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SAFETY FIRST:
PRODUCTION AND EVALUATION
OF AN AUDIO-VISUAL PROGRAM ON INDUSTRIAL SAFETY

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A Thesis Equivalent

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ABSTRACT

Safety First:
Production and Evaluation
of an Audio-Visual Program on Industrial Safety

Anne Dychtenberg

The purpose of this thesis equivalent was to produce and evaluate a twenty-six minute two-part audio-visual program on safety practices intended to provide employees new to CN Rail's Equipment Department with the basic information they would need to protect themselves and their co-workers on the job.

Formative evaluation data was gathered from subject matter experts and from learner-subjects, to provide the basis for product improvement and final production. The evaluation procedure was based on the approaches to formative evaluation suggested by Sanders and Cunningham (1973) and Ardaway (1983). It included the four stages of the Sanders and Cunningham model: pre-developmental activities, an evaluation of objectives, a formative interim evaluation and formative product evaluation. This last stage consisted of a combined pilot/field test that was conducted with ten CN employees.

Although the data for the last stage was to have been gathered from the target population, that is, newly engaged maintenance shop

employees, an unanticipated hiring freeze necessitated the use of available white collar and professional headquarters employees to test the instructional materials. This unanticipated obstacle illustrates the risks and realities of applying academic models outside a controlled environment.

Revisions to the product were guided by the results of pre and post tests, a questionnaire that gathered data on subjects' preferences with regard to production design variables, and by a debriefing session designed to elicit detailed feedback once problems had been identified.

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INTRODUCTION

Purpose of Media Presentation

Canadian National Railway's Equipment Department is responsible for repairing and maintaining the railway's fleet of locomotives and railway cars. Until a hiring freeze occured in early 1985, the department had annually hired hundreds of tradespersons, apprentices and support staff at more than 100 maintenance shops across the country.

Two years before the hiring freeze, in 1983, Equipment training personnel had perceived the need for a pre-packaged standardized orientation program that would provide all new employees with the information they would need to adapt effectively to their new work environment.

While orientation programs had been delivered by some regional training centres in the Equipment Department, content had varied from point to point and the programs had usually been restricted to a particular category of new employees - apprentices - rather than addressing all those that had been newly engaged by the department. In some centres in fact, orientation "programs" had often consisted of

simply distributing print materials that were rarely read by new employees.

An initial needs assessment took the form of interviews with 20 new shop employees as well as a survey of 8 Regional Training Co-ordinators. It identified six broad areas to be included in an orientation program that would provide new employees with the information they would need to facilitate their integration into the company: 1) the activities and structure of CN 2) company benefits 3) the role, structure and personnel of the Equipment Department 4) company rules 5) an introduction to the work site and 6) safety rules.

Based on the availability of company resources, the instructional requirements of the material, and the needs and characteristics of the target population, the stills-to-video format (a format in which stills are transferred to video) was chosen to present information that applied across the CN system, with instructor checklists to serve as guidelines for presenting additional local information in the classroom. A content analysis suggested the subject areas identified in the needs analysis could be presented in five discrete programs.

For the purpose of this thesis equivalent, one of the five programs was produced and evaluated: a twenty-six-minute, two-unit audio-visual program on safety practices intended to provide new employees with the basic information they would need to protect themselves and their co-workers on the job. The project spanned the period May 1984 to December 1986.

Safety Education

Statistics indicate that a high proportion of all industrial accidents occur to employees new to the job, who have not yet developed safe working habits. Experience has shown that one of the reasons for this phenomenon is industry's failure to properly initiate new employees (ILO, 1970).

Indeed, with the advent of the safety movement as well as recent safety legislation, there has been increasing recognition that industrial workers need to be provided with safety education as they learn their trade and become familiar with their new work environments. (Glazener, 1978). It is in the interests of employers to do so, since it is only by providing a well-planned safety program for its employees, that work injuries, and related monetary losses can be prevented. (Occupational Safety and Health Administration, 1971).

In their education manual for workers, the International Labour Organization (ILO) recommends a number of general safety rules that should be covered by an induction program. Included in their list, is the importance of obtaining first-aid treatment, the importance of good housekeeping, the precautions to be taken when heavy loads are being transported through the shop, as well as a number of basics on how employees can help to keep the work-site safe for themselves and others. The ILO recommends for instance, that while it may be necessary to provide employees with a copy of company rules and regulations, it should not be expected that the new employee will retain or even

understand all of the rules. Instead, an orientation should explain the rules that are of immediate concern to the employee.

Educational Context

Target Audience

The media presentation was targeted at three groups of incoming employees: 1) qualified tradespersons, 2) tradesperson apprentices and 3) support staff (such as labourers and cleaners). All of the tradespersons and some of the apprentices and support staff had had previous work experience in a heavy industry context. Reports from the field indicated this workforce was not highly motivated to read.

In 1985, some 97% of Equipment staff was male. However, at that time CN made a commitment to increase the ratio of women hired in blue collar positions. It was anticipated then, at the time of production planning, that aproximately 20% of the audience for the department's safety orientation program would, eventually, be female.

Outline of Content and Format

The initial needs assessment indicated that a large proportion of new employees had been involved in job-related accidents within their first few weeks on the job; the need for an orientation program on safety was thus identified. (See Figure 1, page 16, for an outline of the needs assesment/evaluation process.)

A second stage needs analysis attempted to determine the specific content to be covered. A perusal of accident statistics for the Equipment department identified the three most common on- the-job injuries. Follow-up discussions with a CN safety expert and Equipment training personnel at CN headquarters, identified those safety precautions to observe for avoiding the most common injuries, while suggesting additional information to be presented that was considered crucial for the new employee's protection.

Objectives for the presentation were based on the information gleened from the needs analysis and are in line with the ILO recommendations stated above. (Objectives appear in Tables 1 and 2 on the following pages.) In turn, the specific content was geared to match the stated objectives.

To present the information in appropriately sized chunks that would facilitate learning, the content of the presentation appeared in two parts. This two-part format also allowed the flexibility required to meet training needs in the field. Unit Two, which deals with yard safety rules was intended only for those new employees working in a yard facility. In some cases, apprentices were initially engaged at a shop facility and transferred to a yard several months later. In this situation it was determined that apprentices could view Unit One, which deals with general safety precautions, during their first few weeks in a shop facility, with Unit Two to follow after their transfer to a yard.

Educational Objectives

The global objective of Unit One was to inform new employees about the basic safety precautions they would have to observe in the yard and in the repair shop, to protect themselves and their co-workers. Detailed objectives for Unit One appear in Table 1 below.

Table 1 - Unit One Objectives

After viewing this presentation, the trainee will be able to:

1. Recognize whose safety (s)he is responsible for on the job.
2. Recognize the proper on-the-job attitude to avoid accidents.
3. Recognize how to avoid being injured by a)overhead cranes carrying heavy loads b) moving equipment on the shop floor
4. List the standard safety gear that must be worn in the shop and the yard.
5. Recognize that special protective equipment must be worn for certain jobs.
6. List 2 ways to avoid eye injuries on the job.
7. List the 3 rules for protective posture when lifting heavy equipment or material.
8. Indicate 2 ways to avoid slipping accidents on the job.
9. Describe the procedure to follow if dangerous conditions or unsafe practices are noticed on the job.
10. Recognize how the worksite should be maintained to avoid accidents.
11. Indicate 3 general precautions to observe concerning the proper use of tools.
12. Indicate the correct procedure to follow if an accident occurs.

The global objective of Unit Two was to inform new employees about the specific rules to follow to protect themselves and others in railway yards. Detailed objectives for Unit Two appear in Table 2 below.

Table 2- Unit Two Objectives

After viewing this presentation, the trainee will be able to:

1. List the 3 blue flag rules that must be observed before you begin to work on a track.
2. Recognize when a switch is lined away from a track, with reference to the position of the track's switchpoints.
3. Recognize when a manually operated switch is lined away from a track with reference to the switch indicators on a) main line tracks and b) yard tracks.
4. Indicate how to verify that a)manually operated swtiches and b)electrically powered switches are properly locked.
5. Indicate where, and how many blue flags should be erected on a working track.
6. Indicate the procedure to follow if the blue flag rules are not properly observed.
7. Recognize that it is important to avoid impeding one's hearing in a yard.
8. Recognize the correct procedures to follow when crossing a track.

