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ABSTRACT

The four instructional systems described consist of (1) a system for controlling multiple images that can be assembled in modular fashion starting with existing equipment and systematically adding components as additional functions are required; (2) a more complex system for controlling multiscreen presentations that requires a considerable initial investment of money and personnel; (3) a team training configuration designed to provide orientation or theory to small teams; and (4) a configuration for providing performance oriented training to teams. Discussions are limited to techniques for implementing the instructional strategy, with no attempt to present data regarding instructional effectiveness. A summary of a classroom field test and evaluation of the usability of the modular configuration is included. An operations manual for the complex multiscreen system and a description of the course development of the team training package are appended. (Author/CMV)

AFHRL-TR-77-83

AIR FORCE HUMAN RESOURCES LABORATORY

FOUR SYSTEMS FOR CONTROLLING MULTISCREEN OR TEAM TRAINING PRESENTATIONS

By

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TECHNICAL TRAINING DIVISION
Lowry Air Force Base, Colorado 80230

December 1977
Final Report for period October 1975 – October 1977

AIR FORCE SYSTEMS COMMAND
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This final report was submitted by Technical Training Division, Air Force Human Resources Laboratory, Lowry Air Force Base, Colorado 80230, under project 1121, with HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235.

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This technical report has been reviewed and is approved for publication.

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Technical Training Division

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Many training sequences require the simultaneous presentation of more than one visual image or images with more than one visual component. These may consist of pictorial images accompanied by verbal material, schematics accompanied by legends, comparative pictorials, or diagrams accompanied by pictorial or verbal material. In other situations, coordinated instruction is required for each member of a small team being trained. At present, developing and producing such images is so technically complex that it is not accomplished by the majority of USAF training installations. The objective of this investigation was to develop and describe procedures and techniques for generating and presenting such instructional material.

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Item 20 Continued:

An informal survey of USAF training compatible with multiscreen presentations was conducted to determine types of control techniques that would be of benefit to the Air Force. It was determined that no one system would be appropriate in all situations. Most of these situations could be classified into two categories: first, those in which the student or group of students required more than one simultaneous visual and, second, those in which teams of students required synchronized but different instruction. The first category could be divided into one group that required complex presentations from the beginning and a second group that required less complexity initially, but the complexity could be expected to increase or vary.

This report describes (a) a system for controlling multiple images that can be assembled in modular fashion starting with existing equipment and systematically adding components as additional functions are required, (b) a more complex system for controlling multiscreen presentations that requires a considerable initial investment of money and personnel, (c) a team training configuration designed to provide orientation or theory to small teams; and (d) a configuration for providing performance-oriented training to teams.

The discussions are limited to techniques for implementing the instructional strategy. There is no attempt to present data regarding the instructional effectiveness of the strategy. A summary of a classroom field test and evaluation of the usability of the modular configuration is included.

In order to provide usable guides and still keep the report down to a manageable size, the description of the first two systems are focused on hardware considerations. The description of the third is limited to a brief functional narrative. The discussion of the fourth focuses on courseware development. In any application, attention must be focused on all three aspects but there is enough similarity between the systems that it is felt unnecessary to discuss hardware, courseware, and function for all systems.

For the convenience of the reader, the detailed information on the specific systems has been placed in Appendices. Appendix A provides detail regarding the field trial and evaluation of the modular system described in Chapter 2. Appendix B provides a rather detailed Operations Manual for the complex multiscreen system described in Chapter 3. Appendix C provides a digest of the development of the specific courseware employed in the team teaching application.

This material was developed in response to a specific request and was written to provide some suggestions for agencies considering the initiation of multiscreen or team training media programs. As a result, it is intended as an applications guide and will probably be of rather limited interest to the general reader.

This report is intended to be used in conjunction with AFHRL-TR-75-37, *Quality Assurance of Media Devices and Courseware* and AFHRL-TR-75-68, *Techniques for Generating Instructional Slides*.

PREFACE

This report was completed under project 1121, Technical Training Development; task 112107, Media Design and Evaluation; work unit 11210705. Dr. Marty R. Rockway was the project scientist and Dr. Edgar A. Smith was the task scientist.

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I. INTRODUCTION

This effort was initiated in response to a Request for Personnel Research (RPR 75-20) from the Operations Training Support Laboratory (SAC) at Carswell Air Force Base, Texas. For clarity and background, the initial paragraphs of that RPR are quoted as follows:

> 1. TITLE: Techniques for Utilizing Multiscreen Mediated Programs in Developing and Presenting Instructional Material.
>
> 2. PROBLEM: Many training sequences require the presentation of more than one visual image or images with more than one visual component. These may consist of pictorial images accompanied by verbal material, schematics accompanied by legends, comparative pictorials, or diagrams accompanied by pictorial or verbal material. At present, developing and producing such images is so complex technically that it is not accomplished by the majority of USAF training installations. It is also so time consuming when it is done that the resultant material tends to become outmoded before it is introduced. Recent photographic and electronic developments can provide for more efficient and economical methods of generation and presentation.
>
> 3. OBJECTIVES: The objective would be to develop procedures and techniques for generating and presenting compound and complex visual images that are within the operational capability of USAF training facilities. This will include both the development of control procedures to provide for multiscreen presentations and also for development techniques in which multiscreen techniques will be utilized during development of the training sequence and then reduced to single screen use for actual presentation in the instructional situation. Particular attention will be devoted to problems of revising and updating visual information and control signals.
>
> 4. PRESENT STATE-OF-THE-ART: While the state-of-the-art exists to generate and present compound and complex images, recent innovations in the photographic, recording, and entertainment communities have not been capitalized on by USAF training agencies. It is believed that systematic programs and techniques can be documented that will make the generation of more sophisticated training programs economical and efficient. The electronic and photographic technology exists. It needs to be systematically documented in a manner that enables using commands to take advantage of it.
>
> 5. TECHNICAL FORECAST: It is anticipated that documentation could be developed that would suggest procedures and techniques that could be readily incorporated into ongoing USAF training programs. While some innovation would be required in consolidating existing state-of-the-art technology into usable guides, the probability of success is very high.
>
> 6. BENEFITS: This study promises to make readily available suggestions for technical procedures that could improve training efficiency and effectiveness without increasing expense unduly. In the past, efforts have been made that were technically cumbersome or so involved that they could not be efficiently incorporated into ongoing USAF training programs. Present resource limitations require that if complex visual images are to become practical, procedures must be instituted to conserve manpower and equipment both during the initial development of sophisticated mediated sequences and also during later utilization of the training program. The utilization stage would include not only the actual presentation but also the maintenance of the equipment and the updating of the instructional courseware. It is anticipated that this effort will make available recent innovations in a way that will make such presentations practical and effective.

A part of this request could be met with reports that were in the process of being printed at the time the request was received. The request for photographic methods to facilitate both the development and updating of photographic images could be met by information contained in Appendix A, Captioned Photos as a Production Technique (Smith, 1975; Smith, Hall, & Manson, 1975). These publications present the techniques for maintaining both an acceptable quality of visuals and recorded audio and the methods for fostering reliability of presentations by obtaining and maintaining adequate electronic control impulses.

These publications were made available to Operations Training Support Laboratory (OTSL), and the techniques described were demonstrated during site visits. The proposed techniques were compatible with their procedures. Procedures were implemented to standardize development techniques to capitalize on the advantages of captioned photos. The quality assurance suggestions were forwarded to: Headquarters Strategic Air Command, Offutt Air Force Base, Nebraska. "Instructional Systems Development (ISD) Policy Letter #1 – Quality of Courseware," dated 3 February 1976 formally adopted the standards and made Smith (1975) part of the official Command ISD Implementation Plan 3-76 by reference.

The information presented in this report addresses the remaining portion of the request; i.e., the electronic control system required.

An informal survey of USAF training (compatible with multiscreen presentations) was conducted to determine types of control techniques that would be of benefit to the Air Force. Following this, it was determined that no one system would be appropriate in all situations since the type of training varied greatly. These situations could be subdivided into two categories: first, those in which the student or group of students required more than one simultaneous visual and; second, those in which teams of students required synchronized, but different, instruction. It was also noted that the first category could also be divided into one group that required complex presentations from the beginning, but that this level of complexity would remain rather stable, and a second group that required less complexity initially – but the complexity could be expected to increase or vary over a period of time. As a result, rather than investigating one type of presentation system, an attempt was made to describe a family of system, each of which represent a type of training need. In some instances, representative systems could be found that already exist within the Air Force and experience with them has provided sufficient background so that extensive investigation would be unwarranted. In other cases, it was felt that neither the experience nor documentation were available to meet the needs of the RPR in providing "usable guides" that would facilitate adoption into ongoing USAF training.

In brief, the following sections of this report will describe (a) a system for controlling multiple images that can be assembled in "building block" fashion starting with existing equipment and systematically adding components as additional functions are required, (b) a more complex system for controlling multi-screen presentations that requires a considerable initial investment of money and personnel, (c) a team training configuration designed to provide orientation or theory to small teams, and (d) a configuration for providing performance oriented training to teams.

The discussion will be limited to techniques for implementing the instructional strategy. There will be no attempt to present data regarding the instructional effectiveness of the strategy. It is assumed that the using agency will conduct pilot investigations to determine whether or not they would benefit by employing the strategy. In other words, if the reader feels that he has a requirement, this publication might suggest ways of implementing it. The instructional efficiency and effectiveness would have to be determined by the user. Representative cases are presented where a presentation system was implemented within an ongoing USAF training environment. However, again this discussion is limited to implementation considerations with no attempt to establish whether or not there was an increase in the amount of learning on the part of the student. This report might be considered as covering the first phase of a two-phase study. This report will describe methods of implementing instructional strategies. A second effort would be required to demonstrate the results of implementing them.

In an effort to provide the "usable guides" requested in the RPR and still keep the report down to a manageable size, the description of the first two systems will be focused on hardware considerations and the description of the third will be limited to a brief functional account. The discussion of the fourth, performance oriented team coaching, will focus on courseware development. In any application, naturally, attention must be focused on all three aspects, but there is enough similarity between the systems that it is felt unnecessary to discuss hardware, courseware, and function for all systems. Most of the discussion about developing instructional goals and script preparation are as essential in the development of multiscreen presentations controlled by digital programmers as they are for the development of audio coaching. Likewise, the recorders and radio hardware devices used to implement the audio coaching require careful selection and installation.

II. MODULAR SYSTEM

As noted in the introduction, many instances arise in which it is not practical to establish all of the characteristics of a presentation system at the outset. There is often a need to start with a comparatively simple system and add to the system as the need arises. The commercial market (at the present) includes control systems that provide for this. The particular system selected as representative of this family of control systems is marketed by the Minconi Division of Wollensak/3M. One of the major reasons for selecting it as the representative is that many of the components are presently listed in TA 636 (Table of Allowance – Audiovisual Utilization, Basic 15 September 1977) and it is familiar to many USAF users and maintenance personnel. It has demonstrated reliability and maintainability and its usability features are on the par with present standards. This in no way implies that other makes and models are not also acceptable. It merely reflects the judgement that this is a representative series of devices that has proven to merit consideration. The prospective user should confirm the availability of modules for any system adopted. In this rapidly changing market, modules are added to and removed from product lines frequently.

In the modular configuration, the initial unit is the standard 80-tray slide projector. The equipment used during the evaluation and demonstration of this configuration were standard Kodak AF-2s, since they were on TA 636. If other makes or models are to be used, make certain that they have remote control capability and that the cable connections are compatible with other equipment.

Narration for the slides can be added through the addition of a cassette recorder (Figure 1). Many cassette recorders can be used to not only add the narration, but also to automatically advance the slides. This is the basic AF-2 coupled to a Wollensak 2570 that is typical of units used in USAF learning centers. This is the basic starting point. It should be noted that to this point everything is compatible with the self-contained devices marketed by such firms as Singer, Fairchild, Bell and Howell, and Eastman. These self-contained devices have a projector, cassette recorder/player, and screen built into a single unit. The essential point is that the control signals for all of these units have been developed in accordance with ANSI 7.4 standards, so that a program developed on one system can be used on another.

In any use of three or more projectors, it is critical that the user is able to use the second track of the recorder as a control track, similar to recording the second channel on a stereo deck. Most cassettee recorders that have slide synchronization capability do not have external jacks associated with this track. While they have microphone and speaker jacks that use the audio track, they do not have input and output jacks for the impulses. These sync jacks have been added to the 2570AV and 2590AV series by Wollensak. In effect, they provide a half-track stereo cassette with the audio on the lower track and the impulses on the upper track. As a word of warning to the reader, virtually all audiovisual cassette player/recorders utilize a half-track head configuration. The tapes are played in only one direction. Most comparable home stereo cassette units use quarter track and are played in either direction. Unlike quarter-inch reel-to-reel recorders that use tracks 1 and 3 in one direction with 2 and 4 used in the other, the cassette quarter tracks use both of the lower tracks in one direction and the two upper tracks in the other. As a result, you can play stereo quarter track on stereo half track reel-to-reel devices, as long as it is only recorded in one direction. The same is not true of cassettes. When a stereo quarter track tape is played on a half-track device, you will hear both tracks through one speaker. If one track is audio and the other control impulses, you will hear both through the speaker and the control circuitry will receive nothing. As a result, do not try to mix home stereo equipment with audio visual equipment, especially if duplicators are involved.

There are many dissolve units that can be added to the basic AF-2 coupled to a Wollesak 2570 configuration. Any dissolve unit enables the showing of a series of images that blend into each other without blacking the screen during each change. One limitation of a dissolve unit is that all it can do is dissolve one image into the next. Two projectors alternate images on a single screen. There is no variation in the order, the projectors must alternate between A, B, A, B, etc. All the odd-numbered slides are on one projector, all the even-numbered ones on the other. If a slide is added or subtracted, all slides after that change have to be moved to the other tray.

