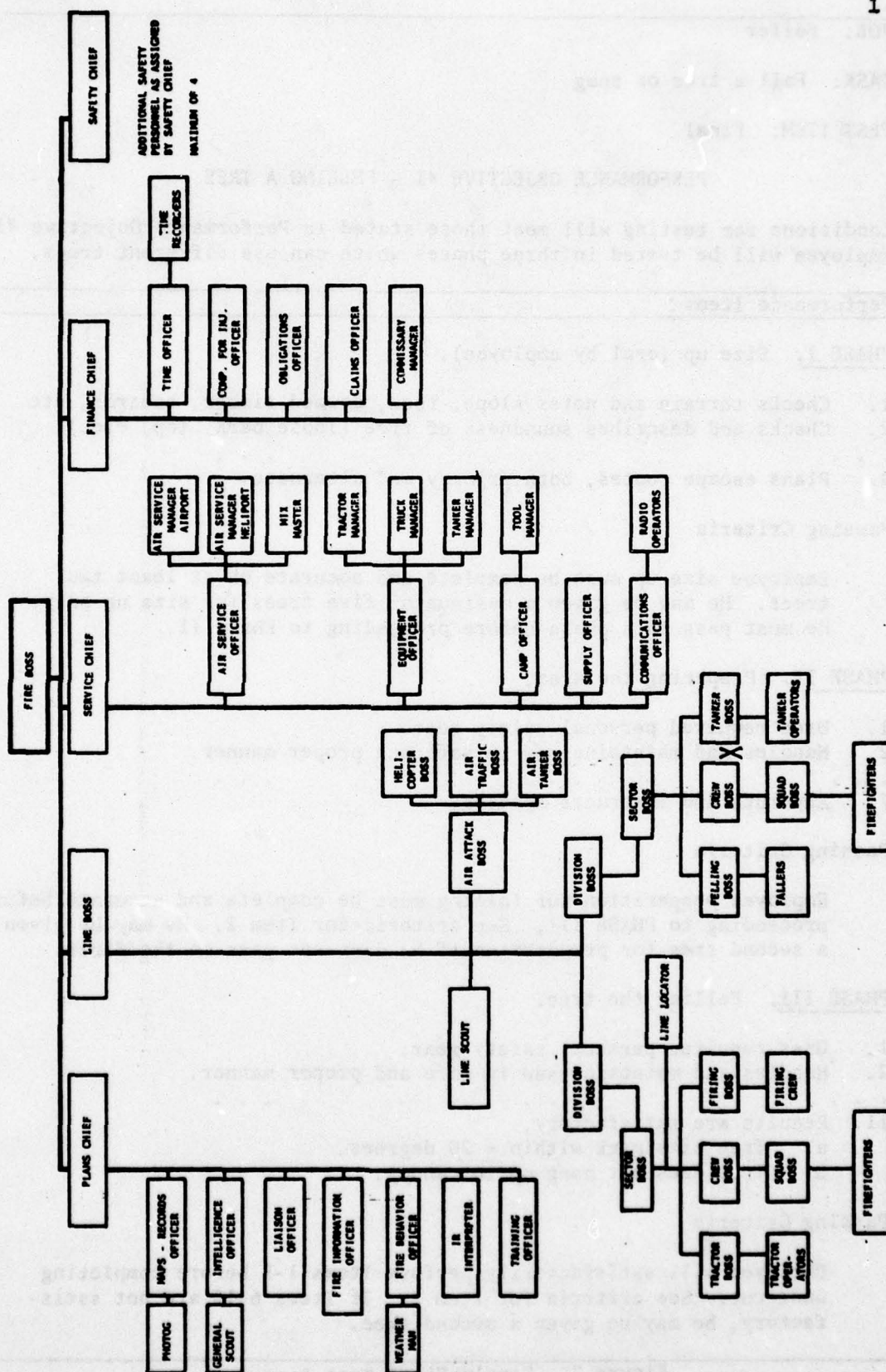
Evaluation continues on the job. After a fire suppression activity, the performance of those involved is evaluated and certification may be revoked. The Coordinating Group member agencies are currently considering limiting the number of teams that are trained and certified to a number that can be expected to have opportunities to maintain the experience requirements for continued certification.