It was assumed that new employees with no previous experience in heavy industry were not likely to be familiar with any of the material to be presented in the program. Those with some industrial experience however, were expected to be acquainted with some of the general safety precautions to be presented, but not with those safety points specifically related to the railway context. For the latter group then, the presentation was intended to reinforce employees' knowledge of the general safety precautions they may already have been familiar with, while introducing railway-related information for the first time.

Rationale for Media Selection and Production Design

A consideration of what Schramm (1977) refers to as the Task, Media, and Cost decision vectors, suggested the stills-to-video format as the most appropriate media for this presentation. This format involves the transfer of stills and slides to video and results in an end product that can depict motion.

An examination of the material to be presented and the tasks to be performed, indicated that a visual element would be required to illustrate the equipment, safety gear and work environments that would be referred to verbally, as well as to present certain safety rules that would require visual discrimination.

At the same time, the need was perceived for a pre-packaged alternative that would ensure that all locations received the same basic information that applied system-wide, while eliminating the need for

instructors to deliver the common material repetitively to each new group of incoming employees. (As one writer suggests (Whitley, 1973) induction programs are often abandoned by their presenters in industry because of the repetitive aspect of delivering classroom orientation programs to successive groups of new employees.)

Since the target population was not highly motivated to read, a print package was rejected in favour of an audio-visual presentation. A slide-to-video format was chosen that involved taping from a screen, the images that were projected by two syncronized slide-projectors. This format was chosen for several reasons. First, it allowed the limited depiction of action while being significantly less expensive than live-action video. While for the most part, the content did not require that motion be depicted, certain behaviors (e.g. how to pick up a heavy load) could be modelled more easily with motion. Using the animation technique of shooting a series of stills depicting a person in motion, action was effectively conveyed by using two syncronized slide projectors, equipped with a dissolve feature, to speed up the action and blend the images. At the same time, the video cassette format was seen by its users in the field as more convenient to use than a slide-tape format.

With an extensive library of existing slides, the CN production facility was well equipped for slide-to-tape production and any original material required could be shot economically. Filming original video material however, would have been extremely expensive since video equipment would have had to be rented and a crew engaged. On the other

hand, transferring the stills to video would keep costs down while increasing the visual appeal of the stills with effects such as fade-ins and fade-outs as well as animation.

The audio-visual program was designed to be group-paced and presented in a classroom setting with an instructor present. There were several reasons for this design: a) new employees were often hired in groups of between 5 and 10, b) this format would allow for additional discussion and questions that might emerge after viewing the unit, c) additional information of local relevance could be presented by the instructor after new employees viewed the program. To facilitate the latter process, instructor checklists were designed to ensure that all points of local concern were covered.

The slide-tape program incorporated the relevant principles of instructional message design outlined by Dwyer (1978) and by Fleming and Levie (1977). The principles, drawn from research in the behavioral sciences, focus on the domains of perception, memory, concept learning and attitude change.

Research findings in the realm of design strategies for ETV (Coldevin, 1981) were also used to guide production decisions concerning such factors as camera shots, review strategies, pacing and performer characteristics.

Production Requirements

All of the equipment, material and additional personnel required was furnished by CN. Following is a list of company resources that were used:

1. photo slide library
2. sound stock library (music and sound effects)
3. graphic artist (for titles and illustrations)
4. computer graphics facilities
5. photo lab facilities
6. recording studio for narration
7. sound mixer (mixing narration, music, sound effects and inserting pulse)
8. 2 slide-projectors
9. Cayote computer
10. Video camera

For the additional photos required beyond the file photos available, the following equipment was used:

1. single-lens reflex camera (35 mm)
2. tripod
3. color slide film
4. lighting kit

Purpose of Evaluation

The purpose of this formative evaluation was to collect data that would gauge the effectiveness of the presentation and guide the process of revision and product improvement. The evaluation was intended to investigate the program's instructional effectiveness as well as the appropriateness of production design decisions for the intended target audience. At the same time, the evaluation sought to ensure that the content was accurate and that it met local training needs.

Operational Definitions

Instructional effectiveness refers to the level of congruence between the learners' performance on criterion referenced tests and the program's objectives. It is to be measured by comparing performance on the pre-test with post-test performance.

Production design variables refers to the strategies employed to organize and present verbal and visual information. Such strategies refer to content variables such as pacing and message structure and technical variables such as the use of music or sound effects and the composition of visuals. The effectiveness of production design variables is to be measured by a questionnaire.

CHAPTER TWO

METHODOLOGY

Literature Review

Evaluation is commonly defined in the educational literature as a formal assessment of the merit of an educational program; it is a process that provides information for decision making.

Until the late 1960's, evaluation decisions were primarily based on comparisons between the merit of a newly developed program and the merit of existing materials. Newly developed program materials however, were frequently judged less effective than existing programs (Dick and Carey, 1978). The need to evaluate instructional material during its development phase, in order to revise and improve it **before** its final distribution, was formally recognized in a 1967 paper by Scriven, Tyler and Gagne. It was Scriven(1967) that coined the term formative evaluation to describe this process, and to distinguish it from what the authors called summative evaluation: the process involved in determining the effectiveness of a product **after** its completion. While the term formative evaluation is relatively recent, and its widespread practice even more recent, the concept has existed for more than six decades.

In the mid-1950's for example, communication theorists Rose and Van Horn (1956, cited in Cambre, 1981) acknowledged the importance of pre-production testing in the context of communication theory. For one-way communication channels such as films and slide-tape programs such testing, they suggested, could establish the two-way communication required to ensure that messages had been properly received by the target audience.

While experimental research in the behavioral sciences and in communications, has suggested a body of principles for instructional message design, researchers (Fleming and Levie, 1977, Coldevin, 1981) have acknowledged the continuing importance of formative evaluation in validating such strategies in the context of the specific educational situation of concern.

Effective formative evaluation involves a continual process of obtaining feedback and revising materials, from the inception of a program, to its final production. However as Weston (1986) points out in her overview of approaches to formative evaluation, the duration of the try-out/revision cycle and the sources of data for revision can vary widely. Sources of data can include (i) self-evaluation of the material by the developer, (ii) expert review, in which one or more experts review the instructional material and suggest revisions, or (iii) developmental testing. Developmental testing may consist of three phases: one-to-one evaluation which can identify major problems, group evaluation, which can provide more extensive data for a more polished revision, and field testing, which involves trying out the materials, which are in a

semi-final state, in a setting which resembles as closely as possible, actual field conditions. While formative evaluation can include any or all of these phases, Weston suggests that the evaluation strategies chosen are determined by practical constraints as well as by the information sought.

One model, proposed by Sanders and Cunningham (1973) suggests a four stage process of formative evaluation that allows for several sources of data. It begins with "predevelopmental activities", that is, formative evaluation work like needs assessment that is conducted before product development has commenced. It is followed by an evaluation of objectives and, once an early draft of the product is prepared, "formative interim evaluation", which can include a variety of activities such as critical appraisal by experts, and student tryouts of the pilot version. The final phase is what Sanders and Cunningham call "formative product evaluation"; this stage involves a large-scale tryout of the product under actual field conditions.

In a paper on corporate training and development, Ardaway (1983) like Weston, suggests implicitly that evaluation strategies must take into account the practical constraints of the context. As he reports, the time constraints imposed by corporate deadlines often means that low priority is given to the evaluation process. In this context Ardaway suggests a time-saving model for formative evaluation that combines pilot, or small group testing and field-testing into a single on-site activity. In this model, a working version of the material is administered to the target group under actual field conditions, with

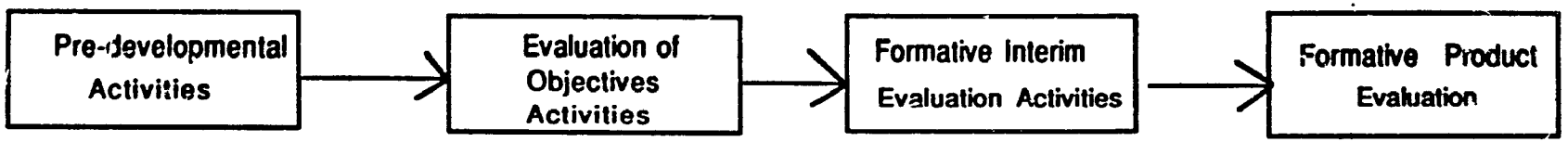
groups small enough to allow for the kind of detailed feedback normally obtained from learners during pilot testing. After the field test is conducted under natural conditions, the data obtained (observations or tests) serves as a reference point for a debriefing session where any difficulties viewers may have had with the material are probed. The working version used in the field test is one that has already been revised in the light of a review, by subject matters experts, of an early version.