COMBINATIONS OF MODULES FOR VARYING TYPES OF PRESENTATIONS

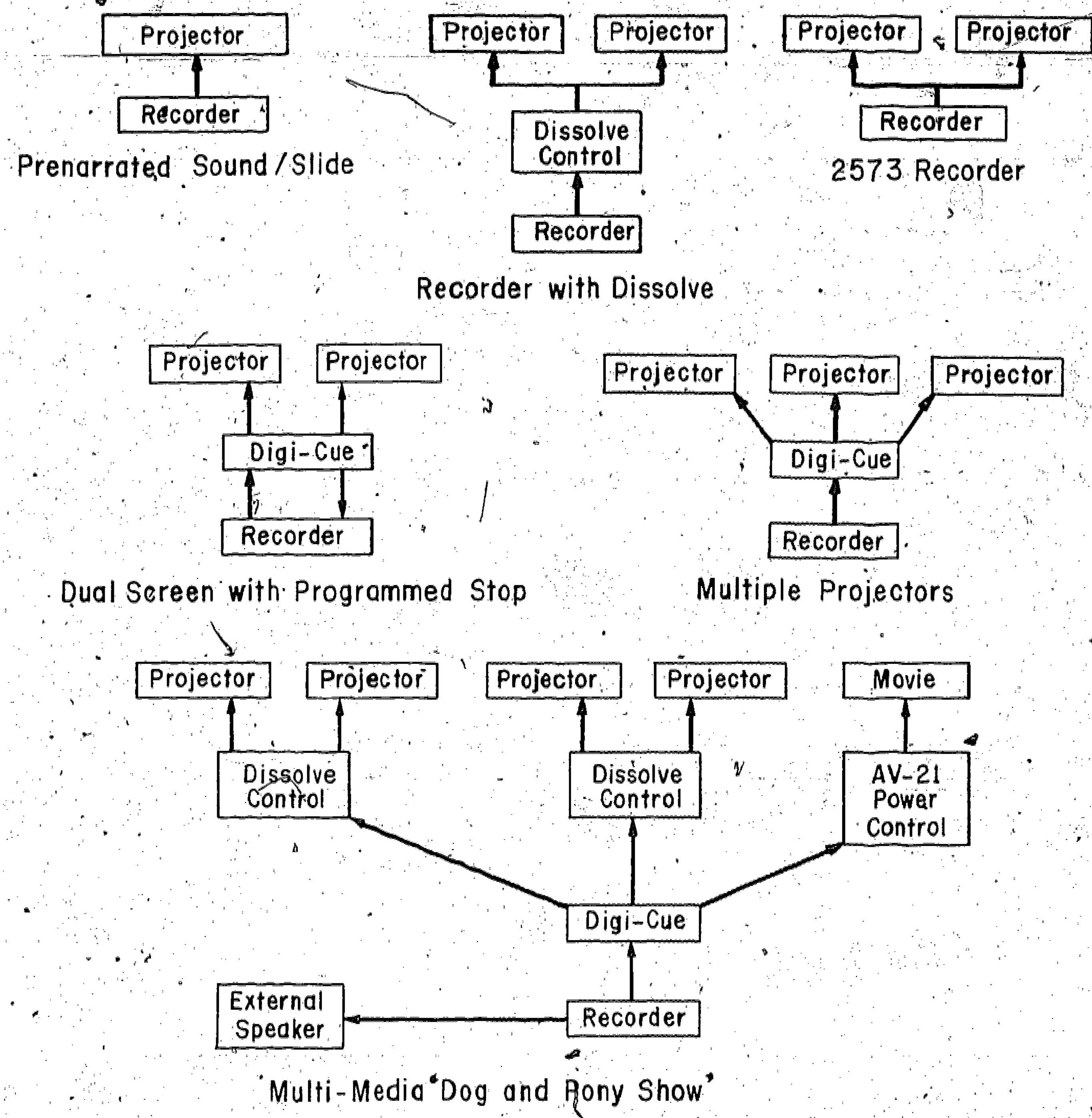

Figure 1. Combinations of modules for varying types of presentations.

If the Wollensak 2570 cassette recorder is replaced with the newer 2573, then a three-speed dissolve unit can be used rather than the one-speed. This enables the use of not only regular dissolves between images, but also fast cuts and slow dissolves or fades.

A more important contribution of the 2573, however, is that you can also control two projectors independently. You do not have to alternate between projectors on a single screen, but can use two projectors on separate screens and advance either one at any time. This allows much more freedom and also enables the use of considerably more complex images. For example, it is possible to compare a normally exposed slide with one that is overexposed one stop, overexposed two stops, underexposed one stop, or underexposed two stops. Since both the normal slide and the abnormal slide are visible to the student at one time, the differences are much more apparent and the concept can be conveyed much more efficiently than is possible with one projector. It is feasible to compare an original slide with a duplicate and a second generation duplicate. If this is done, both the color and contrast changes as well as the cropping changes become very evident. These two examples were used in the investigation and were remarkably effective. If the reader wishes to investigate the effectiveness of dual screen presentations, he is encouraged to try these two samples. There is a great deal of training that requires such comparisons rather than sequences.

A full image of a chart, form, or diagram may be projected on one screen and enlargements of specific portions on the other, or project pictorial slides of printed circuit boards on one screen and the wiring diagrams or schematics on the second. Another possibility is projecting pictorial images on one screen and questions concerning it on the other. The latter example contains some subtle implications that really have to be used to be appreciated. For example, if you show a photo of an aircraft instrument panel (or of the specific instruments being discussed) on one screen, the second screen could provide a question, such as "Can you fly 500 miles with this fuel load?" Without changing the image of the instruments, the question could be changed to reflect change in wind or other flying conditions. Since the first image showing the instruments has not changed, it is evident to the student that the same data are being used. The effect on the student appears to be quite different from an apparently similar presentation in which both images have been changed. Both images could be superimposed on a single screen. This would enable adding words, data, or arrows from one projector onto the image of the other. Without changing the basic image, the words, data, or arrows can be changed or moved.

It is also possible to add a programmer to the 2570 or 2573 cassette recorder and control up to 9 projectors. For example, in one carrel used during the study, a 3-channel programmer was used to control two slide projectors. The third channel was used to control a movie projector so that motion could be added to the presentation when needed. By adding additional dissolve controls and projectors, rather complex presentations could be built up. In order to use the movie projector, an additional module is required. The projector itself is plugged into a power control module. The power control is turned on when it receives a slide advance from the programmer. A second slide advance turns the power control off. This configuration may be expanded somewhat further by using two of the commands to control three speeds of a dissolve control. To facilitate this, the units were designed so that if both the dissolve and the fade commands are given simultaneously, the result is interpreted as a quick cut. This would enable the use of one Pro 9 to control two slide projectors with three dissolve rates on each of three screens and also have three commands left to control movie projectors or room lights.

One of the features of a mediated system that many USAF users feel is essential is programmed stop. This stops the cassette recorder, while leaving the projected image on the screen. Many developers of mediated packages have noted that when they want a student to take an action or solve a problem, there is no way of predicting how long the student will require. It might take 5 seconds to move a switch from position A to B or, if the student is encountering difficulties, it might take considerably longer. One way to accommodate the variation is to stop the recorder while the student is performing. Sometimes the student can stop the cassette recorder manually. However, this is often most undesirable. Students are usually unable to stop the recorder, but can almost always restart it without disruption. As an example, if the students are soldering a connection, they probably have the soldering pencil in one hand and the solder in the other at the moment you want to stop the cassette. If they set the solder down to reach up and turn off the recorder, this interferes with the learning. On the other hand, after completing the soldering, they are ready to set down the solder and to restart the recorder. A foot switch can be used if needed. As a result, many manufacturers have provided the programmed stop feature. Placing the appropriate impulse on the tape automatically stops the recorder. A 1000Hz tone automatically advances the slide; a 150Hz tone automatically stops the cassette recorder when the separate track recording configuration is used. A short impulse advances the filmstrip and a long impulse stops the recorder in the superimposed configuration. Both are provided for in ANSI 7.4. Actually, there is no real reason why slide systems use one configuration and filmstrip the other. Both configurations are suitable for either. In fact, many tapes are made with both sets of impulses on them. The major advance made by the adoption of ANSI 7.4 was the standardization on only two systems. Until then, there were many systems on the market. Courseware prepared on one brand of device could not be utilized on other brands. This was most inconvenient. Unfortunately, no similar standardization was done for multiscreen systems. Programs developed on Brand A must be presented via Brand A. Brand B will not respond to the impulses; Brand C will not respond to either A or B. This is a limitation.

If this programmed stop feature is desired within a multiscreen presentation, it can be provided, but with some difficulty. Cassette recorders such as the Wollensak 2573 can be used either to control two projectors or to control one projector and provide programmed stop. Setting a switch one way routes the 150Hz impulse to circuitry that advances a projector, setting it another uses the same impulse to stop the tape drive. Unfortunately, when you plug into the sync output jack, this circuitry is disengaged. Even with cassette recorders that ordinarily provide programmed stop, this feature cannot be used when decoders such as Digi-Cues are plugged into them. This feature can be regained by routing one projector control cord back to the cassette recorder. One unexpected result of using such a cord is that it often introduces unreliability into the system. If the base has radar or radio facilities, the cable will often act as an antenna picking up stray signals and stop the program erroneously. This can be eliminated by the judicious use of resistor/capacitor combinations or metal oxide varistors (MOV), but this requires some skill and knowledge. This will be discussed further later in this section.

This programmed stop feature becomes even more important if live narration is used within the presentation. While the systems can be wired to stop after each image change, the length of the cable running to the speaker's podium acts as a long antenna. The user may actually hear the local radio station over the PA system and get more erroneous stops than programmed stops. Again, this can be rectified, but it takes a qualified electronics person to do it.

The trade off for all this is cost and reliability. To build up to a two screen presentation in the past required complicated programming and so many interconnecting cables that the system could only be used in group presentations with complicated equipment. If a slightly different control were needed, the entire programming system and equipment had to be replaced, resulting in transitions that were costly in terms of time and money. The cabling was complex and unreliable. With the configuration recommended here, a simple two screen presentation could be done with just the cassette recorder and the projectors without any additional black boxes and cables. The black boxes can be added, as needed, without discarding the original equipment.

This system was implemented within a Mission Applications Seminar, where the automated system was utilized for five weeks and then removed to explore student and instructor acceptance. It was found that, contrary to initial expectations, the automated system increased the contact between students and instructors as evidenced by questions and discussions. This was of major importance in this application, since one of the principal purposes of the presentation is to foster such questions and discussions. It was also determined that increased classroom efficiency could more than repay the initial cost of the equipment. It was estimated that it cost about $3,000 to obtain and install the automated equipment. With it, only one instructor is required per room rather than the two instructors presently required with the manual presentations. This field test and evaluation, as well as a discussion of difficulties encountered in automating the room, are discussed in more detail in Appendix A.

III. COMPLEX MULTISCREEN SYSTEMS

The family of systems to be described in this section are very probably the most underused in training today. While multiscreen, multiimage presentations are used prominently in Chamber of Commerce programs, designed to attract new industry or tourists, they are virtually unexplored in terms of their ability to provide training. The control system greatly increases the content that can be covered in this seminar. This increase is due both to the increased speed of the presentation and, more importantly, to the increase in the types of material that can be presented.

The Arion 909 Digital system will be described here, but there are many other systems available and other comparable equipment could have been selected. Since this is a very rapidly changing area and one that represents a considerable investment, anyone contemplating the introduction of such a system should conduct a thorough survey of the market. Listings of potential sources can be obtained from agencies such as Association for Education Communications and Technology (AECT), 1126 Sixteenth Street, NW, Washington, DC 20036 and National Audio-Visual Association, Inc. (NAVA), 3150 Spring Street, Fairfax, VA 22030.

This section will focus primarily on presentation hardware. A portion will be devoted to using such a system to control a previously prepared presentation. This will be followed by a discussion of how the various components contribute to the program, and how the program is developed. While this discussion is limited to the 909 Digital system from Arion, it typifies this level of sophistication. Any using agency would probably benefit from developing similar documentation. The system is complex enough that very detailed procedures for specific applications are required. This would be especially ture in USAF applications where it can be anticipated that the using personnel will rotate through the duty rather rapidly.

The description here is limited to one representative use of one specific system. In actuality, this application demonstrates only a small proportion of the total capability of the system and of the comparable systems on the market. In brief, this family of devices can easily control presentation in which three projectors are used on each of five screens (or any presentation using less than this number). The projectors can be controlled in any order and with very precise timing. The images on the screen can be controlled to convey motion. In fact, after using such a system, the presentation designer usually finds that a typical movie is very slow by comparison. Presentations can often be produced considerably faster than a movie. The updating of the presentations can be accomplished within a matter of hours if adequate procedures and personnel are available. The instructional applications could well be very cost effective. In situations where it is necessary to illustrate the interrelations between several components or the flow of data or information through a complex network, the visuals could well be very efficient and effective. When the capability to control a dozen latching and a dozen momentary relays is added to this, a considerable amount of equipment could be controlled. For example, oscilloscopes or CRT displays could be activated on command or current flow through the system controlled. It might well be that much of the instruction, presently deemed possible only through hands-on training on expensive weapons systems, could be facilitated by such presentations. Whether these would precede, augment, or replace the actual equipment would depend on the particular application.

Any organization contemplating the introduction of such a system should be aware that such a system cannot be installed casually. The development of the presentation, especially the actual programming, is not especially difficult, but it does require considerable time and freedom. The visuals to be used must be of the highest quality since defects are magnified in such presentations. While many USAF bases have the resources to support such a presentation, it is not the type of activity that can be assigned as a routine additional duty. A worthwhile presentation of this level requires considerable support and respect.

IV. TEAM TEACHING – VISUALS

One type of instruction that is suitable for multiscreen presentations is that of team training. There are many situations in USAF training where the performance of the individual must be integrated into that of a team. Athletic coaches are leaders in team training and probably have best utilized its benefits. Renaming the positions to emphasize the concept, a large school will have an athletic instructor with specialists for each sport. The football instructor will have specialists for the offense and defense and special units. Each in turn will have specialists instructing students in the performances required on the line, or at end, or in the backfield. In obtaining successful performance from any one position, the student has to be able, not only to perform all of his tasks, but, to also integrate this performance into the total pattern of performance of the entire team. Some, but obviously not all, schools are able to train the individuals in such a way that when one student throws a ball, another student is in a position to catch it. Each of the other team members perform very specific duties developed to increase the probability of success of these two individuals. The total instructional pattern might well be the most complex and most highly developed within our culture. This is not intended to have any social implications, but merely to illustrate an example of team training that might be worth emulating in many situations. The analogy might be worth pursuing in terms of behavioral objectives and instructional goals.

Two methods of implementing team training will be covered in this report. The first family of techniques is a relatively simple extension of the techniques described previously. The second family will utilize considerably different techniques and in fact in the basic portion does not use screens at all, but requires the student to observe actual equipment to obtain visual cues. In both instances, attention will be directed at development requirements and instructional strategies rather than hardware. As in previous portions of this report, specific implementations will be described for clarity but these are intended as illustrations of general applications. All of the techniques have a wide range of possible applications. The range of applications is limited primarily by the imagination of the user.

Team Training Carrel

There are many situations where the actual performance to be taught does not lend itself to carrels. If you are teaching students to climb telephone poles or direct traffic at an intersection, it is not reasonable to expect to bring the poles or traffic jams into the carrel. However, sound/slide presentations in carrels can often be of value if used in advance for orientation and familiarization and used after to summarize or reinforce learning. Equipment of the type described previously in this report can be used to augment team instruction in a similar way.

In the specific situation to be discussed here, (four-man munition crews) a special purpose carrel was developed. The carrel was similar to conventional instructional carrels in that it contained the recorders, projectors, and screens needed to convey a sound/slide presentation. The screen area was extended to make it long enough for the showing of three slides side-by-side. For the specific tasks to be taught, three screens were adequate for use with a four-man team. Some situations called for one man to serve as a team chief, who read the instructions from the technical order (TO). In such cases, he must be able to view all three screens. Each of the remaining three students are seated in front of a screen that shows images directly relating to their own function. They are each able to see what they are expected to do. By glancing at the other two screens, they can also become familiar with the tasks being performed by their teammates. Many times it is possible to depict activities that are rather difficult to illustrate with the real equipment. On the actual equipment, they may be performing in an area where they cannot see their teammates.

In other instances, two members have very similar duties. One may be on the right side of the plane and the other on the left, but the duties they perform are similar. In such cases, these two students could view the same screen.

The narration required is different for each of the three screens. A rather trivial example might be for one student to hand a tool to a second student who is working above him. The narration would tell the first student where to obtain the tool and how to select the appropriate one. The narration for the second student would tell him how to use the tool during this specific task.

It is essential that the narrations be synchronized so that when the first student lifts the tool, the second student is ready to take hold of it. This was accomplished by using a quad tape recorder. These devices have four separate heads and amplifiers so that four separate recordings can be made. Since the four recordings are all on the same tape, synchronization between the tracks is maintained. This is in contrast to similar devices that employ four different cassettes. While all four cassettes can be played at one time, the recordings are not necessarily in sync. In this illustration, the students are interacting as a team and the narrations must be synchronized.