PROBLEMS EXPERIENCED

Jim Simmons of the California Division of Forestry reports that 80% of those who were given a pass/fail performance test of Cardiac/Pulmonary Resuscitation 90 days after training failed the test (incorrect rate or volume as indicated by the mannequin used for the test). Follow-up on the 20% who passed the later test showed that their supervisors gave high priority to practicing CPR and maintaining performance levels.

CONTRIBUTING MODELS AND THEORIES

Training, performance evaluation and certification are based on objective measures of job performance requirements. The evolution of the qualification and certification program has addressed management first and then extended to the more technical skills. The evaluation of competence is done both during training and on the job at every stage of career development. Those who fail to qualify don't get, and even lose, their certification. Sample job, task and evaluation specifications are attached. A manual has been developed for course development and format guidelines. A prototype evaluation system is also being developed for use at the local level.



JOB: Feller

TASK: Fall a tree or snag

TEST ITEM: Final

PERFORMANCE OBJECTIVE #1 - FELLING A TREE

Conditions for testing will meet those stated in Performance Objective #1. Employee will be tested in three phases which can use different trees.

Performance Items

PHASE I. Size up (oral by employee).

1. Checks terrain and notes slope, rock, downed timber, hazards, etc.
2. Checks and describes soundness of tree (loose bark, top, etc.).
9. Plans escape routes, both primary and alternate.

Passing Criteria

Employee size up must be complete and accurate on at least two trees. He may be given a maximum of five trees for size up only. He must pass this phase before proceeding to Phase II.

PHASE II. Preparing the area.

1. Uses required personal safety gear.
2. Handles and maintains saw in safe and proper manner.
7. Appoints and instructs spotter.

Passing Criteria

Employee preparation for falling must be complete and accurate before proceeding to PHASE III. See criteria for Item 2. He may be given a second tree for preparation if he does not pass on the first.

PHASE III. Felling the tree.

1. Uses required personal safety gear.
2. Handles and maintains saw in safe and proper manner.
11. Results are satisfactory.
 - a. Tree hits mark within + 20 degrees.
 - b. Tree does not hang up in canopy.

Passing Criteria

Employee will satisfactorily perform Items 1-5 before completing undercut. See criteria for Item 2. If Items 6-10 are not satisfactory, he may be given a second tree.

MEAT and POULTRY INSPECTION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

Dr. Richard Lincoln
Assistant to the Director
Program Training Staff

THE PERFORMANCE SITUATION

A. The U.S. Department of Agriculture employs about 10,000 federal inspectors of meat and poultry. They inspect meat-handling facilities all over the U.S., including meat packing plants, slaughterhouses and ports of entry (for imported meat). Meat packing is big business. The plants are commercial enterprises with strict production quotas. The meat inspectors perform in a very visible role, with constant time pressure. Their adversary relationship with the meat packers demands that they be supported, not only by their own experience and judgment, but by standards which are as well-defined and objective as possible.

B. Until self-instructional guides were introduced about four years ago, training of meat inspectors was quite traditional. They were given several weeks of formal training at a USDA school in Fort Worth. Refresher training consisted mainly of reference by the individual inspector to various manuals which interpreted the standards in federal laws and regulations.

METHODS USED

A. Formal classroom training is gradually being replaced by self-instructional guides. Examples of these will be available at the conference. The guides are usually developed in response to a specific problem area which indicates a need for improved performance by inspectors. This could be a routine performance measure, such as the number of errors on sanitation reports, which is out of tolerance; or it could be in response to a specific crisis, such as an outbreak of salmonella in Georgia.