Evaluation Design

The evaluation design used in this study combines aspects of the models developed by Sanders and Cunningham (1973) and by Ardaway (1983) and described above. A summary of the design appears in Figure 1 on the following page.

The two-step needs assessment described earlier (pp. 2-4)) and summarized in Figure 1, constitutes what Sanders and Cunningham would describe as the study's "pre-developmental activities". This first stage allowed the formulation of a set of objectives for the AV scripts that was approved by the supervisor of Equipment Training at CN headquarters. The approval of objectives constituted the second stage of the Sanders and Cunningham model.

"Formative interim evaluation activities" consisted of a three-step process: 1) student tryouts with available learners as the scripts were developed, 2) evaluation of the two draft scripts by training personnel



I Initial Needs Assessment

a) Interviews (20) with target population

b) Discussions with and survey of Regional Training Coordinators

II Needs Assessment to Determine Content

a) Accident Statistics

b) Interview with CN Safety Expert

c) Discussions with HQ Training Personnel & Regional Training Survey

Approval of objectives by Training Supervisor

I Tryouts with learners as scripts developed

II Evaluation of draft script by training personnel

III Evaluation of revised script by:

a) regional training coordinators' review

b) CN safety expert review

Pilot/Field test with target population

Steps:

1. Pre-test
2. Program presentation (Unit One)
3. Post-test (Unit One)
4. Production Design Variable Questionnaire (Unit One)
5. Debriefing (Unit One)
6. Program presentation (Unit Two)
7. Post-test (Unit Two)
8. Production Design Variable Questionnaire (Unit Two)
9. Debriefing (Unit Two)

Figure 1 Evaluation Design

and 3) evaluation of the revised scripts by regional training coordinators and a CN safety expert. The scripts presented the narration for each frame in one column, with a corresponding written description of the accompanying visual image in the second column.

The first step involved using available naive learners, such as translators, artists or other employees with no field experience, who were asked to read through the material as it was being written, to ensure the message was clear and the language appropriate. Revisions were made in line with the feedback obtained.

Next, the draft scripts were reviewed by four tradespersons with extensive field experience, who were on staff with the training department. Through informal conversations, feedback was obtained on the appropriateness and accuracy of the script's visual and verbal elements and the scripts revised as necessary.

At the third stage, to ensure that the program met regional needs, regional training personnel, the program's users, were asked to review the revised scripts to ensure the information contained was relevant to local needs and practices and to serve as a further check on the accuracy and usefulness of the material contained. Feedback was obtained from the eight regional training coordinators via a questionnaire containing open-ended questions. (See Appendix I for sample questionnaire and feedback obtained.)

As in any large organization, soliciting early feedback from the field is an essential process. From the educational point of view, regional centres are more likely to adopt the program if local needs are met. And from the political point of view, early consultation encourages regional co-operation for both field testing and future projects.

The same questionnaire was used to elicit feedback from a CN safety expert - once again, to verify that the information in the script was accurate.

Once revisions to the scripts were made in response to the feedback obtained from regional training personnel and the CN safety expert, the prototype AV program was produced. While the visuals were in their finished form, with titles, the sound track did not include music or sound effects, eliminating the time and cost involved in editing and mixing a second sound track for the final version.

The fourth stage in the Sanders/Cunningham model: "formative product evaluation" followed the production of the prototype. It consisted of a combined pilot/field test of the materials, using a single group, pre-test post-test design. This approach to the fourth stage was inspired by Ardaway's model (1983) described above and devised to save time in light of the constraints imposed by corporate/industrial deadlines. While some educational settings may allow for separate pilot tests and field tests as well as follow- up field tests to ensure the appropriateness of revisions, at CN, the opportunities for gaining access to the target population have often been restricted by economic

and political considerations.

Figure 1 details the nine steps that comprised the Pilot/Field test. The first step involved the administration of the pre-tests for Units One and Two. The pre-tests for both units were given at the start, to minimize the possibility of contaminating the pre-test results for Unit Two (as a result of learning occuring with Unit One). Following the pre-test, Unit One was presented, the post-test administered, and a questionnaire distributed to elicit feedback on production design variables. Subjects were queried on their preferences regarding content variables such as pacing and message structure, and technical variables such as music and sound effects. A debriefing session followed the questionnaire. It was designed to elicit detailed feedback on problem areas noted after a perusal of pre and post test results and of responses to the production design variable questionnaire. For example, where low scores on post-test items were noted, subjects were probed on whether incorrect responses were due to confusion regarding the question, or misleading or inadequate visual or verbal explanations in the video.

During the debriefing, subjects were encouraged to play an active role in suggesting revisions to the material. An assistant evaluator took notes of the discussion.

The next step in the process was the presentation of Unit Two, followed by the post-test, a production design variable questionnaire and a debriefing session for Unit Two.

Instrumentation

Formative Interim Evaluation

Formal data collection began with a review of the revised scripts by Regional Training Coordinators and a CN Safety expert. For this purpose, a questionnaire was distributed along with a copy of the script. The questionnaire contained five open-ended questions and one question with a 5 point Likert scale. A copy of the questionnaire, along with a summary of the results for Units One and Two are contained in Appendices I and II.

Formative Product Evaluation

i) Pre-test/Post-test. The pre-test and post-test questions were based on program objectives with parallel items for each objective. Test items included both multiple choice and completion question formats. The pre-test and post-test contained the same questions with items re-ordered to minimize testing effects. Tests for Units One and Two appear in Appendices III and IV.

ii) Production Design Variable Questionnaire. Twelve of the 15 items in the questionnaire had a four-point Likert scale format. Respondents were asked to indicate the degree to which they agreed with each of the 12 items. To avoid response bias, half of the statements were stated affirmatively while half were stated negatively. The remaining three questions were open-ended, and designed to solicit respondents' views on any other subjects not covered earlier. The questions appear in Table 3 on the following page. (While changing

attitudes toward safety was not explicitly stated as an objective for the unit, it was, nevertheless, an implicit objective and accordingly, question 12 was included.)

Subjects

At the stage of formative product evaluation, the original intention was to try the materials out with members of the target population; that is, newly hired maintenance shop employees who had been on the job for no longer than 3 weeks. However, at the time of testing, CN was not hiring new employees.

Instead, the materials were tested on 10 employees who worked at various departments at CN headquarters. Subjects were chosen in terms of their availability and the degree to which they would be motivated to go through the materials. While the employees selected did not actually work in the maintenance shops, they were nonetheless motivated to go through the materials, since they frequently made visits to the shops, and felt they needed to be aware of safety issues.

Athough attempts were made to locate subjects that had been recently hired, this criterion was not consistently met. As indicated in Appendix III, members of the sample group had been at CN for periods ranging from three months to 12 years, with a mean tenure of 28.5 months.

Table 3 - Production Variable Questionnaire, Questions

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1. The program gained and held my attention.
2. The points presented in the program were not always clear.
3. The illustrations and photographs helped explain the points presented in the program.
4. I would have preferred a male narrator to a female narrator.
5. There were too few women shown in the program.
6. Music would have made the program more enjoyable.
7. I would have preferred more sound effects to match the illustrations and photographs in the program (eg. like the sound of a train moving down the track which would match a picture of the train).
8. The program was slow and drawn out.
9. The program looked professional and well produced.
10. The individual safety rules and principles were presented too quick to convey the message.
11. More repetition would have helped me remember the points in the program.
12. The program helped me realize the importance of safety.
13. The best thing about the videotape I just saw was:
14. The worst thing about the videotape I just saw was:
15. General Comments. Please feel free to make any comments or suggestions on the program in the space below.