The three narrations are recorded on three of the four tracks of the quad recorder. The fourth track is used for the impulses. In this particular case a Spindler and Sauppe QUADRA QUE was utilized. Impulses on the tape control the three projectors in much the same way as the Arion and Wollensak programmers. While the impulses used are different, in many ways the function performed by the three programmers is similar. Unfortunately, the impulsing systems are entirely different, requiring that the specific programmer be selected and available before the tape can be made. It also prohibits substituting one device for the other in case of emergency. The agency making the tape also has to have the appropriate device to generate the impulses during recording. This emphasizes the advantages of ANSI 7.4 in establishing standard impulses for standard sound/slide and filmstrip equipment. Tapes made for Wollensak devices can be played on Telex, DuKane, Singer, Eastman, or Fairchild equipment. It is not necessary to modify the courseware to make it compatible with different brands. That is not true of the equipment described in this section and in Section III.

Variations

Expansion. If teams are larger than described here, the system could easily be expanded to control more visuals. Controlling 15 or more projectors from one record track is relatively common. However, if more audio tracks are required, the problem might be more difficult. While such presentations as those used in the Birdhouse at Disneyland have many audio tracks, implementing such systems is difficult. A fourth audio track could be used for narration by employing the superimposed control system rather than the separate track. Here the slide advance impulses are 50Hz tones recorded with the narration. This would enable having all four tracks available for narration. It would also be possible to combine more than one audio source and control them by a master unit, but again the implementation would be rather difficult.

Separate screens. There are times, such as the training of flight crews, when it would be desirable to have the visuals in different locations. One specific example would be the currency training given to MAC crews. The system described in this section could be used with very little modification. Instead of having the three visuals presented side-by-side, the projection system could be located in the mockups of the three crew stations. While wires would have to be run from the recorder to the three crew stations, no other alteration would have to be made.

V. TEAM TRAINING – AUGMENTED AUDIO

Inconsistent as it may sound, some of the best audio visual presentations do not include visuals. Examples would include museum tours where the visitor listens to a recording while viewing exhibits. The visual component is obtained by instructing the listener to observe a particular part or aspect of the exhibit. These are considered to be aduio visual packages since they are prepared in such a way that the scene (visual) will be available to coincide with the audio. Some Navy training programs utilize portable tape recorders to provide similar instruction in confined areas. A USAF project used a tape recorder carried with a shoulder strap to present a sequence on the use of a copy camera. A knitting machine on the market comes with a series of records. The user plays the records while operating the device to obtain the desired preliminary instruction. The essential feature is that the recorded message is meaningful only when the listener is observing the associated scene or performing the associated task. The visual aspect is created by the student observing an object, rather than by viewing a projected slide.

The team training task described here is similar. The recorded audio is provided via headphones. The student is instructed to "Look to your left and you will see a large black knob with white numbers on it.

This is the * * * It does * * * Set it to " * * * " The other members of the team perform coordinated tasks in accordance with the instructions they hear (Figure 2). In the specific application to be described here, this is referred to as Audio Team Coaching. It was one of three team teaching techniques used together in a performance oriented team training situation; i.e., munitions loading. The other two techniques were a series of television tapes used to provide familiarization and a second series of television tapes used for remedial training. These were referred to as television team coaching and television-aided remedial study, respectively. This project was accomplished under an AFHRL contract (Pieper, Foss, & Smith, 1973).

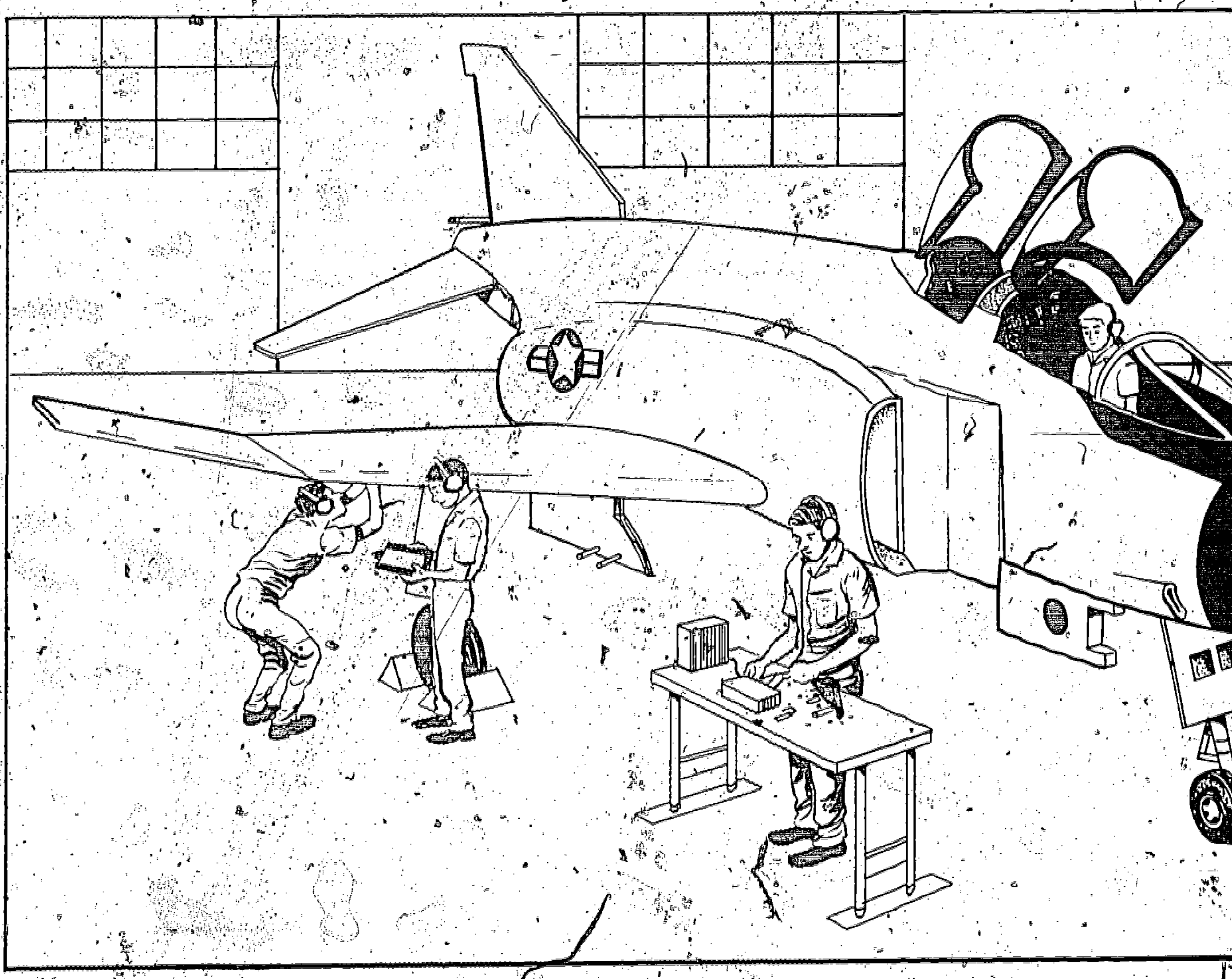

Figure 2: **Audio team coaching.**

VI. SUMMARY

This report was written in response to a request for a guide for use in selecting and implementing systems for generating and presenting complex visual images. There appeared to be no one system that would be suitable for all applications. Within USAF training, some systems appear to be applicable to multiscreen presentations where more than one visual is required in presentations to individuals or groups of students. In other situations, similar techniques are utilized to provide different presentations to the members of small teams. While the mechanics were similar, the utilization is quite different.

Four systems were selected for discussion. While specific devices are described in this report, each was chosen to be representative of a family of options. Two of the families are primarily suitable for complex presentations given to an individual or group. The other two were selected to represent possible applications to team training, where each member of the team requires different instruction, but the team members interact so that synchronized presentations are required.

All applications require even more attention than normal, both to the hardware utilization and the generation of the courseware to be presented. It was noted that defects that might be overlooked in simpler presentations become considerably more serious in complex presentations.

A modular system was described that can be started with only a projector and a tape recorder. Additional modules can be added as more projectors or functions are required. This modular system can be expanded to several screens, with each screen providing dissolves between slides. Movies can be interspersed with the slides, if desired. It is also practical to intersperse live narration with recorded audio if desired. However, it was observed that special care had to be taken to avoid interference from radio and radar.

This system was implemented within a Mission Applications Seminar, where the automated system was utilized for five weeks and then removed to explore student and instructor acceptance. This field test and evaluation, as well as a discussion of difficulties encountered in automating the room are discussed in more detail in Appendix A.

There are a number of programming systems available from commercial concerns that will control very complex presentations. Not only do they control the sequence of slides, they control the timing in several ways, can control filmstrip and movies as well as slides, and also control several associated power sources for lighting and additional devices. The major differences observed in applications of these types of systems were the time involved and the attention to detail. Images are seldom suitable unless they are prepared specifically for the particular presentation. Minor differences in exposure, format, or style destroy the presentation. The presentation mechanics are complex and specific operating procedures are required in developing the program and in conducting the presentation. Most successful presentations are manned by personnel that have been with the project from its conception and have devoted full attention to it over a considerable length of time. Attempts to by-pass these photographic and manning consideration, and assigning responsibility casually to untrained personnel as an additional duty, leads to disappointing results that are often erroneously blamed on hardware deficiencies, rather than being more appropriately attributed to administrative decisions.

The potential instructional power of this type of presentation appeared to be great. While USAF is making some use of this type of system, it is limited. It would appear that there are many training situations that could benefit markedly from their use.

Another training area that appears to merit more attention is that of team training or crew coordination. It is one thing to train each individual to do a task; it is another to train students to interact with other team members. In the first case, the performance cues are a result of the students actions. Step 1 is performed and; if Result A occurs, the student continues to the next step but, if B occurs, the student takes an alternate action. In team training, he is often responding to the actions of others or to the results obtained by another team member. The student is responding to feedback that goes to someone else.

An instructional strategy (designed for this purpose) is the use of four-track audio tape providing instruction through a four-channel radio transmitter. Students receive their individual instructions through receivers in earphones. Since all four instructional channels are recorded on one tape, close synchronization is obtainable. In a similar way, multiple screens and multiple audio channels can provide synchronized instruction to team members to familiarize them with tasks to be performed or to summarize instruction after performance. The mechanics and electronics of such systems are relatively simple and the required equipment is readily available through commercial suppliers.

All of the systems, for supporting either the control of multiple images or synchronized team training, require careful attention to courseware development and program support. Obtaining more sophisticated devices does not provide a means for overcoming difficulties in determining behavioral objectives or in developing instructional material. The more complex systems multiply, these problems rather than eliminating them. The devices can expand your capabilities, but they also intensify your problem.

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APPENDIX A: FIELD TRIAL AND EVALUATION OF MODULAR SYSTEM

Field Trial of Modular System

The modular system was initial tried out at Technical Training Division, Air Force Human Resources Laboratory (AFHRL/TT), Lowry Air Force Base, Colorado. After it had been put through normal acceptance testing, it was further examined by Air Training Command (ATC) maintenance personnel to estimate its maintainability. Most of the components (projectors, cassette recorder players, and power controls) were already within the inventory and had evidenced good reliability and maintainability. The additional units (Digi-Cue and Dissolve Units) were judged to be state-of-the-art since they are all solid-state devices using production printed circuit boards.

A procedure was then developed for the production of presentations. These techniques utilized the captioned photo technique for developing the visuals and utilized the classroom instructor to actually program the cassettes. No special manuals were developed for the instructor, since it appeared that the typical supervising instructor could program his own presentation using the manuals supplied with the equipment. The equipment was set up and a brief demonstration program prepared that was used as orientation to the various personnel employed in the project.

Rather than field test the equipment at Operations Training Support Laboratory, (OTSL), it was decided to initially field test the configuration at Lowry where closer observation would be available without expenditure of travel funds. The Mission Applications Seminar appeared to be a logical candidate. This course is conducted on at least five ATC bases. It is attended by all airmen who enlist for the first time. Thus, it would appear to be representative of USAF training. Presently, this is a 4-hour orientation to the U.S. defense posture followed by a 2-hour discussion of how the student's specific Air Force specialty code (AFSC) (career field) fits within this program. The presentation presently uses three slide projectors and two 16mm movie projectors. One unusual feature is that the audio is a mixture of recorded audio and live audio. This requires the use of the programmed stop feature within a multiscreen presentation.

In both portions of the program, liberal use is made of what they describe as "montage" presentations. These are a series of images that change rapidly to the accompaniment of music. Two of the three slide projectors are used to project on the left screen and right screen, respectively. The third, with a shorter focal length lens, covers the entire screen. The two movie projectors use the right and full (or center) screen. The intent is to convey an overview of Department of Defense (DOD) and the student's future career rather than specific information concerning actual duties. It might be considered to be motivational rather than instructive, assuming that the positive connotation of "motivation" is taken. This requires a rather large number of images per hour of instruction. It also requires considerable practice and attention on the part of the instructors if they are to present the sequences properly. At the present, one instructor usually conducts the discussion, while a second instructor handles the projectors in a projection booth at the rear of the room. This difficulty is confounded by the fact that each career field requires its own unique presentation on the day that those students attend. To simplify this, the section chief developed a technique that to this writer is commendable. The same music and the same number of slides are used in depicting each AFSC. That way the instructors learn one sequence that is used repeatedly, yet the visuals shown to the students are specific to their career field.

To field test the usability of the Modular Configuration, two portions of the Mission Applicator Seminar (MAS) orientation were selected. The first portion would be the initial 4-hour segment (Phase I) that is common for all non-prior-service airmen at all ATC Technical Training Centers. The presentation existed for this; the task here was to convert it to an automated presentation. The second portion was the Cook (AFSC 62230) montage as a representative of the orientations to specific career fields. This was one of the career fields for which they had no material. The material was developed from the beginning. This enabled us to demonstrate the captioned photo technique as a developmental technique as it applies to multiscreen presentations.

Since this was being done as a demonstration project, and the existing conditions were considered to be typical of conditions that were desired for the future, a serious effort was made to obtain measurements of the time required in the conversion of the 4-hour Phase I. The 4 hours includes discussion periods, breaks, and all other activities. The automated portion of the presentation has a total running time of about 2 hours. This is interspersed frequently with the live narration of the classroom instructor.

The conversion of the 4-hour block was accomplished by the Chief of the MAS section. He is a master sergeant and while he is most conversant with the course and the multiscreen presentation used he had no previous experience with the programming of such presentations to control them with the tape recorder. All of his experience was based on the instructor or the additional instructor in the control booth handling the equipment. All told, if the time figures are in error it is probably on the short side – it might be well to assume that somewhat more time, not less, would be required to make a similar conversion or to initially program such a sequence. The automated sequence runs for 2 hours, uses eight trays of slides on six slide projectors and two 16mm movie projectors.

It required a total of 196 hours to convert this Phase I portion of the course. This time was distributed as follows:

(1)	Rewrite of Phase I to effectively utilize both live and taped narration. Includes rewrite, typing and reproduction	58 manhours
(2)	Reposition, edit, and splice 16mm film	20 manhours
(3)	Slide repositioning	24 manhours
(4)	Recording taped narration	7 manhours
(5)	"Marrying" narration tape with program	89 manhours
	TOTAL TIME	198 manhours

Comparable data are not available from the Phase II montage for Cooks. The photography and slide development was the major time requirement and this was accomplished by personnel from this division on a time-available basis with much of it combined with other division activities. Suffice it to say that no evidence was found to contradict the data presented in Smith (1975). That publication suggests that developing a 100-slide presentation will require 91 hours if accomplished using captioned photos, 350 hours if accomplished using graphics, and 214 hours if accomplished using graphics to supplement duplicate slides. The difference in quality was as evident as expected in subsequent duplications. The final montage used 74 slides and runs 4 minutes. Approximately 100 slides were initially prepared with final selection made by the instructor.