B. The self-instructional guides are quite similar to job guides or job performance aids. They are the product of an exhaustive task analysis. The content must be agreed to by a variety of experts at various levels of responsibility in USDA. Experienced and successful inspectors assist with the development. The guides use a format where each inspection procedure is broken down into a sequential series of questions subject to a yes or no response. For example:

"G. Is each piece or package marked with the country of origin's official mark of inspection?

NO - Refuse entry into the United States because of improper marking. Notify the applicant. Turn to Step 10.

YES - Continue to H. "

Each question and answer step is supplemented with detailed drawings depicting the key elements of the procedure.

C. The self-instructional guides have proven themselves. Both the inspectors and USDA management prefer them to the old manuals. They have replaced a significant portion of the formal instruction. Their principal advantages are:

1. They are very definitive. The old manuals left many vague areas subject to the inspector's judgment. These were a constant cause of disputes with the packers and other "customers".
2. They result in better control and standardization of procedures where the penalty for error is high.
3. They supplement memory where it is unreliable, such as when a procedure is performed infrequently (inspecting imported beef from Argentina) or involves meticulous measurements (specification for the welded seams on meat handling tables).
4. They have proven more effective than any teaching technique in guiding the performance of complex tasks.
5. They require an exhaustive task analysis. This exposes logical or substantive errors in the governing directives. USDA regulations have been changed as a result of this analysis.
6. The behavior and terminology is broken down to a level where laymen can understand it.

D. The process used by the Meat and Poultry Inspection Service to validate the guides is interesting. They bring in a group of high school students with no previous experience, either with USDA or on a farm. After studying the guide, they use it in a live test in a meat packing plant. Revisions are made in areas where they have difficulty.

E. "Vindication" of the guides is a measurement process separate from validation. The same measurement process which surfaced the performance problem and prompted development of the guide is used to measure its effectiveness. For example, if 50% of the sanitation reports had contained errors, a target of 5% is established. Progress toward this goal is measured after the guide is distributed to the inspectors.

PROBLEMS EXPERIENCED

A. Agreement on the task analysis for each procedure is difficult to achieve. Typically, 4-6 months is required to achieve consensus.

B. The inspectors cannot use the guides in certain situations. For example, an inspector would lose credibility if he were to leaf through a procedure guide in front of a "customer". USDA is experimenting with various miniature forms for checklists, similar to the crib notes used by college students or football quarterbacks.

C. The inspectors prefer a pocket-size format rather than the standard (8.1/2"x11") size guide.

NOTE: For ten years Dr. Lincoln developed self-instructional guides and other training techniques for health professionals at the Center for Disease Control in Atlanta. He developed a course for nurses and doctors on medical response to disasters. Included in this was a wallet-sized card covering the essentials of triage (segregating badly injured victims for priority treatment) and other emergency medical procedures.

FORD MOTOR COMPANY
Jerry Girtman
Management and Technical Training

THE PERFORMANCE SITUATION

Production equipment is maintained and repaired by journeymen in trades such as Machine Repair, Industrial Electricity, Millwright, Plumbing-Pipefitting. Maintenance and repair involves diagnosis of the cause of malfunction, followed by repair or replacement of components and adjustment.

In all plants, maintenance journeymen are supervised by maintenance foremen. These journeymen may operate from a central location in a plant and be assigned to jobs as they arise, or they may operate from an outpost that deals with a specific production area and specific type of equipment.

The large number of different maintenance tasks and the high volume of many tasks in Ford Motor Company plants make it possible to assign journeymen in ways that make widely different demands on their skill. For example, one electrician may work full-time on building servicing, while another may work on a variety of production equipment which is highly technical and frequently undergoing technological change. In the one case, the job is routine, technologically stable and similar tasks are performed frequently. In the other case, the job frequently raises a variety of diagnostic problems, the equipment is technologically complex and subject to technological change, and some tasks are required to be performed only at long intervals. For example, electronic control devices tend to go for long periods without failure.

METHODS USED

1. ACQUISITION OF COMPETENCE

During the mid-1960s, the number of apprentices in training totalled slightly over 3,000. This has been reduced to slightly over 2,000 at the present time. As a consequence, the apprenticeship program now produces something less than 30% of the required intake of journeymen. The balance are hired, as journeymen, from the outside. The acquisition of competence is different for the two groups.