The sample included a graphic artist and instructional designer from the Equipment training department, three test development technicians, a computer analyst and four junior engineers. Considering the backgrounds of the subjects, the sample group might be characterized as expert/subjects. Although they were not experts in the field of safety, their collective experience meant the group was in a good position to provide critical input on visual and instructional elements as well as content.

CHAPTER 3

RESULTS

Formative Interim Evaluation

Training Coordinator/Safety Expert Questionnaire

A summary of questionnaire results for Units One and Two, including suggestions for revisions, appear in Appendices I and II. When respondents were asked to judge the usefulness of these units on a 5 point scale, the average ranking for Unit One was 4.7, and for Unit 2, 4.4.

Formative Product Evaluation

Unit One

Pre/Post Test

Pre and post test results for Unit One appear in Table 4 on the next page. The total possible score on the test was 23. Despite the high mean pre-test score ($\bar{x}$ = 16.30) and the relatively low mean gain score ($\bar{x}$ = 5.1) a dependent t test indicated a significant difference ($p < .001$) between pre and post test performance.

The individual pre and post test scores for the 10 subjects appear in Appendix V along with data on the subjects' tenure at CN. Scores ranged from 13 to 20 on the pre-test and from 17 to 23 on the post-test. The most obvious explanation for differences in the scores recorded for

Table 4 Pre/Post Test Results for Unit One

measure	no. of cases	total score possible	mean	standard deviation	range	mean gain score	dependent t p value
pre-test	10	23	16.30	2.33	9	5.1	p<.001
post-test	10	23	21.40	1.95	6		

the ten subjects was length of experience. However for Unit One, no significant statistical relationship was apparent between term of service and a) pre-test scores (Spearman's rho=.252; p = .49) b) post-test scores (Spearman's rho=.067; p = .66) or c) gain scores (Spearman's rho =-.336; p = .34)

Item Analysis

To guide the process of revision, the frequency of correct and incorrect answers for each item was tabulated for the pre and post tests. The results appear in Table 5 on the following page.

Column A indicates the frequency of scores, for each test item, that were correct on the pre-test and correct on the post-test; Column B indicates the frequency of scores, for each test item, that were correct on the pre-test and incorrect on the post-test; Column C indicates the frequency of scores, for each test item, that were incorrect on the pre-test and correct on the post-test; Column D indicates the frequency of scores, for each item, that were incorrect on the pre-test and incorrect on the post-test. Answers for questions one to three have been included in the table since these questions asked respondents to list their answers in no particular order.

Table 5 Item Analysis - Unit One

Q#/Answer(where applicable)		A	B	C	D
1	back	5	-	5	-
	slipping	-	-	10	-
	eye	2	-	8	-
2	footwear	8	-	2	-
	hard hat	10	-	-	-
	eyeglasses	10	-	-	-
3	stand close	1	-	9	-
	bend knees	6	-	4	-
	lift with legs	4	-	6	-
4		7	3	-	-
5		9	-	1	-
6		9	-	1	-
7		3	2	5	-
8		10	-	-	-
9 a)		10	-	-	-
b)		10	-	-	-
c)		10	-	-	-
10		8	1	1	-
11		10	-	-	-

A= Correct in pre-test; Correct in post-test

B= Correct in pre-test; Incorrent in post-test

C = Incorrect in pre-test; Correct in post-test

D= Incorrect in pre-test; Incorrect in post-test

As indicated in the table, pre-test results for questions 2, 5,6,8,9,11 were unusually high suggesting a moderately high level of redundancy; at least nine of the ten subjects answered correctly before they saw the unit. With these questions set aside as redundant, a further rank order correlation was conducted between the remaining nine items and work experience. It also failed to indicate a significant correlation. It should be noted that these results have been reported here in view of the significant correlations reported between work experience and test scores for Unit Two below.

Production Variables Questionnaire

Results for the Unit One production variables questionnaire appear in Table 6. (See Table 3 for the questions included in the questionnaire.)

Table 6 presents a summary of answers to the questionnaire's three open-ended questions as well as means and frequencies for the 12 Likert scale items. To avoid response bias, half of the statements were stated affirmatively while half were stated negatively. For consistency, reported scores for questions stated in the negative, have been reversed and are indicated with an R.

In their responses to the Likert scale items, subjects indicated the program held their attention, that the illustrations were effective and the points clearly presented, that the program looked professional and well produced, that there was sufficient repetition, that the pacing was appropriate and that the program helped subjects realize the importance of safety. Answers to open-ended questions indicated that subjects

were particularly satisfied with the reviews and visuals.

At the same time, the majority of respondents indicated, in items 6 and 7, that music and sound effects would enhance the program. Responses to the open-ended questions also included suggestions about how to clarify particular points in the unit.

Table 6 Results, Unit One Production Variable Questionnaire

1= strongly agree 3= disagree R= score reversed
2= agree 4= strongly disagree

Q#	Frequencies				Mean
	1	2	3	4	
1.	0	10	0	0	2
2. R	5	3	2	0	1.7
3.	3	7	0	0	1.7
4. R	0	9	0	0	2
5. R	0	4	3	2	2.7
6.	0	4	6	0	2.6
7.	3	5	2	0	1.9
8. R	0	9	1	0	2.1
9.	1	9	0	0	2.0
10. R	3	7	0	0	1.7
11. R	2	8	0	0	1.8
12.	1	8	1	0	2.0

Table 6 Results, Unit One Production Variable Questionnaire (Con't)

13. The best thing about the videotape I just saw was:
    - Excellent reviews and visuals.
    - The review was excellent. It concisely re-interated all important facts.

14. The worst thing about the videotape I just saw was:
    - Images not sharp - bleeding around figures
    - This point was not clear - When a crane is passing overhead, a buzzer sounds to alert people. Are they supposed to move out of the way of the load? Do they stay within the yellow lines also?

15. General Comments:
    I'm sure there are women working in the shops and I wonder why we never see them?

Results for item 5 were less definitive. Five the of the nine respondents suggested there were too few women in the program.

Unit Two

Pre/Post Test

Pre and post test results for Unit Two appear in Table 7 below. The total possible score on the test was 19. A dependent t test indicated a significant difference ($p < .001$) between pre and post test performance. The pre-test mean was 7.2 and the post-test mean, 16.1, with a mean gain score of 8.9.

Table 7 Pre/Post Test Results for Unit Two

measure	no. of cases	total score possible	mean	standard deviation	range	mean gain score	dependent t p value
pre-test	10	19	7.2	2.573	8	8.9	p<.001
post-test	10	19	16.1	2.079	6		

The individual pre and post test scores for the 10 subjects appear in Appendix III along with data on the subjects' tenure at CN. Scores ranged from 3 to 11 on the pre-test and from 14 to 19 on the post test. A significant statistical relationship was established between length of experience and pre-test results (Spearman's rho = .721; p=.02) and between length of experience and gain scores (Spearman's rho = -.700; p=.02). However there was no significant statistical relationship between length of service and post-test scores.

Item Analysis

To guide the process of revision, the frequency of correct and incorrect answers for each item was tabulated for the pre and post tests. The results appear in Table 8 on the next page.

Column A indicates the frequency of scores, for each test item, that were correct on the pre-test and correct on the post-test; Column B indicates the frequency of scores, for each test item, that were correct on the pre-test and incorrect on the post-test; Column C indicates the frequency of scores, for each test item, that were incorrect on the pre-test and correct on the post-test; Column D indicates the frequency of scores, for each item, that were incorrect on the pre-test and incorrect on the post-test. Answers for question three have been included in the table since this question asked respondents to list their answers in no particular order.

Items 6,4, and 2 had particularly high pre-test results; of the 10 subjects, nine chose the correct answer in the pre-test for question 6, with seven of ten subjects choosing the correct answer for items 4 and 2. For items 1, 8, 10 and 15, five subjects chose the correct answer in the pre-test.

Another result of note is that for question14, three subjects did not choose the correct answer in the post-test while for question 8, four subjects did not choose the correct answer in the post-test, with one of these having chosen the correct answer in the pre-test.