The classroom instructor, under the section chief's supervision, was able to accomplish the programming without difficulty. The total time spent on programming after the slide sequence was established was about 2 hours for the two of them. One slightly unexpected observation was that when it came to actually accomplishing the programming to sequence the montage of slides with the musical background used, the classroom instructor had considerably better success than either the chief of the section or the writer. Youth and sense of rhythm probably had much to do with it.

Installation of the equipment into the classroom was performed by personnel from Training Services Division, Lowry AFB. These personnel had initially wired the room. It has a dual control capability with the instructor having duplicate controls on the podium for all projection and lighting equipment. The only mechanical difficulty encountered which might be of concern to the reader was that the projection booth had provisions for two movie projectors and three slide projectors. Since the automated presentation included dissolves, three additional slide projectors were required. This was accomplished by stacking the projectors in pairs and slightly increasing the height of the windows involved. The projection booths built since have the larger windows. Retaining the Programmed Stop feature of the cassette recorder was somewhat more difficult. As mentioned previously, this feature is required so that live discussion can be intermixed with recorded programs. The normal functioning of the cassette recorder is altered; i.e., when the sync control for the programmer is plugged into the recorder, the program stop circuitry is disengaged. Contacting the manufacturer obtained the required information to overcome this. The suggested solution requires running one wire from the programmer back to the Remote Start/Stop jack on the recorder. A programmed slide change on the appropriate channel results in the necessary stopping of the cassette recorder/player.

If more channels are required for projector control (three dissolve speeds for each of three pairs of slide projectors plus two movie projectors plus one programmed stop requires 12 channels rather than 9), the additional control can be obtained by altering the programming. The first three channels were assigned to the right screen. Only the two cables associated with medium and slow dissolve rates were connected to the dissolve unit. Activating channel one produces a medium dissolve, channel two produces a slow dissolve, one and two combined produces a quick dissolve, leaving channel three free to activate the power control which controls the movie. The second series of three channels controlled the left screen in the same way. The third series of three controlled the center screen with the last channel (9) used to provide Programmed Stop since no movie is required.

This application requires a multiple screen presentation using a combination of recorded and live narration. The cassette recorder used provides Programmed Stop in normal use. However, this circuitry is disengaged when the programmer is connected to it, since plugging the cord from the programmer into the Sync Output jack disconnects this circuit. Mincom Division, 3M furnished a modification of the 2570 that in essence allows you to treat the recorder as a projector. Quoting from his letter, "The Digi Cue command produces a momentary relay contract closure of 0.4 sec. By connecting these contacts of a dedicated channel to R311, the desired effect is achieved. When the contacts close, C308 discharges. When the contacts open, C308 recharges firing the SCR and energizing the stop solenoid. Access to R311 is easily accomplished by wiring the lower two (unused) pins on the Jones Plug to R311." This modification should be done by qualified maintenance personnel who have access to the service manuals for the Wollensak 2570. The numbers referred to are references to specific locations noted on the schematic diagram provided as Figure 6.2 of that manual. Restarting the recording is accomplished by connecting the push button used by the instructor to a plug that is inserted into the Remote Start/Stop jack. On the Wollensak 2570 or 2573, this is on the side near the speaker jack. A special 0.206" diameter jack is used to prevent inserting the plug into the wrong jack. Unfortunately, these are rather unusual jacks and can be difficult to locate. We were able to locate plugs of the correct diameter, but they were too long. Wire was wrapped around the shank to effectively shorten it. At times, we have disconnected the Preamp Output jack and used it instead. If the reader desires more information on any of these modifications, he is encouraged to contact Training Services Division, Lowry AFB, Colorado 80230.

When this system was tried out before actual classroom implementation, it was found that all features except the Programmed Stop were reliable. The Programmed Stop function worked reliably in terms of stopping the cassette player at the appropriate time. It consistently stopped at the desired point. However, many extraneous Programmed Stops occurred that were not desired. Discussion with the designer of the programmer and with the electronic personnel within AFHRL/TT and Training Services Division ultimately resulted in corrective techniques. Part of the unreliability was determined to have been caused by noise spikes generated by switch closure of the relays within the programmer. These were initially quieted by a resistor/capacitor combination being added across the slide advance terminals within the programmer. A set was added to each of the 9 channels. Additional spikes were encountered in the classroom, apparently caused by a radio transmitter located within the building. These were dampened by placing a 0.1 mfd capacitor and a 100 ohm resistor in *series* near the plug going to the Remote Start/Stop jack of the cassette player. Subsequent correspondence and discussions with factory personnel indicated that while these solutions were acceptable to them and would not alter warranties, they recommended the use of G.E. V40LA2A MOVs (Metal-Oxide Varistors). These MOVs capable of handling 40 volt spikes were added to the programmer in place of the previous resistor/capacitor combination. These solved the problem and also noticeably reduced the sparking observed within the relays. It would appear that they will not only improve the functioning in this particular configuration, but also increase the life span of the unit in any use. An additional MOV was inserted in *parallel* in the cassette player used in the classroom as a safety feature. With these modifications, the configuration operated very reliably.

Evaluation of Modular System

To obtain an evaluation of the classroom suitability of the equipment, the automated program was implemented within the on-going MAS. The automated program was used exclusively during a 5-week trial period. At the end of that time, the automated equipment was returned to AFHRL and the seminar again conducted as it had been before the trial. In accordance with the intent of the study, the evaluation was directed primarily at classroom usability, acceptability to instructors and students, and reliability. Amount of information conveyed to students was not a factor as this is not an essential aspect of the seminar.

Before implementation, the instructors varied in their reaction to the proposed program. A few who were administratively responsible for the course thought it might have some advantages primarily in eliminating the need for two instructors in each classroom. Many of the instructors expressed considerable misgivings about the project. Most of the reluctance appeared to center around a rather prevalent feeling that the automated presentation would reduce the instructor's interaction with the student. Since this is a motivational course, an intense student-instructor interaction and dialogue is essential. The majority of instructors could probably be described as being curious but not enthusiastic.

After the trial was over, the instructors were allowed a week to readjust to the non-automated mode. They were then asked to write a brief statement summarizing their impressions of the trial. Due to the small number of instructors, no attempt was made at a formal questionnaire or structured interview. It was felt that unstructured personal comments regarding advantages and disadvantages might be more revealing. The verbatum comments by the seven instructors involved are as follows:

a. Insures standardization in program and allows instructor more flexibility in answering questions. He can stop the program at any time. Also allows more involvement with the class instead of separating him from the class by the podium." Disadvantages: None.

b. Insures standardization in the information presented to the students. Allows flexibility for the instructors in the classroom. Disadvantages: Human error. Quality of all media must be excellent. Anything less is greatly amplified. Program errors must not exist."

c. Allows one instructor per class. Much more freedom in classroom (can stay away from podium – especially if we get a stop on films)." Disadvantages: Can't think of any.

d. Ability to move around – get away from the podium. Disadvantages: The short delay in advancing the slides.

e. "Ability to move around more freely – and get more involved with the students while you are away from the podium. It also gives you the chance to observe the students more when you are having discussions. Disadvantages: The short pauses.

f. The instructor can move around the classroom which gives them more freedom. Can stop the program anytime the instructor wants. (No disadvantages noted.)

g. It allows one instructor to handle a class from start to finish by himself. This provides a good continuity throughout the session. It gets the instructor from behind the podium and into a better student/instructor relationship. The narration provides more opportunity for the instructor to be aware of questions and promote discussion that is lost when the instructor must read the script. Disadvantages: Once you've tried it you don't want to go back (to manual control)."

During the trial, a full day's demonstration/seminar was conducted by Lowry MAS personnel for representatives of Hq ATC, Randolph AFB, Texas and the MAS personnel of Chanute AFB, Illinois; Keesler AFB, Mississippi; Lackland AFB, Texas; and Sheppard AFB, Texas. This group recommended that the automated technique be implemented within all MAS classrooms. At the conclusion of the trial, the Commander, USAF School of Applied Aerospace Sciences, Lowry AFB forwarded a letter to Hq ATC. The following are extracts from that letter:

1. We have completed our test of automating Phase I of the Mission Application Seminar. The initial reaction from students and our instructors has been extremely favorable. Students have responded with enthusiasm to the variety of media used in presenting the seminars and the instructors have appreciated and capitalized on the versatility built into the automated program. The automated equipment has proved to be 100% reliable during the 15 November through 16 December 1976 test period – zero malfunctions during presentation.

2. The following conclusions and recommendations should assist you in determining the feasibility of Phase I automation throughout the Command:

a. To properly present the automated version of MAS all Centers must be equipped with like equipment. This is essential to standardization throughout the Command and to insure that programs developed by the OPR are compatible with equipment used by all activities.

3. The automated system provides for the electronic control of the presentation which in turn frees one instructor from each classroom. It also provides a more consistent presentation and enables the instructor to concentrate more on the students rather than the mechanics of generating the right audio visual device at the right time. While installation and equipment may cost in the neighborhood of $3,000 per classroom, this will be virtually a one-time expenditure, considering the life of the hardware involved is rated at seven years. The resulting cost avoidance by eliminating the additional instructor is estimated at $10,000 per classroom (per year).

4. Based on our test of automating Phase I of MAS and the concept of the entire MAS program, we will realize many benefits with this standardized, yet fully flexible, presentation. Since all

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non-prior-service airmen are exposed to MAS, it is important that they will all receive the information in the same manner and intent that was originally conceived. Automating the program accomplishes that objective. Benefits include but will not be limited to:

a. Reduced manpower required for classroom presentation.

b. More effective utilization of instructor personnel (program update, development, research, etc.).

c. Reduced training time required for qualification of instructors.

d. Increased reliability of presentation.

e. Increased instructor/student interaction.

5. In addition, a fully automated dissolve presentation was tested for compatibility with this system. The use of the quick cut, normal dissolve and slow dramatic dissolve add markedly to the presentation. With equipment described herein, the program can be initiated without the dissolve feature and the dissolves added later at minimal expense without replacement or modification of existing equipment or facilities.

6. One last point has become clear as a result of this test. It is imperative that software must be of the highest quality to insure reliability and maintainability of the programmed information used in the presentation.

7. While this discussion has been primarily restricted to Phase I, an exploration of Phase II material was conducted. This indicated that the equipment described is both compatible with, and adequate for, Phase II presentations.

Two comments are appropriate regarding this ATC evaluation. The instructors commented on an undesirable pause in changing slides. In the normal situation using slides in a briefing, the instructor has remote control in his hand. When he completes a topic and wants to advance onto the next, he depresses the slide advance button. It takes about 0.8 seconds before the next image is on the screen. In the configuration used here, the same remote control is used and the instructor again has it in his hand. However, when he depresses the advance button it actually activates the tape recorder rather than the projector. The recorder has to get up to speed, respond to a slide advance impulse and then it activates the programmer which in turn activates the dissolve unit which activates the projector. All of this only takes about two seconds, but the difference is noticeable. With practice, the delay can be minimized. But the problem does have to be kept in mind while making the initial tapes. Pauses between topics should be minimized.

The second comment is to re-emphasize the point made by the instructor who commented, "Quality of all media must be excellent. Anything less is greatly amplified." This is definitely correct. When two slides are on the screen side by side, differences and defects *are* emphasized greatly. The differences in color balance, contrast ratio, and density between an original slide and a duplicate slide can at times be overlooked when they are presented one after another. In a multiscreen presentation where they are presented side by side, the differences are glaring. The same is true of the audio tape. The impulse track is particularly sensitive to imperfections. If one word in a narration is muffled, the listener can fill in from context and may not even notice the defect. If any one impulse in an automated presentation is muffled, the entire presentation is ruined.

INSTRUCTIONS FOR USING THIS MANUAL

The material in this manual is discussed in narrative form first. During this discussion you are welcome to use the equipment if you desire to follow the procedures by actually doing them.

Following the discussion of each task there is a PRACTICAL EXERCISE. For these you must actually accomplish each step. As you proceed through, complete each numbered step in the exercise before going on to the next. Also, complete each PRACTICAL EXERCISE before going on to the next task. Assistance is available if needed.

This manual was prepared for the in-service training of personnel associated with the Media Design and Evaluation Section, Air Force Human Resources Laboratory, Lowry Air Force Base, Colorado. While its general procedures are representative of many multiscreen presentation systems, some of the specific instructions should provide a model to guide you in establishing specific procedures for your unique application.

1. Presentation of Prerecorded Program

To provide a practical demonstration of the ARION DIGITAL PROGRAMMING system and to clarify some of the concepts and procedures, one specific example will be used intially. The example used here will be the Digi-Cue portion of "Techniques of Utilizing Multiscreen Presentations." Before continuing with these instructions, obtain four slide trays and the audio cassette for that program. These will provide an example of a two screen presentation using two projectors on each screen (Figure B1). Other configurations would be similar, varying only in using more or less equipment; i.e., if you wish to use three projectors on each screen, then obviously the additional projectors would have to be used.

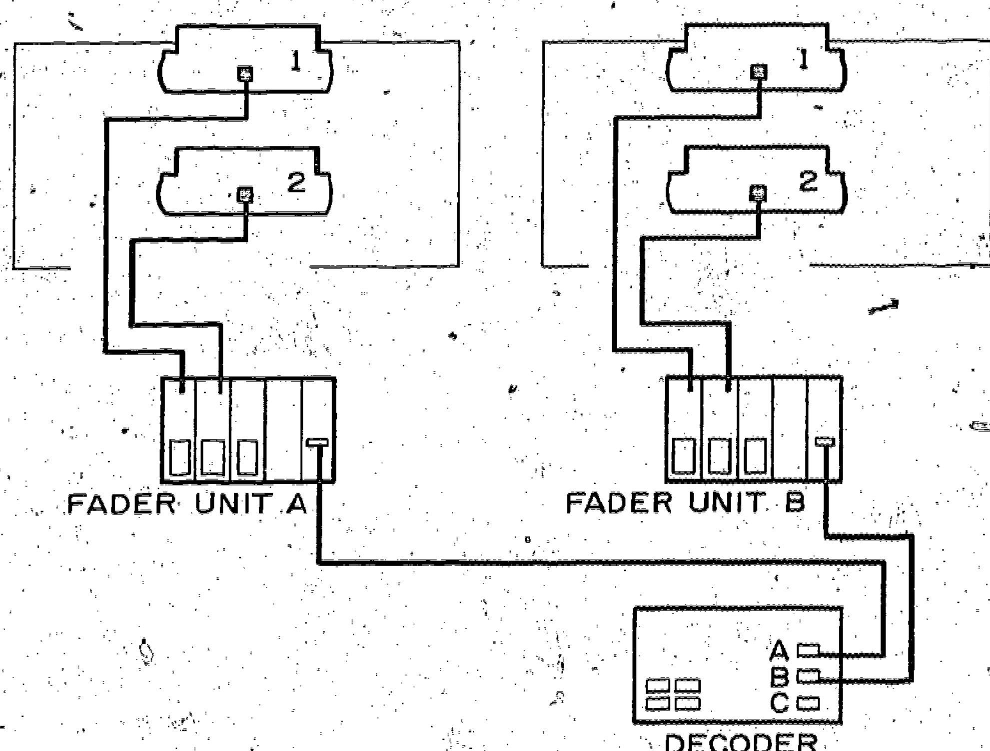

Figure B1. Equipment configuration for dual screen four projector presentation.