1.1. THE APPRENTICESHIP PROGRAM

- A. Selection. In recent years, apprentices have been selected from existing employees of the company. When the pool of those qualified to enter the program is depleted, tests are administered to those employees who wish to enter the program.

The tests measure verbal and arithmetic aptitude, mechanical reasoning and translation of two-dimensional drawings into three-dimensional space. Minimum scores for each aptitude

and for the total test battery have been established for three groups of trades - Maintenance, Metal and Electrical. Opportunities have been provided at some Ford locations for those who fail to qualify to get individually prescribed and administered self-instruction. When they achieve the qualifying standard in this instruction, they are not required to repeat the qualifying test.

The tests have been developed to correlate with the abilities required in the apprenticeship program, as opposed to any academic level, and there is no match with specific grade levels.

- B. Apprenticeship Training. On entry into the apprenticeship program for a given trade, the apprentice is given a book for the basic tasks of the trade. The book specifies each task in the format shown in Figure 1. The apprentice is given in-plant opportunities to master a task. How he does so is up to him - trial and self-evaluation; ask questions of the journeymen with whom he works, or refer to a book.
- C. Evaluation. When the apprentice believes he has mastered a task, he will ask the supervisor or assigned checker to check him out. The supervisor or checker will either sign-off in the apprentice's book (see Figure 2) or recycle the apprentice for the task. When the supervisor or checker certifies the apprentice can perform a task, the apprentice is given the opportunity to master another task. When the apprentice completes the basic tasks, he is given a book of advanced tasks.
Completion of the basic and advanced tasks is the minimum requirements of the trade. Depending on the trade, apprentices may acquire mastery of the basic and advanced tasks in from one to two years. However, the apprentice program consists of a total of 7,424 hours of shop-training work assignments.
- D. Related Training. In addition to the 7,424 hours of in-plant training, apprentices take 576 hours (over four years) of related community college training. The apprentice is required to meet specified standards in the related training. Apprentices may rework any part of the curriculum until they meet the required standard.

1.2. HIRED-IN JOURNEYMEN

It is not possible to formally evaluate and train hired-in journeymen with respect to the tasks of the trade. During a 90-day probationary period, hired-in journeymen are assigned to tasks and informally evaluated. Opportunities for hired-in journeymen to learn are provided by assignments to work with journeymen who have experience in the plant.

2. MAINTENANCE OF COMPETENCE

In Ford Motor Company, maintenance of competence has two aspects:

- A. Maintaining competence in infrequently performed tasks.
- B. Updating competence in response to technological change.

A. MAINTAINING COMPETENCE

Competence is not evaluated except when performance of a task is required. Steps taken to maintain competence depend largely on the senior management of a plant and will range from little action (relying on vendor services to deal with infrequent problems) to one or more of the following:

- 1. Provision of adequate job aids and reference materials.
- 2. Provision of simulators to enable journeymen to practice diagnostic and repair procedures off-line.

B. UPDATING COMPETENCE

The steps taken to update competence in response to technological change depend largely on the management of a plant. Ford Motor Company management policy provides plant management with a considerable degree of autonomy. Practices vary widely from the least to the most sophisticated. The following are used to update competence:

- 1. Send journeymen to formal courses offered by the vendor. These vary widely in quality and effectiveness.
- 2. Develop instructional materials (self-instruction, video, audio-visual) for technological developments of general application, and make these materials available to plants on request.
- 3. Conduct state-of-the-art analyses of the tasks, job aids and training required by a specific technological development and develop the necessary job aids and training programs. In some cases, the training will involve simulators.
- 4. Do nothing. As problems arise, bring in the vendor. While solving the specific problem, the vendor may instruct journeymen about the equipment.

3. REESTABLISHMENT OF COMPETENCE

In general, when an individual journeyman appears to be unable to perform tasks of a given kind, he is not assigned to jobs requiring competence in these tasks. There is plenty of opportunity to usefully employ journeymen

in less demanding tasks.