Table 8 Item Analysis, Unit Two

Q#/Answer (where applicable)	A	B	C	D
1	5	1	4	-
2	7	1	2	-
3 ensure switch lined away from your track	-	-	9	1
install blue flags	2	-	7	1
switch locked	-	-	8	2
4	7	-	1	2
5	3	-	7	-
6	9	-	1	-
7	1	1	7	1
8	5	1	1	3
9 a i	2	-	7	1
a ii	3	-	5	2
b	2	-	5	2
10	5	-	5	
11	2	1	6	1
12	3	-	5	2
13	-	-	9	1
14	-	-	7	3
15	5	-	4	1

A= Correct in pre-test; Correct in post-test

B= Correct in pre-test; Incorrent in post-test

C = Incorrect in pre-test; Correct in post-test

D= Incorrect in pre-test; Incorrect in post-test

Production Variables Questionnaire

Results for the Unit Two production variables questionnaire appear in Table 9 on the next two pages. (See Table 3 for the questions included in the questionnaire.)

Table 9 presents a summary of answers to the questionnaire's three open-ended questions as well as means and frequencies for the 12 Likert scale items. To avoid response bias in the latter items, half of the statements were stated affirmatively while half were stated negatively. For consistency, reported scores for questions stated in the negative, have been reversed and are indicated with an R.

In their responses to the Likert scale items, subjects indicated the program held their attention, that illustrations and photographs helped explain the points presented in the program, that the program looked professional and well produced, that the program helped them realize how important safety is, and that for the most part, there was enough repetition in the program to help trainees remember the points. They also indicated satisfaction with having a female narrator. Answers to open-ended questions indicated that subjects found the drawings effective and the review sections helpful.

At the same time, respondents indicated where improvements could be made to production variables. Results for question 7 indicated that seven subjects would have preferred more sound effects in the program. Answers to the open-ended questions included suggestions with regards to the size of title letters, colour tone, and the synchronization of visual and audio elements.

Table 9 Results, Unit Two Production Variable Questionnaire

1= strongly agree 3= disagree R= score reversed
2= agree 4= strongly disagree

Q#	Frequencies				Mean
	1	2	3	4	
1.	1	8	1	0	2.0
2. R	0	5	5	0	2.5
3.	2	8	0	0	1.8
4. R	0	8	0	0	2.0
5. R	0	6	3	0	2.3
6. R	0	5	2	0	2.3
7.	1	6	3	0	2.2
8. R	0	8	2	0	2.2
9.	0	9	1	0	2.1
10. R	1	6	3	0	2.8
11. R	1	7	2	0	2.1
12.	0	7	2	0	2.2

14. The best thing about the videotape I just saw was:
    - Effective drawings
    - Review sections were helpful
    - It (finally) gave me an explanation of blue flag safety rules.

Table 9 Results, Unit Two Production Variable Questionnaire (con't)

15. The worst thing about the videotape I just saw was:
    - "Lined into/away" hard to follow
    - Lettering not always clear or large enough
    - Hard to remember colours of switch indicators
    - Colour was off (blue flags looked green)

16. General Comments:
    - Adjust visual/narration synchronization
    - Review 3 blue flag rules with captions
    - Eliminate explanation of gap opposite working track.be made to production variables.

Results for other items were less definitive. Half of the respondents to question 2 indicated that the points presented in the program were not always clear. (Responses to the open-ended questions provided more information about the specific concepts that were problematic for some subjects.) Four suggested the questions asked in the unit were too simple, while three indicated the rules and principles were presented too quickly to convey the message. Two subjects also indicated that music would have made the program more enjoyable and two suggested that the program was slow and drawn out.

CHAPTER FOUR

DISCUSSION

Interim Formative Evaluation

Training Coordinator/Safety Expert Questionnaire

Questionnaire results confirmed that regional training coordinators and a CN safety expert considered both Units One and Two to be useful elements of an orientation program. At the same time, suggested revisions were incorporated into the script, upon which the pilot video, used in the formative product evaluation, was based.

Formative Product Evaluation

Unit One

Pre/Post Test

The high pre-test scores for this unit suggest that much of the content may be redundant or the test questions too easy; this is particularly true in the case of questions 2, 5,6,8,9, and 11 where at least 9 out of 10 respondents chose the correct answer in the pre-test. Nevertheless, the decision was made to maintain the content of the unit, for two reasons: 1) since the sample was not representative of the

target population there was no evidence that the material would be redundant for the intended population and 2) the units were intended to serve as a review for new employees with some shop experience.

After a persual of post-test results during the pilot/field test, difficulties were noted with questions 4 and 7. (These difficulties were later confirmed by the item analysis, which appears above in Table 5). The source of these problems was investigated during the debriefing session where suggestions were made for revisions that would improve the clarity of the test question or the relevant section of the production. (See Appendices VI and VII for lists of revisions made.)

Production Variables Questionnaire

The production variables questionnaire provided important data for decisions regarding program revision. Despite the fact that most items yielded favorable responses, all negative responses were probed in the debriefing to ensure that no important flaws were overlooked. (See Appendix VI and Appendix VII for lists of revisions made.)

The fact that half the respondents indicated there were too few women shown in the program influenced the decision to include more photographs of women.

Since only 4 of 10 respondents indicated they may have liked music added, the decision was made not to add music to the program.

The fact that the program helped 9 of the 10 subjects appreciate the importance of safety, may be attribued to two elements in the unit. According to the International Labour Organization (1970) workers frequently do not display appropriate attitudes toward safety because they find it difficult to imagine how an accident could affect them or because they consider accidents to be unavoidable, like bad weather or diseases (1970). The unit may have counteracted these tendencies by demonstrating a work accident in the opening sequences of the unit, as well as by demonstrating to employees how they can act to prevent work accidents.

Unit Two

Pre/Post Test

Unlike Unit One, statistical analysis of Unit Two indicates a significant relationship between length of service and results on both pre-test scores and gain scores. This may be accounted for by the fact that at least one subject with relatively short tenure at CN (and possibly others) had had exposure to the shop environment and not to the yard. In fact, familiarity with CN shops or similar industrial environments likely accounts for the generally higher pre-test scores on Unit One.

As indicated in the results section, several questions (6, 4, 2, 1, 8, 10, 15) were answered correctly by at least 5 subjects in the pre-test. As was the case with Unit One, the material had not been tried out by the intended target audience and as a result there was some reluctance to increase the level of difficulty of these questions or to eliminate the corresponding content from the program on the assumption that the questions were testing redundant material. Instead, the questions and the corresponding instructional materials were retained in the final version.

There were however, some minor modifications to question 8, where a preliminary perusal of test results suggested a problem and the follow-up debriefing session, some potential revisions. (See Appendix VI for the revision made.) Also, as mentioned in the results section, the item analysis performed after the pilot test confirmed that for question 8, four subjects had indicated incorrect answers in the post-test - one of them after marking the correct answer in the pre-test.

The item analysis also indicated that three subjects were unable to correctly answer question 14 in the post-test. This, combined with feedback obtained in the debriefing session, suggested there was some confusion about how manually and electrically powered switches were locked. To clarify these concepts, appropriate revisions were made in the production. (See Appendix VII for revisions.)

Questions 10, 11 and 12 were eliminated from the test since the corresponding instructional material was edited from the video. This occurred as a result of an unplanned review of the video by a CN safety expert; he concluded that the section of the video dealing with objective 3, (the colours of switch indicators and how they could be used to detect whether the switch is lined away or into mainline and yard tracks) was inaccurate. It was decided, in consultation with the training supervisor, that the effort required to revise this section was not cost or time efficient, and that the section would be eliminated.

Production Variable Questionnaire

As indicated earlier, five of the 10 subjects indicated that some points were not presented clearly. The debriefing provided the opportunity to probe subjects on the specific points that were unclear and revisions were made accordingly.

Suggestions gleaned from both the debriefing and the production variable questionnaire concerning the improvement of production related elements of the video, were also incorporated into the final version of the program. (See Appendices VI and VII for revisions made.)

The fact that seven of the nine respondents to question 12 indicated the unit had helped them realize the importance of safety may be attributed, as suggested above, to the fact that a yard accident at the beginning of the program set the scene for the unit, and that workers were encouraged to take personal responsibility for preventing accidents.