2. Projectors

Four Ektagraphic AF-2 slide projectors are required. Two project on each of the two screens. The projectors for the left screen are the A set. The projectors for the right screen are B. The top projector in each set is number one. The bottom is number two. Considerable care is required in assuring that the projected images on each screen are registered and the two screens present images that are properly aligned and of the same size. Set-up slides should be available in slot 79 of each of the four trays. The red slide in the number one projectors and blue in the number two projectors should simplify this task.

Take care that all projectors are focused and aimed. DO IT NOW.

After the projectors are focused, set the sliding switch to FAN; i.e., projectors are turned on but the lamp is off. The DECODER will turn on the lamp and advance the slides through signals to the FADER unit. If the projectors are accidently left in the ON position (high or low) the slides will be advanced properly but the image will always be projected on the screen. This will interfere with the image from the other projector.

3. Fader Units

Each screen requires a 904 FADER UNIT (Figure B2). Like the projectors this must be plugged into a standard AC receptacle. IT IS ESSENTIAL THAT THE FADER UNIT AND ALL PROJECTORS CONTROLLED BY IT BE ON THE SAME PHASE OF THE AC LINE. Do not plug the FADER into one circuit and the projectors into another. One simple method of assuring proper phasing is to plug all units into a portable power outlet strip. This phases the units and also enables you to turn on all three devices as a unit. Due to the rather heavy load required for the projection lamps, it is desirable to plug one FADER and its projectors into one circuit and the other FADER and its projectors into another. The rest of the equipment does not use enough current to cause concern.

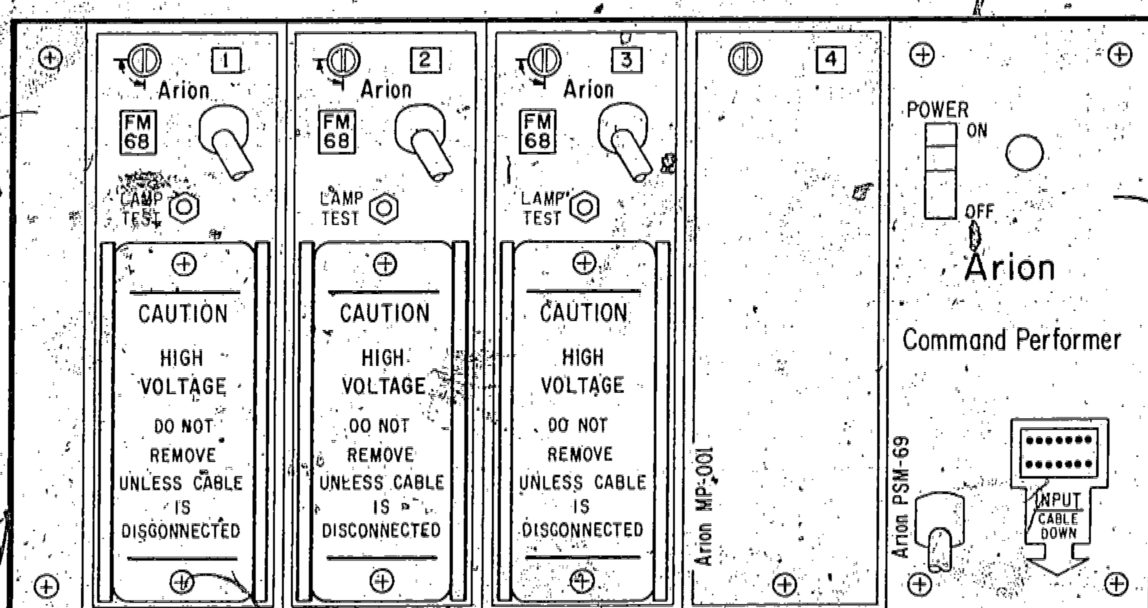

Figure B2. ARION 904 fader unit.

The FADER that controls the left screen is designated A; the one for the right screen is designated B. Thus, you have FADER UNITS A and B, each with a projector one and a projector two; i.e. a FADER and set of projectors for each screen area.

Each FADER contains three modules and a power unit. Each module can control one projector. The cord from the module plugs into the AF-2 as if it were a remote. The FADER can control three projectors, but we are only using two. Use modules one and two and just leave three unused.

4. Decoder Connections

The DECODER (Figure B3) takes the digital signals from the tape recorder and decodes them so that it can control the projectors through the FADER units. The DECODER is connected to the FADER by the flat 14-wire cable. On the rear of the DECODER there are seven 14-pin male receptacles and one standard phone jack. The set of three 14-pin receptacles is labeled PROJECTOR OUTPUTS. Plug cable A into PROJECTOR OUTPUT A and cable B into PROJECTOR OUTPUT B. Receptacle C on the DECODER is not used in this example but could be used to control a third set of projectors.

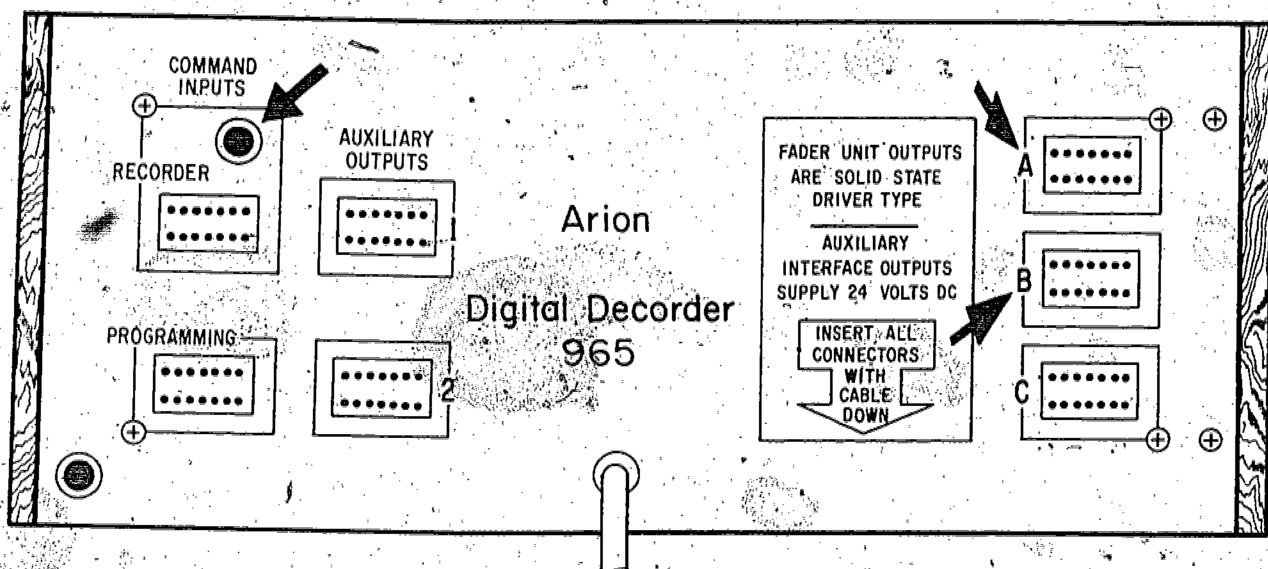

Figure B3. **ARION 965 digital decoder – plug-in points.**

PLUG THE CABLE IN WITH THE CABLE GOING DOWN FROM THE PLUG. Be careful not to use force on the plugs; they are delicate. Once the units are connected, they are normally left unchanged for considerable periods of time. While the units can be taken apart and reassembled as many times as you desire, the type of presentation used with this type of equipment usually dictates a rather stable set-up. This is the main reason that most of the equipment is probably already hooked up for you now. However, finish the instructions to verify that it is correct. You need to know how to hook it up so that you can add to it or move it.

5. Connecting the Decoder and Recorder

The DECODER is connected to the TAPE RECORDER by simply inserting one end of a standard phone plug into the COMMAND INPUT jack on the back of the DECODER and into the SYNC OUTPUT jack on the top of the Wollensak 3M 2570 CASSETTE RECORDER. There is no volume control for this outlet, it is factory set to the necessary 1 volt P/P output. If a reel-to-reel recorder is used, plug into the right channel speaker outlet. Some volume adjustment might be required to obtain reliable performance.

Both the DECODER and RECORDER are plugged into a standard 115 VAC outlet. It is not necessary to match the phase of these units and they draw very little power so there are no special considerations in plugging them in. However, by this time, you have a total of eight different units plugged into the 115 VAC outlets. Each must be both plugged in and turned on. Omitting any one of the operations ruins the entire presentation so a very systematic approach must be used. In our lab, all units are left plugged into their outlets and are left turned on. The slide projectors are left with the power set at FAN. When the slide trays are first put on, this setting may be changed while you are setting up and focusing the projectors, but the switches are returned to FAN when the set-up is complete. While the trays may have been reversed to project the focus slides in slot 79, when the presentation is started they need to be set to slot one. After initial set-up, the trays will automatically return to this slot one position. This operation is called HOMING and will be discussed later. To make the turn-on somewhat simpler, in the lab we have all 115 VAC controlled from the central console. To turn on the system the main power has to be on. The DECODER and CASSETTE RECORDER have their own switches. All of the units for the left (A) screen are controlled by a single button but the comparable series for the right (B) uses the bottom three buttons. The difference is due to matching the phasing of the 115 VAC. The normal buttons for us to use for the right screen were in phase. However, the buttons normally used for the left screen are not in phase, requiring the use of a power strip. This is simpler in that it requires only one control button but it does add an additional extension cord into the system.

The essential requirement is to employ a procedure so obvious that you can follow it blindly since you will probably be talking to a group while turning it on during an actual presentation. Any one error on your part will probably require aborting the presentation and starting over which is highly undesirable. You must develop a very ritualistic and simplistic turn-on procedure.

To facilitate this turn-on procedure here, all 115 VAC is controlled through the master panel with the buttons named. All of the buttons associated with normal presentation are blue. Therefore, you should be able to activate the entire system by depressing the blue buttons. ALWAYS DOUBLE CHECK THE TURN-ON BEFORE ANY PRESENTATION SINCE THE PROJECTORS ARE USED FOR MANY PURPOSES AND THE WIRING COULD BE CHANGED.

6. Step-by-Step Turn-On Procedures

1. On Console, turn on MAIN POWER.

2. On main console, press (illuminate) all blue buttons; i.e., CASSETTE RECORDER, DECODER, SCREEN A, SCREEN B, PROJECTOR 3, and PROJECTOR 4. As the buttons are pressed, double check each device in turn to assure that it turns on.

3. Focus and aim all projectors.

4. Check slide trays: Trays A1, A2, B1, and B2 should be on the appropriate projector with the number on the tray centered in the front of the projector. If tray is not centered, depress the HOMING button on the DECODER and hold it for about 2 seconds. This will start the HOMING sequence which reverses the slide trays. The sequence will continue after you release the button. To stop the sequence, depress the HOMING button momentarily. These are special trays modified for this purpose and will stop the trays with slide one ready to be projected. This HOMING can be accomplished after each presentation to return the trays to the beginning so you are ready for the next showing. It should be noted that the first slide goes in slot one, not in zero. You may have to advance the trays one slide if the trays removed from the projector.

5. Place cassette in CASSETTE RECORDER.

6. Just before beginning the presentation, depress the HOMING button momentarily (1/4 second). This will reverse the projectors one stop. If any projector does reverse, depress HOMING again until all projectors are at the beginning. Also, listen as you release the HOMING button to make sure none of the projectors advance. With the special trays, if the trays are in the correct position they will stay there. However, the projectors often advance one slide for unexplained reasons when any equipment is turned on or off. This momentary despressing the HOMING will assure that the slides are at slot one.

7. Play the program. Home projectors and rewind tape.

7. 909 Electronic Memory Programmer

Explaining the PROGRAMMER (Figure B4) is a little bit like describing a typewriter for the first time. There are a number of ideas that have to be discussed before you can start typing. There are the keys that produce the letters, but unfortunately you also have to describe how to put the paper in, the space bar, the margins, the back space, etc. As soon as you can get started typing, then the whole keyboard starts to make sense. The PROGRAMMER is very similar; once you get the programming started there are really only a very few keys to push.

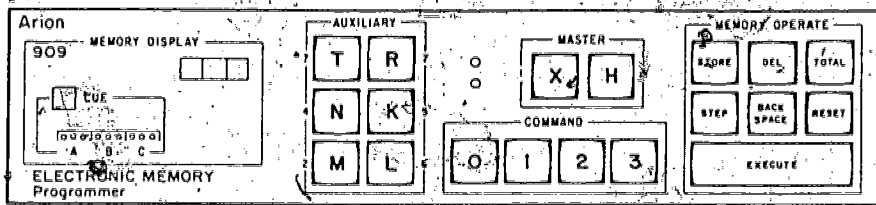

Figure B4. ARION 909 electronic memory programmer – keyboard.

To try to make it easier, we will first go through some of the mechanics of the PROGRAMMER without having it hooked into the system. That way you do not have to reset projectors each time you start. After you become familiar with the PROGRAMMER, we will hook it into the rest of the system. For now, just turn on the PROGRAMMER button on the main console. All of the other devices can be off. The PROGRAMMER has a rather heavy fan in it that you will hear when it comes on. As with any electronic device, do not block the air flow through the unit or it will overheat rapidly.

This portion of the manual will consist of two sections. The first part is a narrative description of the unit. This will be followed by a Practical Exercise in which you are requested to actually operate the unit.

a. *Memory Operate.* On the right of the PROGRAMMER are a set of keys labeled MEMORY OPERATE. They operate the memory within the unit. They enable you to add to the memory, to erase parts of it, and to find different parts of the program that is stored in the memory. One word of warning, this memory lasts only as long as the unit is turned on. Any time you turn the power off, the entire memory is erased.

The STORE key is used when you want to store information in the memory. There are two LEDs (red lights) in the middle of board. When the top one is illuminated, it indicates that you are STORING information into the memory – the programming you are doing is being added to that you have previously done. If it is not on, the memory is not being changed; i.e., you can practice.

Depressing any of the other MEMORY OPERATE keys will turn off the STORE function. Again, this is indicated by the upper LED.

DEL stands for DELETE. If you depress it while STORING a program, you will erase that step from the memory.

The TOTAL key will show you the total number of cues you have programmed. The number will be shown in the MEMORY DISPLAY on the right-hand side. When you first turn the device on, this will be an automatic 024.

Depressing the STEP key will advance you through the program one step at a time. It is often used to check the program for accuracy. If you hold the button down, the unit will cycle through the program at a rate of 25 per second and stop on the last cue. This is referred to as FORWARD SCAN. It is very convenient when you want to add to the end of a program.

The BACK SPACE is similar to STEP but in the other direction. Depressing it lightly will back the program up one cue. Holding it down will cycle the program backwards at 25 cues per second. Unlike the STEP, this cycle does not stop at the beginning but starts over and continues the cycle. This is referred to as REVERSE SCAN.

The RESET key moves the display and the memory to the first cue in the program.

The long EXECUTE key is used to "release" the cue to the recorder or DECODER.

b. *Master Keys*. To the left of the memory keys are two MASTER keys. They determine how the projector will behave when its lamp is turned off. X calls for the projector to advance to the next slide. H calls for the projector to hold at this slide by not advancing. The most used key is X and it has been made automatic. All lamp commands will be X commands unless the H is depressed.

c. *Command Keys*. The COMMAND keys select which projector receives the command. When you are actually programming, these are the keys that usually result in the command going out to the projectors. I suspect that is where the name came from. The 0 is for no projectors. The 1, 2 and 3 designate projectors and can be used individually or in any combination depending on which projectors are wanted.

d. *Memory Display*. The MEMORY DISPLAY shows the commands and their numbers. If you will turn the PROGRAMMER off for a few seconds and then on again, the number 024 will appear in the window. This is just a number that automatically comes on at the beginning. As you program, the number here will indicate the cue you are on. Now, depress the STORE key and then the COMMAND key 1 three times. By the word CUE in the window there should be a number one. If you look at the left-hand side of the X key you will see the number one. The H key is three. The 1 in the window indicates that the cue is an X (projectors to automatically advance after fading the lamp off). In the upper right corner of the window is another one (1) indicating that this is the first cue. At the bottom of the window are three areas labeled A, B, and C. The letters indicate the FADER UNIT or screen area. Above each letter are three LEDs (light-emitting diodes) that indicate the specific projector. If you look closely, you will be able to see that the first cue calls for turning on projector one in each FADER UNIT.