When a general lack of competence is evidenced (for example, when the maintenance journeymen in a plant are unable to diagnose and fix a problem in a complex of production equipment), management responses will vary as for updating competence. In addition, management may decide not to acquire equipment utilizing the technology for which they do not have the necessary technical competence.

PROBLEMS EXPERIENCED

In general, the company is concerned about updating journeyman competence in response to technical change and about getting an adequate supply of the competencies required.

The Management and Technical Training Department is engaged in a continuing effort to develop methods to resolve these problems. It is constrained by real-world considerations such as union agreements with respect to journeymen, the conflict between training and releasing essential people for training, the apparent cost of developing and implementing job aids and training in a cost-conscious environment.

CONTRIBUTING MODELS AND THEORIES

The Management and Technical Training Department is committed to an approach which begins with the end product. If a problem is satisfactorily solved, how would we know it, what would be the evidence? Working back from this, one looks at why people have problems in doing the job. What can be done to the job to reduce the demand on individual skill? Will improved reference materials, drawings, schematics make the job easier? Will job aids help?

Once the demands on individual skill have been reduced, one looks at the task requirements, tests for what journeymen already know, and does what is necessary to close the gap.

This approach does not necessarily result in training in the theory of electronics. It may result in training in making certain measurements and interpreting the results as they apply to diagnosing a problem.

FIGURE 1

Test Instruments

Task #19

- I. Task: Identify and use electrical test instruments.
- II. Performance Test: Given the following list of electrical test instruments and the attached reference material:

- . Identify each of the test instruments by its correct name.
- . Use each of the test instruments according to the usage and care guidelines outlined in the attached reference material.

	PAGE	APPRENT. DATE	CHECKER DATE
. Test Coil	176		
. A.C. Voltmeter	177		
. Ohmmeter (V.O.M.)	178		
. Clamp-on Ammeter	179		
. Continuity Testers (Flashlight)	181		

FIGURE 2**Basic Troubleshooting Procedure**

Task #21

I. Task: Basic Troubleshooting

II. Performance Test: Given the necessary test equipment, the electrical basic troubleshooting procedure and a malfunctioning machine which contains 110 volt control devices, do the following:

Steps		APPRENTICE DATE	CHECKER DATE
1	Determine the first action in the machine cycle that did not occur.		
2	Determine if there is power to the control panel at the supply side of the disconnect.		
3	Identify and replace blown fuses in the master panel.		
4	Determine if there is power to the control circuit at the load side of the control fuses.		
5	Check the components between the supply side of the disconnect switch and the load side of the control fuses.		
5A	Determine if there is power at the load side of the main fuses in the control panel.		
5B	Identify and replace blown fuses in a main power circuit.		
5C	Identify and correct the cause of blown fuses.		
5D	Check control transformer.		
5E	Replace transformer.		
5F	Identify and replace blown fuses in a control circuit.		
5G	Identify and correct the cause of blown fuses.		
6	Determine if there is power to the solenoid circuit at the load side of the solenoid fuses.		
7	Identify and replace blown fuses.		

PENNSYLVANIA POWER & LIGHT COMPANY

Bill Lerch - Training Director

THE PERFORMANCE SITUATION #1

Combustion turbine equipment is used to generate electricity when there is an outage of main production plant and, occasionally, to meet exceptional load demands. The equipment is at remote locations, usually at the site of a sub-station. Normally it is remotely started and automatically synchronized with the phase of the power line. However, when there is a power blackout, no power is available for the remote start and the equipment must be manually started and synchronized. While automatic synchronization is possible, it is not cost effective to provide the necessary automation equipment.

The combustion turbine generating equipment is normally maintained and operated by a special small team which visits the sites in sequence. In an emergency situation, the equipment must be started and synchronized by other people drawn from groups such as sub-station repairmen who normally have nothing to do with the combustion turbine equipment.