CHAPTER 5

CONCLUSION

Since the subjects used in the pilot/field test were not members of the target population, some of the evaluation results (particularly the pre/post-test results) were somewhat inconclusive. However, as Weston (1986) points out in her overview of approaches to formative evaluation, any type of review intended to improve materials before production increases the effectiveness of instructional materials. Moreover, the learner-subjects used in this study provided extensive and valuable feedback to guide the process of revision. Because of their varied professional backgrounds and their knowledge of CN, subjects were able to provide useful feedback not only on content, but also on the visual and instructional aspects of the production.

The reason that members of the target population were not available for testing of course, was due to the hiring freeze that had occurred in early 1985. This was the beginning of a process of downsizing that will continue into the early 1990's. While the instructional material was released in its final form in 1987, it was not used until earily in 1989 when some limited hiring occurred.

Unfortunately, a lack of long-term corporate planning with regards to hiring needs, combined with a military-like middle management bias to proceed until told otherwise, resulted in a product that may not be used frequently enough to justify the expense involved in its development.

On the other hand, these safety videos could be valuable for employees transferring to the Equipment department from other departments within CN. (During this period of down-sizing, transfers between departments is now the most common way of filling vacancies.) What is needed however, is a recognition that transferred employees need to be oriented to their new jobs, as well as a committment to do so.

While ideally, product testing continues until materials consistently produce satisfactory results, (Weston, 1986) in this case, it would have been very difficult to defend re-testing to CN management since such a procedure would have broken a precedent in a department where the norm had become established as one phase of pilot testing that used between 6 and 8 subjects, where the ISD paradigm was still slowly gaining acceptance. An important factor linked to such reluctance, was the expense involved in taking employees off the floor or yard and paying them their regular wages for almost two days of testing (recall that this was one of five videos being produced and evaluated). Moreover the value of further investment in the product would most likely have been challenged, given the fact that no hiring was taking place.

At the same time it should be mentioned that even if the program had been used by new employees and found effective, as measured by post-test results, the crucial measure of the program's success would have been the extent to which subjects complied with the safety rules and practices outlined in the units. As the International Labour Organization (1970) has pointed out however, rules must be enforced to be effective. In fact, the ILO maintains (1970, p.134) that training or safety instructions "which are systematically ignored should not be used by management as a means of escaping responsibility for accidents resulting from failure to obey them."

The conclusion is clear: If safety training is to produce results, it must not only be effective; such training must go hand in hand with diligent enforcement. The extent to which safety regulations are enforced at CN however, has not been documented.

As Weston (1986) and Ardaway (1983) have suggested, the evaluation strategy chosen on any project is largely determined by inherent practical constraints. Ardaway has pointed out that in the corporate world, the time constraints imposed by deadlines, means that evalution often assumes a low priority; it is a reality that has necessitated creative short-cuts to evaluation.

As this study illustrates, constraints related not only to available time and money, but also to changing corporate policies and plans, can influence not only the selection of the evaluation strategy, but also the extent to which the strategy is realized as planned.

In the context of any applied evaluation, it must be recognized that the use of evaluation models outside a controlled environment is necessarily an adaptation of the ideal. In an open system, one can only hope to apply the appropriate principles and strategies with as much rigour as the system permits.

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APPENDIX I

Training Coordinators/Safety Expert Questionnaire Results

Unit One

Answers are indicated in italics.

1. Do you find the information contained in this script is both accurate and corresponds to the situation in your region? If not, please comment.

   Yes. (mentioned by 4 respondents)
   Accurate and corresponds well.
   Not sure about information in slide 69 in some shops and yards.
   Information contained in script is accurate and corresponds to situations in our region.
   Frame 11- should be "working in and about cars and locomotives" instead of "working on railway tracks"
   Frame 17 - add " That includes a hard hat...to protect you from falling objects and ***blows to the head."***
   Frame 26 - delete word "heavy". Any load can be dangerous, not only heavy ones.
   Frame 43 - change "walk on rails" to "step on rails"

2. Do you find the suggested visuals appropriate for illustrating the information contained in the script? If not, please comment.

   Yes (mentioned by 6 respondents).

Suggested visuals are appropriate for illustrating information contained in this script.

3. Do you feel this unit would be appropriate and interesting for all new employees in your region? If not, how could it be changed so it would be suitable and interesting for all new employees? Please comment.

   Yes (mentioned by 6 respondents)
   Appropriate to all.
   Some slides in this module pertain to craftsmen, but would also be beneficial to others in their place of residence.

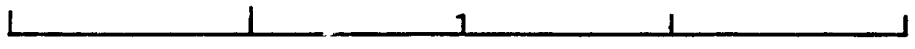
4. Do you feel this script:
   a) contains any unnecessary information? (Please specify)

   No (mentioned by 8 respondents)

   b) is missing some important information (Please specify)

   No (mentioned by 8 respondents)

5. How useful do you feel this slide-sound show would be for inducting new employees?



1	2	3	4	5
not at all useful	somewhat useful	moderately useful	useful	very useful

Frequencies					Mean
1	2	3	4	5	
-	-	-	2	5	4.7

6. Do you have any other suggestions for improving this script?

Delete the expletive in frame 1.

Frame 69 - no warning systems exist at Moncton Shops as described.

none

It is a good script.

APPENDIX II

Training Coordinators/Safety Expert Questionnaire Results
Unit Two

1. Do you find the information contained in this script is both accurate and corresponds to the situation in your region? If not, please comment.

   Yes (mentioned by 5 respondents)
   Excellent
   Frame 3 - script should be "working in and about cars and locomotives" instead of "working on railway tracks"
   Frame 33- script should read "Whenever you have to work on cars and locomotives outside shops" instead of "working on a track"

2. Do you find the suggested visuals appropriate for illustrating the information contained in the script? If not, please comment.

   Yes (mentioned by 8 respondents)

3. Do you feel this unit would be appropriate and interesting for all new employees in your region? If not, how could it be changed so it would be suitable and interesting for all new employees? Please comment.

   Yes (mentioned by 6 respondents)

4. Do you feel this script:

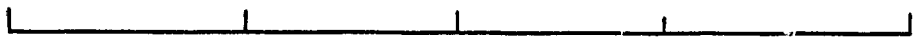
   a) contains any unnecessary information? (Please specify)

   No (mentioned by 6 respondents)

   b) is missing some important information (Please specify)

   No (mentioned by 7 respondents)

5. How useful do you feel this slide-sound show would be for inducting new employees?



1	2	3	4	5
not at all useful	somewhat useful	moderately useful	useful	very useful

Frequencies					Mean
1	2	3	4	5	
-	-	-	1	7	4.4

6. Do you have any other suggestions for improving this script?

   No (mentioned 6 times).

APPENDIX III

Pre/Post Test, Unit One

1. **List the three most common on-the-job injuries.**
   1. _____
   2. _____
   3. _____

2. List the three standard pieces of protective gear that must be worn in the shop and in the yard.
   1. _____
   2. _____
   3. _____

3. List the three rules for positioning and moving your body so as to avoid injury when lifting heavy equipment or material.
   1. _____
   2. _____
   3. _____

Please circle the <u>best</u> answer for the questions that appear below.

4. On the job:
   a) you are responsible for your safety.
   b) only your supervisor is responsible for the safety of your co-workers and visitors to the shop.
   c) you are responsible for your safety and the safety of others.
   d) a and b.

APPENDIX III

Pre/Post Test, Unit One

5. If you see an oil spill or an icy surface:

   a) and it covers a large area, report it to your supervisor or to a safety representative.
   b) and it covers a small area, clean up the spill yourself, or spread sand on the ice.
   c) step around it to avoid slipping and advise others to do the same.
   d) a and b.

6. Since rules can't be written to cover every situation on the job:

   a) you will have to make up and submit safety rules to your superiors that cover any dangerous situation you find.
   b) you must be alert at all times.
   c) you have to take risks on the job.

7. When an overhead crane is about to move a heavy load:

   a) a buzzer or bell will sound to tell you to be alert to the load passing above.
   b) you must be sure to stay between the yellow lines as the load passes above.
   c) a buzzer or bell will sound to tell you to move away from the path of the passing load.
   d) a and b.