Watch this series of LEDs as you depress COMMAND key number two (2). The second LED under A will illuminate. The other windows are blank since you have not yet indicated what you want the other FADER UNITS to do. The first time you depress a COMMAND key it automatically goes to FADER A. The second goes to B, and third to C. At this point the cue is automatically transferred into memory. You will hear a soft click as the information is sent to memory and the cue number will advance to 2. Depress COMMAND key 2 twice more and observe this. The total MEMORY DISPLAY will now indicate that the cue was for an X (1), it is the second cue, and all three FADER UNITS have projector two turned on. If all of the projectors for any FADER were to be turned off, there would be no LEDs indicated for that FADER.

Practice on this until you are comfortable with it. If the STORE light goes out, just depress the STORE key again to reinstate it. It will go out anytime you depress a MEMORY OPERATE key other than STORE. Notice that the number of cues is counted and displayed in the upper right corner of the MEMORY DISPLAY. Use the STEP, BACK SPACE, TOTAL, and RESET keys until you are familiar with them. Do not worry about the DELETE at this time. We will discuss it shortly.

We have some code sheets that we use to develop programs. Figure B5 is a sample. The cues we are working on now are listed under COMMANDS in the middle of the page. RESET the PROGRAMMER and depress the STORE key.

The first command is 000 000 000. The circles represent the three projectors for three FADER UNITS. If the circle is black, it indicates that this projector should be on. 000 000 000 indicates that none of the projectors are on; i.e., the screen is blank. This also turns off any projectors that may be on. This command is always used as the first and last command to assure that all projectors are off and provides for a standard way of starting a presentation. It is accomplished by depressing the 0 COMMAND key three successive times.

The second command is ●00 000 000. This indicates that projector one should be turned on by FADER UNIT A and that no projectors are being used by either FADER B or C. It is entered by depressing COMMAND key 1 and 0 then 0 again. The third cue is ●00 ●00 000. It is entered by depressing COMMAND key 1, then 1, then 0. If the projectors had been turned on during this, the first cue would have produced a blank screen. The second would have projected a slide onto the left screen. The third would retain the image on the left screen and add an image on the right screen.

We are only using two projectors on each of the first two FADER UNITS. As a result, programming for projector 3 will be the same as programming for projector 0 since there is no third projector. By the

ARION 909 Digital Memory Programmer - Code Sheet — page 1

Title: 1121-07-05

Author: Smith

Date: 15 Jun 77

Always start programming with RESET then STORE.

Always end programming with 000 000 000.

Screen A	Screen B	Screen C	Cue	RTA	COMMANDS			Notes
:	:	:	1	0	000	000	000	
1 :	:	:	2		000	000	000	
:	2 :	:	3		000	000	000	
:	: 3	:	4		000	000	000	
:	4 :	:	5		000	000	000	
: 5	:	:	6		000	000	000	
:	: 6	:	7		000	000	000	
7 :	:	:	8		000	000	000	
:	8 :	:	9		000	000	000	
:	: 9	:	10		000	000	000	
:	10 :	:	11		000	000	000	
: 11	:	:	12		000	000	000	
:	: 12	:	13		000	000	000	
:	13 :	:	14		000	000	000	
:	: 14	:	15		000	000	000	
15 :	:	:	16		000	000	000	
:	16 :	:	17		000	000	000	
:	:	:	18		000	000	000	

Figure B5. **Code sheet for use with ARION 909 digital memory programmer.**

same token, it makes no difference what cue you give FADER C since it is not turned on. However, the PROGRAMMER stores the cue automatically only when it has a cue for all three FADERS, i.e., you will hear the click and see the transfer only after it has had three COMMANDS. When using only two FADER UNITS, this is simplified by always calling for 0 on the FADER C. On the code sheets, the column for FADER C is just left blank.

Return to the beginning by depressing the RESET key and reprogram the first 18 cues. Do not forget to depress the STORE key before beginning because using the RESET key has turned it off. This is a safety feature that protects the program from accidentally being changed when you do not want to. It is a little like having to depress the RECORD button on a tape recorder. Unless you do it, you are not recording. DO IT NOW.

With these 18 cues left in memory, depress RESET again. Now go through the program a step at a time by depressing STEP. Check the LEDs in the display against your programming sheet to see if you made any errors.

Practice this as much as you like. If you can do this without trouble, the rest is easy. But make certain you are comfortable with this.

8. 965 Digital Decoder

The DECODER is the decoding element of the Arion system. It decodes the digitally-coded cues from the tape or the PROGRAMMER and translates them into the impulses used by the FADERS to control the projectors.

Front. On the front of the DECODER (Figure B6) are two switches and three indicator lights. The two switches are on the right of the faceplate. The top switch is POWER. It turns the unit on and off. There is an indicator light to the side of it to show when the unit is on.

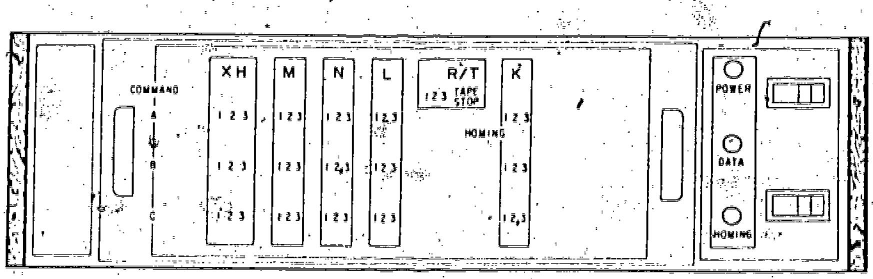

Figure B6. **ARION 965 digital decoder – front view.**

The bottom switch is for HOMING. This is discussed in more detail in Section 13. If you move the HOMING switch to the left, all projectors will reverse one slide if any slide other than number one is in the projector. If the first slide is in the projector, the projector will go through the reverse cycle but the tray will not reverse. The special Arion trays are modified by replacing one of the pins with a steel wire to accomplish this. Holding HOMING to the left briefly, the unit will electronically time the impulse and reverse the projectors one slide. If you hold HOMING to the left for a full second, the projectors will continue to reverse. Depressing the HOMING switch a second time stops the cycle. The indicator light is on during the HOMING operation.

The center light indicates that the unit is receiving data from the recorder or PROGRAMMER. If a prerecorded tape is being played, this light is ON as long as the DECODER is receiving the signals from the tape recorder. When the DECODER is connected to the PROGRAMMER with the standard phone jack, this light is also on continuously if both units are turned on. When the DECODER and PROGRAMMER are connected with the 14-pin flat ribbon cable, the indicator light will be off most of the time. It will light up momentarily when the EXECUTE bar is depressed.

The main area of the front of the DECODER is covered with a red plexiglass panel. This panel is divided vertically into columns and horizontally into rows. The rows are labels A, B, and C and represent the three FADER units. These rows also reveal the various circuit boards within the DECODER. You can get into these by using the handles on the end of the plexiglass panel. The casual operator will not have occasion to handle these boards.

The columns on the display panel are designated by letters at the top of the column. The letters indicate the type of cue that is being decoded. Within each column, LEDs behind the numbers 1, 2, and 3 indicate the specific slide projectors or functions involved.

The first (X H) column indicates the projectors that are on. The LED just under the X or the H will light momentarily as each lamp cue is decoded. The LED in back of number 1 in row A will come on and stay on if the command calls for the first projector on FADER unit A. The 1, 2, and 3 indicate the projectors; the A, B, and C rows indicate the FADERS. When the LED is lit, the associated projector should also be on. It is important to note that this display indicates the current screen image; i.e., the projectors that are presently projecting. As such, it is often different from the display in the PROGRAMMER since this indicates the following cue. While you are creating the program and are storing cues in memory, the Programmer display and the Decoder display are the same if both units are turned on. However, when the cues are being executed from memory, the PROGRAMMER always shows the cue before it is executed and the DECODER after it has been executed.

The Arion unit has many capabilities that are not discussed in this manual. One of the major ones is the capability to control several momentary and several latching relays. These can be used to control lights, movie projectors, viewgraph projectors, and the like. In a training environment, they could be used to turn on electronic test equipment or tools. For example, if you were teaching a student to solder, these latching relays could be used to turn on the soldering iron so that it was hot when the student needed it and then turn it off when the student progressed beyond that point. Rather elaborate training applications could be developed using these since it would be relatively easy to control a dozen or two dozen relays.

The only use made here of this portion of the Arion system is the use of K-1 and K-0 in the HOMING sequence.

The LED under the R/T will light momentarily whenever a fade or time interval is decoded. When a fade rate changes, the R/T LED will light momentarily and the 123 LED pattern will change. The 123 LEDs stay on. If none are lit, it indicates an instant fade rate. If all three LEDs are illuminated, it indicates a 16-second fade. The full set of rates is given in Table B1 in Section 11 "Fade Time Code."

Back. On the back of the DECODER (Figure B7) are seven 14-pin male receptacles, two phone jacks, and a circuit breaker. When connecting the system together, some of these were discussed.

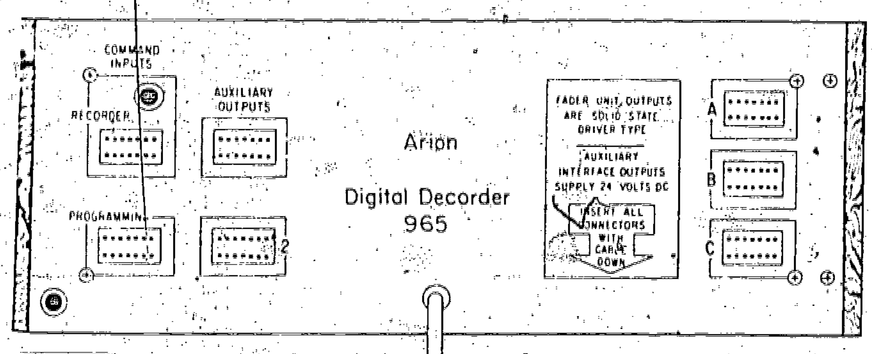

Figure B7. **ARION 965 digital decoder – rear view.**

The FADER UNITS are connected to the DECODER via the three receptacles labeled A, B, and C. Make certain that the cable goes *down* from the receptacle. It helps to mark the ribbon cables to assure that receptacle A is connected to FADER A. Marking the cables A, B, and C is the simplest way. This avoids interchanging two cables. When you are first setting up the system, you usually have time to trace the cables and assure that they are correct. Many times, however, you will find yourself in a situation where the cables are removed from the unit requiring that they be replaced. If you are under pressure at that time, it is easy to interchange two. This results in a presentation that is obviously not running properly but the eeror is often deceptively difficult to diagnose and correct. When you have this many components interconnected, Murphy's law takes charge with a vengeance. Especially, if the audience is seated.

The phone jack marked COMMAND INPUTS is used to connect the DECODER to either the PROGRAMMER or the recorder. The 14-pin receptacle is used only when using the DECODER to automatically stop the recorder. Incidentally, you can do this with the Wollensak 2570 series cassette recorders by coming in thru the responder jack. You cannot use the STOP feature within the recorder since plugging into the sync output jack disengages this circuitry. An accessory cable is required for this. This was discussed in detail near the end of the Section II report body.

The 14-pin PROGRAMMING receptacle is used to connect the DECODER to the PROGRAMMER when you want to see the projected image while you are generating the program. With this receptacle interconnected with its mate on the PROGRAMMER, you can watch the projected images while STORING the cues in memory.

9. Programming – General

To operate the slide projectors from the PROGRAMMER, complete the set-up procedures for a presentation. All units except the cassette recorder will be used. Next, connect the PROGRAMMER to the DECODER. To do this insert a phone plug into the upper phone jack on the back of the PROGRAMMER (Figure B8). Insert the other phone plug into the jack on the rear of the DECODER (Figure B7 in previous section). There is a jack under the words COMMAND INPUTS. It is the same jack used for connecting the recorder to the DECODER. If only one connecting cable is available, it can be unplugged from the recorder and inserted into the PROGRAMMER. It is convenient to use two cords while you are putting the commands onto the cassettee but other than that only one cord is required.

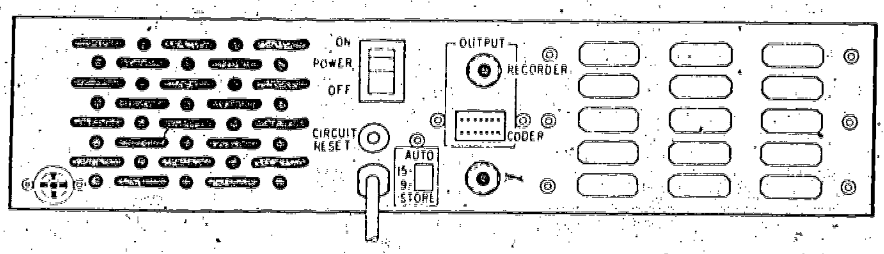

Figure B8. ARION electronic memory programmer – rear view.

A 14-pin cable is connected between the DECODER JACK on the PROGRAMMER and the PROGRAMMER JACK on the DECODER.

Since interrupting the power to the PROGRAMMER erases its memory, it is usually wise to unplug it from its normal plug and plug it into a wall outlet. Then if you use the MAIN POWER switch to turn off the projectors and faders you do not lose memory. Losing memory is usually not serious if the program has been written out. However, the lost time does add up if you lose the memory by cutting the power every time the phone rings. Having the PROGRAMMER on a separate line helps. Turn all units on.

Return to Figure B5. There are additional copies of it. Take one out and keep it with you. Until now we have been using Figure B5 to turn on the LEDs in the PROGRAMMER. We will now translate them into images on the screen.

Two points have to be kept in mind before starting. First, the 909 was built to control three projectors on each of three screens. While we are only using part of this capacity, we have to program the

The major place this affects us, is in the number of commands that it takes to make up a "cue." A cue is complete only when you have told all three FADER UNITS what to do. We will adjust for this by just continually telling FADER UNIT C to do nothing.

The second point is that you always have to tell the unit exactly what you want at each step. The unit has been devised to do a lot of things automatically. For example, the automatic X makes it so that it will always advance to the next slide unless you specifically tell it not to. However, if you want an image to stay on the screen when the other screen changes, you have to tell it to stay there. You do this by repeating the previous command. Note that a COMMAND is what you tell any one FADER (thus projector) to do, while a CUE is the full set of three COMMANDS (one to each FADER) that are performed together.

With these points in mind, and with all units turned on, we will start to program. At the top of each CODE SHEET we have repeated the instructions ALWAYS START PROGRAMMING WITH *RESET* AND *STORE*. Keying RESET sets the memory to the beginning. If the unit has been turned off, the beginning is indicated by the number 024 appearing in the MEMORY DISPLAY of the PROGRAMMER. Keying STORE will turn on the red LED next to it.

Cue one is 000 000 000 – all projectors off. You have to tell each FADER to turn on zero projectors. The first group of 000 represents FADER A. The second set represents FADER B and the third represents FADER C. Each circle within the group of three represents a specific projector. If the circle is filled in, the projector should be on. If the circle is open, the projector should be off. ●00 indicates that the first projector is on, the second and third are off. We are not using the third projector so it is always 0. To accomplish this 000 000 000 cue, key the 0 command button three successive times. Always start each program with this command. In the event that a projector is erroneously on, this will turn it off. It is a good safety practice.