Starting the equipment is relatively straightforward. The critical task is to synchronize the generator with the line supply. Failure to synchronize correctly will lead to failure of other equipment in the system and cause an extension of the blackout.

METHOD USED

A job aid is provided at each site for start-up and synchronization. Those who may have to start up the equipment are given on-site training and supervised practice in the use of the job aids. The training is given by instructors or supervisors, supported by an instructors' manual. The instruction and practice is given only once. Evaluation of the acquisition of competence is by observation of performance during the supervised practice.

Maintenance of competence is entirely by the provision of the job aids.

Evaluation of the maintenance of competence is by evaluation of the effectiveness of the job aids at the time of their development. In other words, if the job aids are demonstrated as effective at the time of development, then it can be assumed that they will be effective when used at a later date. Updating competence in response to technical change will be by updating the job aids.

THE PERFORMANCE SITUATION #2

Power company linemen face the hazard of shock and cardiac/pulmonary arrest. When this occurs to a man up a pole, the requirement is to lower the man as quickly as possible and perform CP Resuscitation. All linemen are required to be competent in lowering a man with a hand-line and performing CPR.

The linemen have a vital interest in becoming and remaining competent in both lowering and first aid procedures.

Lowering techniques involve available equipment - such as a screwdriver driven into the pole to support the hand-line.

METHODS USED

Training in CPR is part of an ongoing program in first aid. The instruction is by videotape and simulated practice using a mannequin that provides feedback on the effectiveness of the performance.

Instruction in lowering by hand-line is done by videotape and practice using a dummy. A mobile training van is used and the instruction and practice is done on-site at a regular line pole.

Evaluation is self-evaluation. Due to the obvious self interest in competence, evaluation is on the cautious side. Competence is maintained by refresher cycles of the first aid (2 year cycle), CPR (1 year cycle) and hand-line lowering (1 year cycle). The men say they need refresher instruction and practice in CPR and hand-line lowering on a six month cycle. The frequency of instruction and practice is desired to maintain speed rather than to refresh forgotten procedures. Hand-line lowering is too rough to be practiced with a real person.

THE PERFORMANCE SITUATION #3

Emergency situations, such as those created by an ice storm, are the subject of pre-established plans. The plans specify the emergency organization, who is in charge and who are the key people, what resources are available and how to get them, and contingency plans for variations in the emergency situation. Contingency plans include, for example, calling in resources from other parts of the system if the severity and extent of the ice storm grows.

The emergency plans require the coordination of people in the performance of their normal work to meet special situations. The problem is thus largely a management performance problem.

METHODS USED

Simulations (not computerized) are used to train and practice managers in implementing emergency plans. The key problem is when to go to the next step in the plan - when to call in additional support or declare a system-wide emergency. People in the emergency situation tend to be conservative due to the high cost of going to the next step. Criteria for these key decisions have not been established.

THE PERFORMANCE SITUATION #4

Some 7,000 people in the system submit expense accounts. The accounting requirements were modified to meet company and IRS requirements. The modifications had to be implemented but the effort and time required to train 7,000 people was prohibitive.

METHODS USED

First, the expense claim form was redesigned to prompt correct expense accounting. The form was, in fact, a job aid. Then the 20 chief clerks responsible for processing claims were trained to inspect claims using the new forms and to instruct people how to remedy deficiencies in their claims.

CONTRIBUTING MODELS AND THEORIES

The Pennsylvania Power & Light Company training department uses a problem-solving approach directed toward the organizational accomplishment required. The approach is presented in a videotape that will be available at the ARI conference.

A CASE STUDY IN THE USE OF JOB AIDS

Ivan Horabin

THE PERFORMANCE SITUATION

When Olivetti introduced a new type of electric typewriter, it was faced with the task of enabling large numbers of dealer employees to demonstrate and service the machines. The servicemen typically had no prior experience of typewriter diagnosis and repair.

METHOD USED

A set of manuals was developed which provided:

1. Instruction on the operation of the typewriter.
2. Instruction on the principal mechanisms of the typewriter.
3. A set of job aids to be used on a 'need to know' basis when a machine had to be repaired.