APPENDIX III

Pre/Post Test, Unit One

8. If you see any dangerous conditions on the job:
   a) you must report them to your supervisor or a safety rep.
   b) you must avoid them.
   c) you must let your workmates know about the problem.
   d) you must report the problem to the general superintendent.

9. Circle the <u>three</u> answers that apply in all cases:

   To safely use a tool, you must be sure:
   a) to use it for its intended purpose only.
   b) you oil it before using it.
   c) that it is marked with a CN stamp.
   d) to inspect it for defects before you use it.
   e) that you know how to use it.

Please fill in the blanks.

10. Watch where you are going and be sure of your footing to avoid _____.

11. To avoid accidents, the worksite should be kept _____.

12. To avoid eye injury, you must make sure you have the right eye protection for _____ and that your eye protection is clean. Another way to avoid eye injury, when you are passing a welding area is to _____.

APPENDIX III

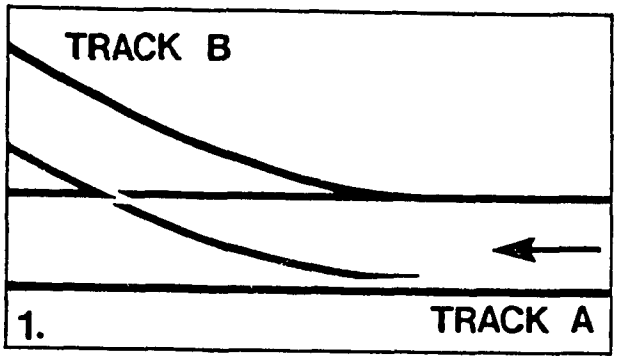
Pre/Post Test, Unit One

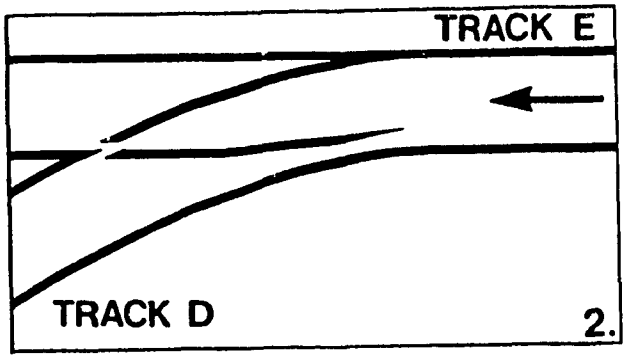
13. If you or one of your workmates has an accident, the first thing you must do is _____. Then, you must alert _____ as quickly as possible so an ambulance may be called if necessary and the proper accident forms filled in.

APPENDIX IV

Pre/Post Test, Unit Two

Check the correct answer for the following questions.





1. In illustration 1 above, the switch is:
   _____ lined into track B.
   _____ lined away from track B.

2. In illustration 2 above, the switch is:
   _____ lined away from track D.
   _____ lined into track D.

3. List the three main blue flag rules that must be observed before you begin to work on a track.
   1. _____
   2. _____
   3. _____

APPENDIX IV

Pre/Post Test, Unit Two

Indicate whether the following statements are true or false by placing a T or F in the space indicated.

4. _____ You may wear ear covering in a yard as long as it doesn't interfere with your hearing.

5. _____ You can safely cross a standing train as long as you cross on a part that doesn't move.

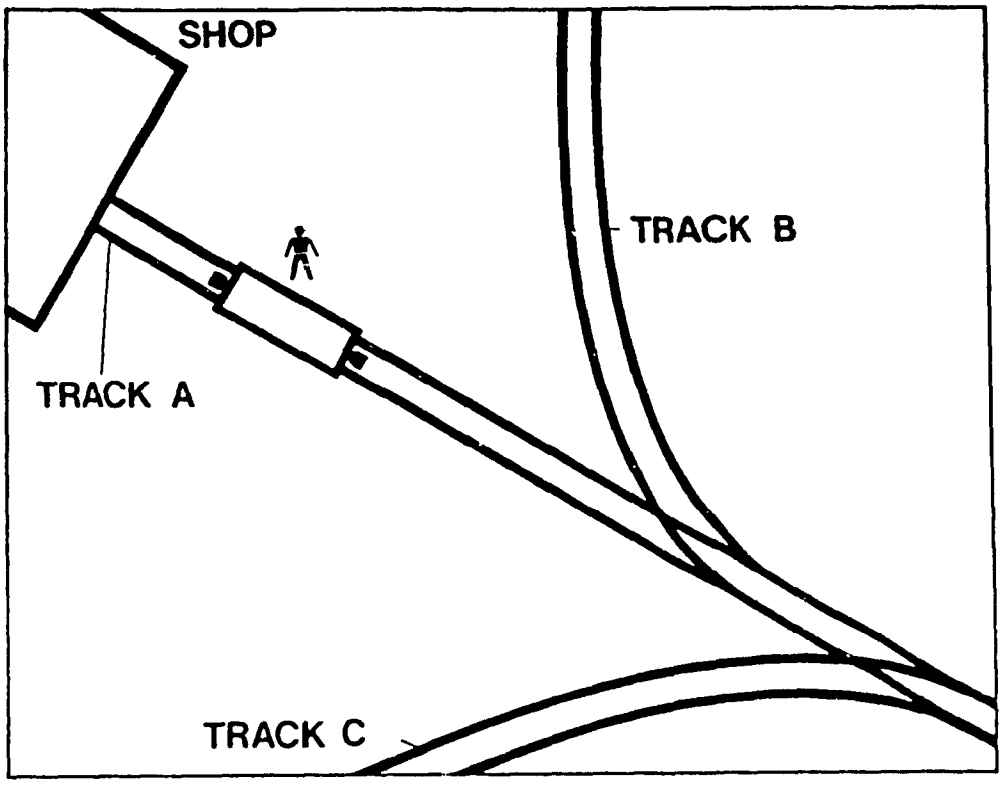
6. _____ As long as you are at least one foot away from it, you may walk next to a passing train.

7. _____ If you are crossing a set of tracks, you may keep two feet away from standing equipment as long as it is protected by blue flags.

8. _____ You must not walk between the rails unless you have blue flag protection..

APPENDIX IV

Pre/Post Test, Unit Two



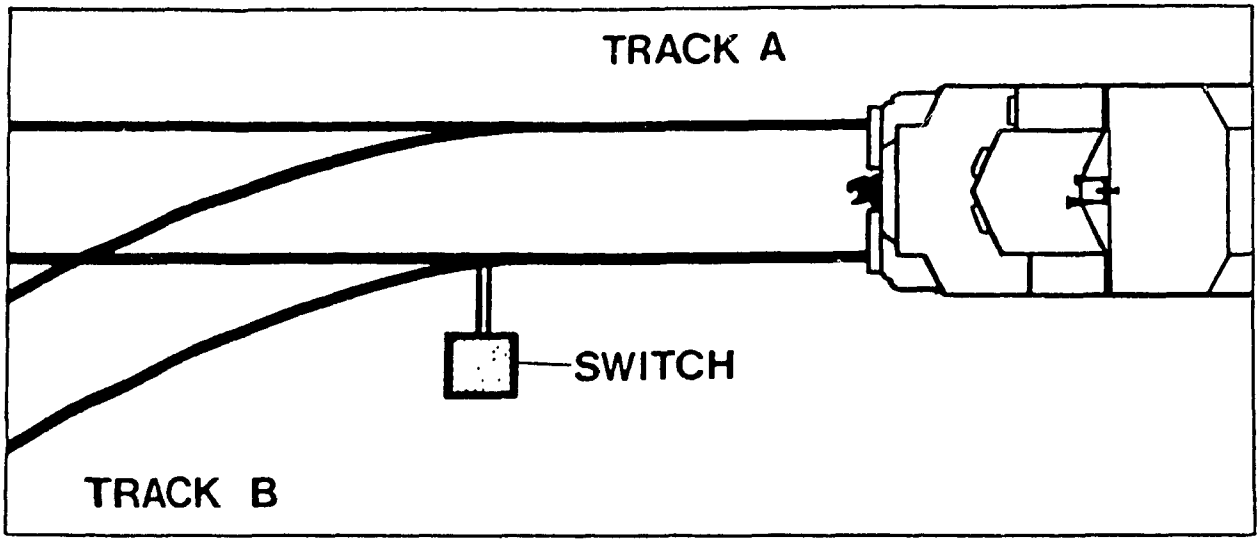
9. a) Draw in the blue flags you would require if you were working on the car indicated in the illustration above. (Be sure that blue flags are properly set up on the tracks.)

b) In the situation shown above, how many switches would you have to check to ensure they/it were lined away from track A ? _____

APPENDIX IV

Pre/Post Test, Unit Two

Please circle the <u>best</u> answer for the questions that appear below.