Cue two is ●00 000 000. The first circle in the first series is filled in indicating that FADER A should turn on its first projector. FADER B continues to have no projectors on. This is accomplished by keying the COMMAND key 1 then 0 and 0 again. When you complete this, an image should appear on the left screen.

Cue three is ●00 ●00 000. This tells FADER A to leave its lamp on and for FADER B in turn on the lamp in projector one. An image should now appear on the right screen to complement the one that remains on the left screen.

Cue four calls fro ●00 0●0 000. FADER A continues to project its image but FADER B changes to projector two. You would key 1 and than 2 then 0. Notice that a number of things have actually happened here. You have told FADER A to continue to show its image. You have told FADER B to turn off the lamp in projector one and to advance that projector to the next slide while at the same time turning on the lamp in projector two. That is a lot of information. It is all executed as a single cue.

Cue five is ●00 ●00 000. Again the left screen continues, but the image on the right screen changes. FADER B turns on the lamp in projector one again but since it has advanced it is a new image. At the same time it douses the lamp in projector two and advances it to be ready for its next slide.

Cue six calls for 0●0 000 000. You key in COMMANDS 2 0 0. The left screen changes; the right screen goes blank.

Cue 7 is 0●0 0●0 000. Observe the LEDs in the MEMORY DISPLAY as you key in these COMMANDS. Keying the first 2 results in the second LED in the first series being illuminated. These LEDs illuminate immediately when you key in the COMMAND rather than waiting for the full cue. The display for FADER B and C are blank since you have not given them a COMMAND yet. As you key in the second 2, the LED in the second series illuminates. As you key in the 0 for FADER C, the CUE is complete and the PROGRAMMER releases it to the DECODER and FADERS. All windows are blank waiting for the next series of COMMANDS.

If you are not certain what COMMAND you gave FADER A or B you can check it by looking at these LEDs. If you had made an error, you can erase the incomplete cue by depressing the X button. Then key in the correct COMMANDS.

Cue in number eight and nine.

At this point we want to stop programming and see what we have accomplished. To do this, key in 000 000 000 which turns off all projectors. Always complete any programming with this cue so that all projectors are off. While the PROGRAMMER loses its memory when the power is turned off, the DECODER and FADERS do not. If you discontinued after completing cue nine and turned off the system, the next time the system was turned on, the cue would still be active and the projectors that were illuminated as you finished would come on again. This throws the next presentation out of sync. ALWAYS START AND END ANY PROGRAMMING WITH 000 000 000. Even if you are only going back to check the program you are doing, key in 000 000 000. When you again go into STORE to continue programming, replace the 000 000 000 with the next cue as if you were making a correction.

In the rest of this manual, we will at times abbreviate the cues to digits rather than the symbols; i.e., 2 1 0 rather than 0●0 ●00 000. However, do not forget that the 0 is as much of a COMMAND as any other number – you do have to key in the 0 COMMAND.

Return all projectors to their beginning by using the HOMING switch to the DECODER. Now WITHOUT TURNING OFF THE PROGRAMMER, key the RESET BUTTON. This should automatically take the unit out of STORE. Red light goes out. The MEMORY DISPLAY indicates that the memory has returned to cue one.

While you were programming, the MEMORY DISPLAY displayed the cue as you entered it so that you could verify its accuracy. If it is not what you anticipated, you can correct it before continuing. When you are replaying from memory, the MEMORY DISPLAY shows the next cue coming up. This is what your program will advance into. If you depress EXECUTE, this cue will be released into the DECODER which results in the first cue being displayed on the screen. Cue one is for a blank screen (0 0 0). The MEMORY DISPLAY shows that the next cue calls for the left screen to be illuminated. Keying EXECUTE again releases this cue resulting in projector one FADER A being illuminated. Each time the MEMORY DISPLAY will indicate the next cue in the program and keying EXECUTE will release this cue resulting in the desired image change. The LEDs in the DECODER show the present position of the projected images. It is, therefore, one cue behind the PROGRAMMER. Use EXECUTE to complete the 10 cues.

Now, HOME projectors and reprogram all of Figure B5. Remember to key RESET and STORE before starting to program. This assures that you are at the beginning and that the program is being STORED into memory. When playing back, again depress RESET but not STORE since you want to play back out of memory, not add to it. In either event, you always key RESET before starting to assure that you are at cue one. The exception to this, of course, would be when you are developing a program and want to continue where you left off. You would use STEP or BACK SPACE to get to the starting point.

Return to the beginning and play it back.

Practice this until you are comfortable.

It is probable that you have 28 cues stored in the memory of the PROGRAMMER at this point. If you reprogrammed Figure B5 without interrupting the power, both series will be in the memory.

10. Editing and Correcting

After the program has been stored in memory, it can be proofed by RESETTING and using the STEP key to advance through the program one cue at a time. The MEMORY DISPLAY can be compared with the code sheet or the visuals on the screen can be compared with those required by the script.

One of the major advantages of this digital memory type of programmer is the ease with which corrections can be made.

Additions. If a cue was omitted from the program, it can be inserted. Again, referring to the program on Figure B5, assume that cue 5 was accidentally omitted. Remember that the STEP and BACK SPACE keys can be used to find specific cues. Keying the STEP key lightly advances one cue at a time. Holding it down firmly scans through the program rapidly. The BACK SPACE is similar. One difference is that the STEP key stops at the end of the program while the BACK SPACE repeats the cycle over and over. The STEP key can be used to get to the end of a program in much the same way that the RESET key returns you to the beginning. If Cue 5 was omitted, STEP or BACK SPACE to Cue 4. Depress STORE and key in the proper cue. Step back through the program to verify that the modification is as you wanted it.

It is usually desirable to check the total number of cues against the code sheet. The portion of a program shown in Figure B5 has 18 cues. If you depress the STEP key and hold it down firmly, it will advance to the end and stay there. If it were to stop at 18, you would have confirmed that you at least have the correct number of cues. If you later add or delete cues, this number should change accordingly.

You can also confirm the number of cues by keying TOTAL but as we will note in a moment, the TOTAL can count some functions that do not show as cues. While it is consistent and can be used to confirm that a correction has been made, it will not necessarily correspond with the total number of cues. It will never be less than the number of cues, only equal to or more.

Deletions. If you wish to delete a cue, locate it with the STEP and/or BACK SPACE keys. Key STORE then DELETE. When the DELETE key is depressed, the cue will be erased from the memory and the MEMORY DISPLAY shows the previous cue. The DELETE key should take the unit out of STORE. If more than one cue is to be DELETED, STORE has to be keyed in each time. Eliminating the cue will shift all of the following cues one number. This may result in making all the numbers recorded on a code sheet incorrect. For example, if Cue 6 were eliminated from the program and the cue erased from the memory, then Cue 7 would become Cue 6, etc. Rather than changing all of the numbers recorded on the code sheet to reflect merely a number change, you could first DELETE Cue 6 and then add another cue identical to Cue 5 in its place. Since the FADERS respond only to changes in the program, the additional Cue 5 would not influence them. It would keep the number series correct.

This concern with the recorded numbers might be more meaningful after you complete a recording in which the script is typed out and all slide changes are noted in it by inserting the cue numbers on the script. Altering a full script just to add or substract one from each number is a chore. Not doing it can cause difficulties. Correcting the program by deleting one cue and adding a duplicate is often the most expedient alternative.

Changes. If Cue 4 had been accidentally entered as 2 2 0 rather than 1 2 0, locate Cue 4, Key STORE then DELETE. This takes out the erroneous data. Key STORE again followed by 1 2 0 which adds the correct data where the erroneous data was taken from. This results in a correction that does not alter any other aspect of the program.

When programming, if an error is detected before the cue is completed, the partial entry can be erased by keying X. This starts the cue over.

Editing and Correcting – Practical Exercise

Complete each numbered paragraph before continuing to the next.

1. Turn off PROGRAMMER momentarily then turn on. All other units may be off.

2. Key STORE. Enter Cues 1 and 2 of Figure B9.

3. Enter the first COMMAND (Key 2) for Cue 3 but not the second or third.

4. While observing the MEMORY DISPLAY LEDs. Key X. Note that the X erases the incomplete cue. If you detect an error while entering a cue, the partial entry can be erased by Keying X. Then enter the correct cue. Also, notice that Keying X does not take you out of STORE. Neither does it count as a cue.

5. Enter Cue 3 and balance of Figure B9.

6. Key TOTAL and note MEMORY DISPLAY. It should be 8. If not, start from the beginning and try again.

7. RESET.

8. STEP through sequence comparing LED display with code sheet. They should match.

9. STEP and/or BACK SPACE to Cue 5.

10. Key STORE then DELETE. Keying DELETE backs MEMORY DISPLAY to Cue 4.

11. RESET.

12. STEP through sequence comparing LED display with code sheet. You should observe that Cue 5 has been erased.

ARION 909 Digital Memory Programmer - Code Sheet

page ____

Always start programming with RESET then STORE.

Always end programming with 000 000 000.

Title: Corrections

Author: Smith

Date: 20 Jun 77

Screen A	Screen B	Screen C	Cue	RTA	COMMANDS	Notes
:	:	:	1		000 000 000	
:	:	:	2		000 000 000	
:	:	:	3		000 000 000	
:	:	:	4		000 000 000	
:	:	:	5		000 000 000	
:	:	:	6		000 000 000	
:	:	:	7		000 000 000	
:	:	:	8		000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	

Figure B9. **Editing and correcting – practical exercise.**

13. Key TOTAL: Total now should be 7.

14. BACK SPACE to Cue 6 in the MEMORY DISPLAY. Note that the LEDs for Cue 6 correspond to Cue 7 on the Code Sheet. All cues after the one erased have been shifted one number.

15. BACK SPACE and/or STEP to 4.

16. Key STORE then key 000 000 000, (Cue 5 on Figure B9).

17. RESET and STEP through sequence to verify that correct Cue was entered.

18. Key TOTAL. It should again be 8.

19. Go to Cue 5.

20. Key STORE then DELETE. Key STORE then enter Cue 4 from Figure B9.

21. RESET and STEP through program to compare MEMORY DISPLAY with Code Sheet. All cues should correspond except that Cue 5 has been changed to be identical with Cue 4. There will be no screen changes when this cue is EXECUTED.

22. Key TOTAL. It should be 8. You have eliminated a cue without changing the position of the remaining cues.

23. Repeat above exercise with projectors active if you desire. Observe the screen image parallels the changes in the LED display.

11. Fade Rates

We have been programming slide changes by telling the FADERS the order we wanted. We have not been indicating how fast we want the changes to occur. The program can not only tell the FADER to change slide 67 to slide 68, but also tell it how fast to make the change.

The right-hand series of keys on the PROGRAMMER are the AUXILIARY keys. One is labeled R. This stands for rate of dissolve or rate of change. Any of five dissolve rates can be programmed. For example, if you program R-0 (key R followed by the 0 COMMAND key) one image will be replaced by the next almost instantly. If you want to dissolve one image into the next, R-1 will result in a 2-second dissolve. Table B1 gives the various dissolve rates.

Table B1. **Fade Rates**

R–0	Instant
R–1	2-second dissolve
R–12	4-second dissolve
R–13	8-second dissolve
R–123	16-second dissolve

In the MEMORY DISPLAY a 7 will appear to indicate the R. The COMMAND key will be reflected in the second and third LED display, but not in the first. Programming the R will not change the cue number shown in the MEMORY DISPLAY, but does add to the total reflected when the TOTAL key is depressed. This is why the TOTAL is not the same as the number of cues; i.e., the TOTAL is the number of cues plus the number of auxiliary commands. The PROGRAMMER releases the rate information with the cue. When STEPPING through the program, these show like a cue. When EXECUTING the program you can see the lights flicker when the rate is entered in advance of the cue, but it is only a flicker. Rate changes are recorded on the code sheet in the column RTA. They are entered into the program as the first part of the cue.

If you do not specify the change rate at the beginning of the program, the DECODER probably will select R-0 (instant) automatically. However, it is recommended that you do specify the change rate. Make it a practice to STORE R-0 000 000 000 as the first cue in any program. Also make it a practice to STORE 000 000 000 as the last cue not only in every program, but also in every programming segment even if only part of a program is being accomplished.

This will be discussed in more detail when we consider time sequences, but note that in entering R-1, only one COMMAND is given rather than three. This is reflected on the code sheet by drawing a line through the B and C sections.

Fade Rates – Practical Exercise

Complete each numbered paragraph before continuing to the next.

1. Turn on the PROGRAMMER, but leave the DECODER off. Projectors and FADERS may be either way. With the DECODER off they are effectively out of the system since no commands reach them. This set-up allows you to PROGRAM without the projectors. This is often convenient – in fact it is usually preferred with STORING a program.

2. STORE the cues on Figure B10. Notice that you can hear the clicking sound as the fade rates are programmed, but that the cue number given in the MEMORY DISPLAY does not advance. The rate and the COMMANDS are part of the cue. Some of the cues call for more than one command key being depressed together. Cue 8, for example, will result in two images being superimposed on the screen.

3. RESET.

4. Use the STEP function to advance through the program and compare the LEDs in the MEMORY DISPLAY with the code sheet. For R, the LEDs in the B and C FADER area are lit, not the ones in the A area.

5. RESET.

6. Turn on DECODER and remainder of system. Advance through the program by keying EXECUTE. Notice the different dissolve rates on the screen.

7. The final image illustrates the superimposition of one image over another. While this is not restricted to dissolve presentations, it is often particularly effective using a dissolve.

8. RESET and HOME.

9. Practice. Include superimpositions by programming both 1 and 2 for the same FADER – just key 1 and 2 together. You can add and substract superimpositions in any order by using a cue to add or omit the second image.

12. Timing

There are times when cues occur too rapidly to execute manually. An illustration is when you would want an arrow to flash on and off to draw attention to a particular part of the screen. There are other times when the time is critical. An example would be when you want to demonstrate the rate at which some phenomenon happens. You can program a stored time interval that is entered only once into the program. It then stays in the memory until it is cancelled by an end-of-sequence cue. All of the cues in a timed sequence are executed following one keying of the EXECUTE key or one impulse from the cassette.

The time intervals available are 1/8 second, 1/4 second, 1/2 second, one second or any combination or multiple of these.

The cues for time intervals are shown in Table B2.

Table B2. **Timing Intervals**

T–23	1/8 second
T–1	1/4 Second
T–2	1/2 second
T–12	1 second
T–3	End of Sequence
T–13	Do nothing or dummy cue.

If, for example, you desire to have Cue 7 follow Cue 6 by exactly 1/2 second, enter Cue 6 then T-2 (to start the timing sequence) then Cue 7 then T-3(to end the timing sequence). When it is played back,

ARION 909 Digital Memory Programmer - Code Sheet

page____

Always start programming with
RESET then STORE.

Always end programming with
000 000 000.

Title: Dissolve

Author: Smith

Date: 17 Jun 77

Screen A	Screen B	Screen C	Cue	RTA	COMMANDS			Notes
:	:	:		R	000	[redacted]		
:	:	:	1		000	000	000	
:	:	:	2		000	000	000	
:	:	:	3		000	000	000	
:	:	:		R	000	[redacted]		
:	:	:	4		000	000	000	
:	:	:	5		000	000	000	
:	:	:	6		000	000	000	
:	:	:		R	000	[redacted]		
:	:	:	7		000	000	000	
:	:	:	8		000	000	000	
:	:	:	9		000	000	000	
:	:	:		R	000	[redacted]		
:	:	:	10		000	000	000	
:	:	:	11		000	000	000	
:	:	:		R	000	[redacted]		
:	:	:	12		000	000	000	
:	:	:	13		000	000	000	

Figure B10. **Fade rates – practical exercise.**

keying EXECUTE for Cue 6 will start the electronic clock so that it will trigger Cue 7 at the end of 1/2 second. The T-3 will stop the timing sequence so that Cue 8 will wait for the next EXECUTE or tape cue.