Servicemen were given about four hours of instruction and practice at Olivetti centers. The instruction dealt with dismantling and assembly of 'tricky' components.

A follow-up study showed that, using the job aids, servicemen were able to service faulty typewriters with 100% accuracy.

The set of manuals will be available for inspection at the conference.

I. INFREQUENT PERFORMANCE

Radio-Teletype Operator

Mission: The radio-teletype operator rarely has an operational requirement to use International Morse Code although it is part of the job description. The concept which requires the operator to be able to Morse Code is based on the knowledge that it is an effective but slower and less efficient means of overcoming atmospheric conditions and electronic warfare tactics which would otherwise severely restrict or eliminate the Army's ability to communicate. The operator is typically found in combat divisions and operates in high frequency radio nets and radio teletype nets which interface FM radio nets and wire communications.

Training: The radio-teletype operator receives Morse Code training in Advanced Individual Training and must meet a specified level of proficiency. On-the-job training is conducted at the option of the units, but generally is not emphasized. Field Training Exercises rarely, if ever, require the use of Morse Code because most exercises are in support of combat training exercises during which routine communication procedures are practiced.

Situation: In combat we anticipate the extensive use of electronic warfare which will disrupt our normal communication procedures. In this event, our primary means of passing traffic will be Morse Code. The operator must be able to use the key set to transmit messages directly, rather than prepare tapes. Critical areas are the ability to provide continuous flow of message traffic and to efficiently and accurately prepare tapes and/or transmit in real-time.

Constraints: Since little training follows initial training, the typical operator is unable to meet even the minimum Morse Code requirements. Garrison practice using dummy traffic is generally regarded as undesirable because it is boring and lacks the realism of a Field Training Exercise. During field training, the focus is on the activities of the combat elements rather than the

communications support elements. Practicing Morse Code procedures would slow down and interfere with the maneuver element activities and consequently is disregarded in most cases.

Question: How can we develop a training program which will increase the readiness of the radio-teletype operator to effectively and efficiently use? International Morse Code?

II. PROMPT ACTION

Radio-Teletype Operator

Mission: The radio-teletype operator is found in Armored, Infantry and Mechanized Divisions and is responsible for operating radio-teletype Nets. Radio-teletype communications are an integral part of the divisions communication system and provide printed page messages. All operations are in the secure mode. The Armored, Infantry and Mechanized Divisions use communications to provide internal and external command and fire control communications, operation nets, administrative and logistics nets and intelligence nets. Among other responsibilities, the operator is expected to be able to operate effectively in an electronic warfare environment where the enemy uses electronic countermeasures to jam or initiate friendly communications. Operations under such conditions are called electronic counter-countermeasures.

Training: The operator receives the vast majority of their electronic counter-countermeasures training in an Advanced Individual Training Course. Once assigned to a unit the operator rarely, if ever, receives additional electronic countermeasures training. Furthermore, since electronic warfare is practiced rarely during Field Training Exercises, the operator has little opportunity to practice electronic counter-countermeasures.

Situation: Since radio-teletype nets provide almost all command, control, intelligence and fire direction communications, it is essential that operators are able to continue to operate in an electronic warfare environment. Furthermore, it is imperative that prompt electronic counter-countermeasures be taken to avoid the interruption of critical communications. Among the possible actions are: polarizing antennas; relocating; using Morse Code and transmitting at slower rates. Failure to take prompt actions can jeopardize fire missions, coordination of maneuver elements and dissemination of urgent intelligence reports.

Constraints: As mentioned earlier, electronic warfare is practiced rarely during field training exercises. Most communications are practiced under ideal conditions (no artificial problems imposed) and therefore, maneuver elements conduct their practice with ideal communications. While commanders could direct electronic warfare practice, it is rarely done. Garrison practice of electronic counter-countermeasures is unrealistic and not performed under the pressures of field or combat conditions.

Question: How can we train radio-teletype operators to react promptly and efficiently to an electronic warfare environment?