10. The illustration above shows a manually operated switch and two tracks A and B. If the switch indicator was green, that would indicate that the switch:

a) is lined away from track B if track A is a main line track.

b) is lined into track B if track A is a main line track.

c) is lined away from track B if track A is either a main line track or a yard track.

d) is lined into track B if track A is a yard track.

11. If the switch indicator in the illustration above was red, that would indicate that the switch:

a) is lined into track B if track A is either a main line track or a yard track.

b) is lined away from track B if track A is a main line track or a yard track.

c) is lined into track B if track A is a main line track.

d) is lined into track B if track A is a yard track.

APPENDIX IV

Pre/Post Test, Unit Two

12. If the switch indicator in the illustration on the previous page was yellow, that would indicate that the switch:
    a) is lined into track B if track A is either a main line track or a yard track.
    b) is lined away from track B if track A is a main line track or a yard track.
    c) is lined into track B if track A is a main line track.
    d) is lined into track B if track A is a yard track.

13. When checking that manually operated switches are properly locked, you must be sure that:
    a) personal locks are removed and replaced with a standard switch lock.
    b) the standard switch lock is securely fastened.
    c) the standard switch lock is removed and replaced with a special personal lock.
    d) you have spoken with your supervisor to find out if the switch is locked.

14. To ensure that electrically powered switches are locked:
    a) check that the padlock is properly closed.
    b) check that the proper electrical switch has been turned on.
    c) check with your supervisor or the responsible person in your area.
    d) a and c.

15. To protect those working inside the shop, the derail must be:
    a) locked.
    b) properly placed on the track.
    c) removed from the track.
    d) a and b.

APPENDIX V

Individual Pre/Post Test Scores for Units One and Two with Length of Service

		Unit One			Unit Two		
Subject	Term of Service	Pre-test Score	Post-test Score	Gain Score	Pre-test Score	Post-test Score	Gain Score
1	6 months	13	22	9	3	13	10
2	8 months	11	17	6	7	15	8
3	72 months	16	22	6	11	15	4
4	144 months	20	22	2	9	17	8
5	3 months	15	22	7	6	19	13
6	7 months	17	21	4	4	18	14
7	17 months	16	23	7	10	18	8
8	13 months	14	19	5	6	14	8
9	7 months	20	23	3	9	18	9
10	8 months	21	23	2	7	14	7
	$\bar{x}$ =28.9 months						
Spearman's rho		.252	.067	-.336	.721	-.145	-.700
p		.49	.66	.34	.02*	.66	.02*

* Significant at 5% level

Appendix VI

Revisions to Post-Test, Unit One

Question 7. b) **Changed from:**

you must be sure to stay between the yellow lines as the load passes above

to:

you must be sure to stay inside the pedestrian walkway if the load passes directly above

Source of feedback for revision: Pre/post test scores

Debriefing

Question 12 **Changed from:**

To avoid eye injury, you must make sure you have the right eye protection for _____ and that your eye protection is clean. Another way to avoid eye injury, when you are passing a welding area is to_____

to:

To avoid eye injury, a) you must make sure you have the right eye protection for the_____and b) when you are passing a welding be sure to _____.

Source of feedback for revision: Pre/post test scores

Debriefing

Appendix VII

Script/Production Revisions, Unit One

1. Frame 32 - Narration and visual changed to clarify where one is to stand to avoid moving equipment

   Source: Pre-Post test, Question 7 ,
   Attitude Questionaire, Question 14
   Debriefing

2. Frame 40 subtitle should read You are Responsible for Your Safety and Others' Safety

   Source: Pre/Post test, Question 4
   Debriefing

3. Frame 64 and 65 - Narration changed to clarify and simplify the point that slipping accidents can be avoided by being sure of your footing

   Source: Debriefing

4. Frame 21 - visual should have been changed here to clarify the point, but no suitable visual was available.

   Source: Post-test, Question 4
   Debriefing

5. Frame 71- Photo substituted since original shot, with image reflected in an oil spill, caused confusion

Source: Debriefing

Appendix VIII

Revisions to Post-Test, Unit Two

Question 8 **Changed from:**

You must not walk between the rails unless you have blue flag protection

to:

You should not walk between the rails unless it is required for your job and you have blue flag protection.

Source of feedback for revision: Pre/post test scores
Debriefing

Question 9 **Changed from:**

In the situation shown above, how many switches would you have to check to ensure they/it were lined away from track A?___

to:

In the situation shown above, how many switch(es) would you have to check to ensure they/it were lined away from track A?___

Source of feedback for revision: Pre/post test scores

Questions 10, 11, 12 were eliminated since the corresponding content in the video was removed.

Appendix IX

Script/Production Revisions, Unit Two

1. Frames 12, 13, 65, 67 - The narration was better syncronized with the visuals.

   Source of feedback for revision: Attitude questionnaire
   Designer Review

2. Frame 14 - To relate the concept of blue flag rules to the visuals that depict the context in which they are applied, a left-frame shot of the blue flag rule book was inserted, with the existing Frame 14 shot inserted in the upper right corner and the frame 15 shot dropped into the lower right corner. The narration was adjusted accordingly.

   Source of feedback for revision: Debriefing

4. Frames 18,30,31, - Size of titles was increased for easier viewing.

   Source of feedback for revision: Production Variables Questionnaire
   Debriefing

5. Frames 20,25 - To clarify the concept that the switch must be lined away from the working track, an explanation was added to the narration of these two frames, indicating that leading wheels cannot jump the gap.

Source of feedback for revision: Pre/post test scores
Debriefing

6. Frame 33 - This frame was eliminated to simplify the explanation of the "lined into/lined away" concept.

Source of feedback for revision: Production Variables Questionnaire
Debriefing

7. Frames 34 - 53 - This section was eliminated since it contained inaccuracies.

Source of feedback for revision: Safety Expert

8. Frame 56 - A split screen was created for this frame with the visual, an electrically powered switch, moved to the left; inserted on the right was first a caption, "Locked by remote control" followed by the frame 57 shot, the remote control console. The change was made to clarify that it was the person in the control tower that locks electrically powered switches.

Source of feedback for revision: Pre/post-test scores
Debriefing

9. Frame 58 - The narration was edited to begin over the shot of the manually operated switch (frame 58 shot) rather than over the shot of the remote control console (frame 57 shot). The change was made to eliminate confusion about how electrically powered and manually operated switches are locked.

Source of feedback for revision: Pre/post-test scores
Debriefing

10. Frame 67 - A red "X" was superimposed on the incorrect example depicted in the slide to emphasize that this was not the correct way to position a blue flag.

Source of feedback for revision: Pre/Post/test scores
Debriefing

11. Frame 68 - To eliminate confusion caused by a slide that did not illustrate the point well, another photograph was substituted.

Source of feedback for revision: Debriefing

12. Frame 92 - A super was added, indicating the required 10 foot distance that must be observed by an employee when next to standing equipment.

Source of feedback for revision: Pre-post test
Debriefing

13. Frame 95 - The photograph was re-shot to depict an employee walking between tracks, not rails.

Source of feedback for revision: Pre-post test
Debriefing

14. Frame 97 - The wording was changed here to more accurately describe the rule to follow when crossing a standing train.

Source of feedback for revision: Safety expert review

15. Frame 98 - A red "X" was superimposed on this slide to emphasize that this is not the correct way to cross a standing train.

Source of feedback for revision: Pre/post-test scores
Debriefing