III. TEAM EFFORT

TOW - Heavy Anti-Tank Weapon

Mission: The TOW is a heavy anti-tank weapon which fires a wire-guided missile. A TOW section, comprised of two squads with one weapon per squad, is deployed usually against enemy tanks or other armored vehicles.

Training: TOW crew members are trained in operation and maintenance of the TOW system in Advanced Individual Training courses. Additionally team training is conducted at the unit level and during training exercises.

Situation: When a TOW section is deployed against advancing enemy tanks or other armored vehicles, the section leader will control and coordinate fire within his sector. Coordination is accomplished through radio nets when TOW's are mounted in vehicles. For TOW's not in vehicles, hand and arm signals or smoke are used to relay commands. As much coordination as possible should be made prior to engaging the enemy. However, not all coordination can be made in advance. The TOW section seldom will know when and in what strength enemy formations will appear. Therefore, it is imperative that the section leader have the ability to coordinate the actions of the two squads at all times. While radio communications and visual signals may be adequate methods of communicating in most situations, electronic warfare and/or unusual terrain features may preclude the use of either method. In such cases, the section leader may lose control of one or both squads. With squads normally placed 300 meters apart, control problems are not unlikely, especially when visual signals are to be used.

Question: Recognizing the possible control and coordination problems, how can we train TOW sections to operate effectively as a team under such conditions?

IV. NO-REAL WORLD TRAINING

REDEYE

Mission: REDEYE is a man-portable surface-to-air missile system designed to provide combat units with the capability to destroy low-flying enemy aircraft. The successful engagement of targets requires the performance of specific steps and the application of specific rules and criteria.

Training: REDEYE training is conducted primarily in Advanced Individual Training courses and practiced during range firings. Simulators are also used to provide practice for REDEYE teams.

Situation: The employment of REDEYE is sufficiently complex that realistic training is necessary to enable REDEYE teams to perform under combat conditions. Tasks such as tracking and ranging, target identification and infrared acquisition require frequent training and practice to maintain proficiency. These tasks require coordination between team chief and gunner and depend on the quick reaction of both members in applying appropriate training. Decisions, based on specific rules and situations, must be made quickly and correctly.

Constraints: The REDEYE systems trainer and associated training materials are classified. Therefore, certain restrictions are placed on the use of both for training. Both the use of the REDEYE and the simulator for training are primarily administrative activities in which real world conditions are not permitted. There are financial constraints which limit live firings and safety requirements which detract from the realism of the exercises.

Question: Within the financial and safety constraints, how can we effectively train REDEYE teams to be thoroughly prepared to perform in combat?

V. INCREASED INTENSITY AND SCOPE

Forward Observer

Mission: The Forward Observer provides support to maneuver forces. (Armor, Infantry, Airborne, Mechanized Infantry and Airmobile Units) during day or night conditions, under all environmental conditions, in peacetime training exercises or actual combat.

Training: Artillery Forward Observers may be either officers or enlisted personnel. Officers receive initial training during the Artillery officer basic course. Enlisted men are initially trained in an Advanced Individual Training course. Further training is conducted at the unit level. Field training exercises are also conducted and provide near ideal practice insofar as basic skills are concerned.

Situation: During combat conditions, Forward Observers must be able to assimilate skills and training in the use and maintenance of communications equipment, vehicles, and equipment used in locating and identifying targets. The skills involved must not only be performed quickly and with a high degree of precision; they must be performed under great psychological stress and physical danger. The concept of first round accuracy places still greater demands on the Forward Observer. While the mechanics of the Forward Observers' duties are effectively trained under existing programs, little has been done to simulate the psychological conditions associated with combat.

Constraints: Current training programs do not adequately simulate the psychological impact of combat on Forward Observers. Peacetime safety regulations place many restrictions on training situations which might be used to train Forward Observers in a realistic combat environment.

Question: Within the constraints of safety regulations, how can we train Forward Observers to deal with the psychological conditions which combat would create?