If you want 1 full second intervals between each of Cues 3 through 7, enter the cues through 3 then T-12 (you will hear it click as usual when a cue is entered though it does not advance the counter), then enter the rest of the cues through 7. Now enter T-3 to stop the timing sequence and proceed as usual. Cue 3 will start the entire timing sequence and it will continue automatically through Cue 7 with each being presented at 1-second intervals. The automatic timing sequence will stop at 7 and you proceed as usual.

The "do nothing" or "dummy" cue (T-13) is for use when you need to lengthen the periods. If, for example, you needed one 3-second pause between two slides, if the first slide were to be called up by Cue 6, you could follow Cue 6 with T-12 to start a timing sequence, then add T-13 as Cues 7 and 8 to expand the time, then Cue 9 followed by T-3 to stop the timing sequence. The DECODER will add time for Cues 7 and 8 but not change anything else. The next slide would then come up at Cue 9, 3 seconds after the slide for Cue 6.

Duplicating the COMMAND keys would accomplish the same but might be more difficult to remember at times. With the T-13, one cue can be used no matter what the image configuration on the screen is.

The "dummy" T-13 is the only one that is counted as a cue. The other timing cues are entered as part of the projector cue.

Both the T and the R cues require only one COMMAND keying rather than the normal three. This is because the cue is not passed individually to the FADERS but controls all of them as a group. To indicate this on the code sheet, the last two 000's are lined out. When you are programming with only the PROGRAMMER on, you can hear the unit click. Lining out the last two commands on the code sheet is a reminder to insert only one COMMAND on these cues.

When you are STEPPING through the program to compare the LEDs in the PROGRAMMER with the code sheet, for the R cues the LEDs for FADER B and C illuminate rather than those FADER A. For the T cues, all three groups of LEDs light, rather than just A. Also, each requires the keying of STEP even though they do not count as full cues. When EXECUTING, they do not require a separate keying of EXECUTE and the LEDs just flash on. You can confirm their accuracy when proofing the program, but when EXECUTING the program they become part of another cue.

Timing – Practical Exercise 1

Complete each step before going on to the next.

1. With the PROGRAMMER on but DECODER off, store codes from Figure B11.

2. STEP through program to confirm. Observe LED display for the T COMMANDS. Also, note that STEP must be keyed for them though they do not count as cues. On the MEMORY DISPLAY, both T and R are coded 7. X is 1, H is 3, and K is 5. The numbers are next to the keys on the PROGRAMMER.

3. Turn on DECODER and projectors.

4. EXECUTE program. The sequence should progress at 1-second intervals until it is completed.

Timing – Practical Exercise – 2

Complete each numbered paragraph before going on to the next.

In this exercise we do not want the projectors to advance after the lamp is turned off. To accomplish this, the automatic X must be replaced by the H. You can either key H before each cue on hold it down with the left hand while the right hand does the keying of the COMMAND keys. Incidentally, if you leave your right hand on those COMMAND keys, you soon get so that you can "type" the COMMANDS. The only slightly confusing thing is that the first finger is on the 0 and the second on the 1, etc.

1. With the DECODER off, enter the sequence from Figure B12 into memory.

2. RESET.

ARION 909 Digital Memory Programmer - Code Sheet

page ______

Always start programming with RESET then STORE.

Always end programming with 000 000 000.

Title: Timing - 1

Author: Smith

Date: 20 Jun 77

Screen A	Screen B	Screen C	Cue	RTA	COMMANDS	Notes
:	:	:		T	000 [redacted]	
:	:	:	1		000 000 000	
:	:	:	2		000 000 000	
:	:	:	3		000 000 000	
:	:	:	4		000 000 000	
:	:	:	5		000 000 000	
:	:	:	6		000 000 000	
:	:	:	7		000 000 000	
:	:	:	8		000 000 000	
:	:	:	9		000 000 000	
:	:	:	10		000 000 000	
:	:	:	11		000 000 000	
:	:	:	12		000 000 000	
:	:	:	13		000 000 000	
:	:	:		T	000 [redacted]	
:	:	:			000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	

Figure B11. Timing – practical exercise – 1.

ARION 909 Digital Memory Programmer - Code Sheet page____

Always start programming with RESET then STORE.

Always end programming with 000 000 000.

Title: **Alternation**

Author: Smith

Date: 17 Jun 77

Screen A	Screen B	Screen C	Cue	RTA	COMMANDS			Notes
:	:	:		T	000	000	000	
:	:	:	1	H	000	000	000	
:	:	:	2	H	000	000	000	
:	:	:	3	H	000	000	000	
:	:	:	4	H	000	000	000	
:	:	:	5	H	000	000	000	
:	:	:	6	H	000	000	000	
:	:	:	7	H	000	000	000	
:	:	:	8	H	000	000	000	
:	:	:	9	H	000	000	000	
:	:	:	10	H	000	000	000	
:	:	:	11	H	000	000	000	
:	:	:	12	H	000	000	000	
:	:	:	13	H	000	000	000	
:	:	:		T	000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	

Figure B12. Timing – practical exercise – alternation.

3. With the STEP key, advance through the program to confirm it.

4. RESET.

5. Key EXECUTE. If properly programmed this one touch of the EXECUTE will activate the entire sequence.

6. RESET.

7. Turn on the DECODER, FADERS, and projectors.

8. EXECUTE. Note that the image on the screen alternates between the same two slides.

9. Go to Cue 1 and change the time to another value; i.e., STORE, DELETE, STORE T- (any value you choose).

10. EXECUTE again.

11. Without erasing memory, RESET to beginning and insert sequence from Figure B13. This will automatically move the sequence you just completed so that it will be the second half of one presentation.

12. Confirm entries by STEPPING through.

13. EXECUTE with projectors. This technique is often used to emphasize captions or arrows.

14. This new portion will leave one image on the screen and intermittently superimpose a second image on it.

13. Homing

Homing is a single cue that homes *all* slide trays to the number 1 position. In order to use it, the slides must be in the Arion-Modified Carousel homing trays. If you examine one of them you will note that one of the "gear teeth" on the bottom has been broken off. It has been replaced by a spring steel wire. If the tray is traveling forward, this will serve as a tooth and advance the tray. However, if the projector is in reverse, the projection that reaches for the tooth does not make contact. As a result, the tray stays in one place even though the projector goes through the reversing cycle. This enables all projectors to be reversed to the number 1 slide and stop there. Additional cues are given to assure that all projectors have returned. Then the cycling is stopped.

The continuous reverse cycle is given to the projectors for 5 seconds longer than actually required. In this way, if you get a projector that is a little slower than normal, it still reaches the HOME position. The additional cycles do not change the position of projectors that have already reached HOME, since they remain at the number 1 position once they have reached it.

Many projectors have a tendency to unpredictably advance one slide anytime the power is turned on or off for them or any of the other equipment in the system. To avoid getting out of sync because of this, one final HOME cue is given after the HOMING cycle is discontinued. It is also a very good precaution to apply this single HOMING just prior to starting any presentation. If you hear a projector reverse, check to make certain that the projectors were HOMED, then apply it one final time.

The HOMING cycle can be controlled in two ways, manually at the DECODER or with recorded cues. These two are separate – if you start the cycle with a recorded cue, you must stop it with a recorded cue. If you start it manually, you must stop it manually. Turning off the MAIN POWER also stops it, so if all else fails, turn off MAIN POWER momentarily.

Manual. To home the projectors manually, depress HOME on the DECODER and hold it for about 2 seconds. The projectors will start to recycle and will recycle continuously after the switch is released. After all trays are at the number 1 position, (stop reversing) depress HOMING momentarily to discontinue the cycle. Following this, again depress the switch momentarily to apply a single reverse impulse. This is automatically timed by the unit so you do not have to hold the key down.

Again, when giving a presentation first turn on all equipment then depress HOMING momentarily. Any projector than has erroneously advanced will be returned. If you do hear a projector reverse, repeat.

ARION 909 Digital Memory Programmer - Code Sheet page____

Always start programming with RESET then STORE.

Always end programming with 000 000 000.

Title: **Flashing**

Author: Smith

Date: 17 Jun 77

Screen A	Screen B	Screen C	Cue	RTA	COMMANDS	Notes
:	:	:		T	000 000 000	
:	:	:	1	H	000 000 000	
:	:	:	2	H	000 000 000	
:	:	:	3	H	000 000 000	
:	:	:	4	H	000 000 000	
:	:	:	5	H	000 000 000	
:	:	:	6	H	000 000 000	
:	:	:	7	H	000 000 000	
:	:	:	8	H	000 000 000	
:	:	:	9	H	000 000 000	
:	:	:	10	H	000 000 000	
:	:	:	11	H	000 000 000	
:	:	:	12	H	000 000 000	
:	:	:	13	H	000 000 000	
:	:	:		T	000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	
:	:	:			000 000 000	

Figure B13. **Timing – practical exercise – flashing.**

Recorded. The same two cues can be recorded. The Cues K-1 0 0 and K-0 0 0 are used. To start the HOMING cycle, cue in K-1 0 0 at the end of the presentation. The tape recorder is left running during the HOMING sequence. After the last projector has reached the number one slot, wait an additional 5 seconds to allow for variations between projectors. Then key in K-0 0 0. This will stop the HOMING cycle.

This is followed by the equivalent of the momentary manual action that applies a single reverse impulse. Since it is difficult to program rapidly enough, the timing (T) sequence is used. Key K-1 0 0 to start the HOMING CYCLE. Key T-1 for a 1/2 second time interval. Key K-0 0 0 to stop HOMING. Key T-3 to indicate end of time sequence. This will apply the momentary input. However, the tape recorder is running, DO NOT FORGET TO STOP THE TAPE WHEN YOU TURN OFF THE PROJECTORS. Otherwise, the pressure stays on the cassette and this can damage the recorder.

Homing – Practical Exercise

1. With PROGRAMMER on and DECODER off, program code sheet input from Figure B14. Note that R and T inputs are followed by only one COMMAND key rather than three. To indicate this, the last two key positions have been lined out.
2. STEP through program to confirm it from LEDs on PROGRAMMER.
3. Turn on DECODER and PROJECTORS. Advance through program by keying EXECUTE. Note that trays are HOMED and then HOME is confirmed with a single impulse.
4. REPEAT.

14. Memory Transfer

If you desire to retain your program, it can be transferred to a cassette. This can later be re-entered into the PROGRAMMER for presentation. It can also re-entered into the PROGRAMMER, changed, and re-recorded.

To do this, connect the PROGRAMMER to the recorder by using an audio patch cord to connect the *upper* plug on the back of the PROGRAMMER to the high-level (phono) plug of the cassette recorder. Set the recorder to automatic level for recording. Typical steps for doing this are:

1. Press the TOTAL key and record the total number of steps in the memory.
2. Only the patch cord going to the recorder should be plugged into the PROGRAMMER.
3. Start the cassette recorder in record, automatic gain.
4. Wait 15 seconds for the leader to clear and the recorder to stabilize.
   a. press and hold RESET
   b. press and release STEP
   c. release RESET

The transfer process will start and continue rapidly until the entire memory has been transferred to the tape. The transfer stops automatically. The memory also remains in the PROGRAMMER.

5. Wait 10 seconds before stopping the recorder. It is usually desirable to record only one program on a cassette. They are so brief that locating them is difficult otherwise, However, since so little tape is used, you might as well record it two or more times on the same cassette.

Reloading. To reload the program into the PRGRAMMER, connect one end of the audio patch cord to the speaker output of the recorder. Connect the other end of the cord to the *lower* input jack (memeory input) on the back of the PROGRAMMER.

The recorder playback level has considerable latitude. Set the playback level of the cassette recorder to 4. If the transfer is erratic, adjust this until the transfer is stable. The unreliability can be caused by having the setting either too high or too low so some experimentation might be required. Since you are only playing back about a half minute or recording, this does not take much time. Once the correct level is set, it will remain the same for that recorder. The transfer steps are:

ARION 909 Digital Memory Programmer - Code Sheet page

Title: Homing

Author: Smith

Date: 20 Jun 77

Always start programming with RESET then STORE.

Always end programming with 000 000 000.

Screen A	Screen B	Screen C	Cue	RTA	COMMANDS			Notes
:	:	:		R	000	000	000	
:	:	:	1		000	000	000	
:	:	:	2		000	000	000	
:	:	:	3		000	000	000	
:	:	:	4		000	000	000	
:	:	:	5		000	000	000	
:	:	:	6	K	000	000	000	
:	:	:	7	K	000	000	000	
:	:	:	8	K	000	000	000	
:	:	:		T	000	000	000	
:	:	:	9	K	000	000	000	
:	:	:		T	000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	

Figure B14. **Homing — practical exercise.**

1. Rewind the tape to the beginning.

2. Start the tape in playback mode.

3. Press the STORE key. If STORE is depressed before the leader clears the recorder, the ERROR light will come on. Simply depress STORE again to correct this. This will cause the error light to go out without stopping the tape and starting again. If the error light comes on during the transfer, you must start over. (ERROR light is the LED below the STORE LED.)

4. Press and hold TOTAL. Stop recorder.

5. Press TOTAL. If the transferred total is not the same as the original memory total, repeat the transfer.

6. If a cassette recorder is used that has input and output jacks for the impulse channel, these may be used instead of the audio channel. This will also enable you to use the audio channel and impulse channel independently. By dictating the name of the program onto the tape just prior to the recording of the impulses, several programs can be stored on the same cassette.

Memory Transfer – Practical Exercise

1. Connect audio patch cord between upper plug on back panel of PROGRAMMER and hi-level input of recorder.

2. Turn on PROGRAMMER – other units should be off and unplugged from PROGRAMMER.

3. Program sequence from Figure B15. Repeat program until approximately 100 Cues are in memory.

4. Depress TOTAL and make a note of the reading.

5. Start cassette recorder with Record Mode set to AUTO and RECORD button depressed for recording.

6. Let recorder run for 15 seconds to clear leader and beginning of tape.

7. Press and hold RESET; Press and release STEP; release RESET.

To Re-Enter Cues into PROGRAMMER

1. Connect audio patch cord between speaker outlet of recorder and lower input jack (memory input) on back of the PROGRAMMER.

2. Rewind cassette.

3. Set volume to 4. (may need later adjustment if transfer is erratic.)

4. Start cassette.

5. Key RESET and STORE. If error light comes on, press STORE again. Continue to do this until leader clears recorder.

6. As soon as the transfer is completed, immediately press and hold TOTAL. After the transfer is complete, wait 10 seconds. Stop the recorder, then release TOTAL. This will prevent the error lights from coming on when the recorder is stopped.

7. If error lights comes on during transfer, start the transfer again.

8. Depress TOTAL. Total now should be twice the original program; i.e., you have transferred a duplicate program to the PROGRAMMER. The duplicate is now ahead of the original.

9. Depress STEP and watch LEDs. You should be able to determine the accuracy of the transfer by watching the pattern. If not, STEP through cue by cue and compare with code sheet. If the obtained transfer is not accurate, repeat the transfer.

ARION 909 Digital Memory Programmer - Code Sheet

page ____

Always start programming with
RESET then STORE.

Always end programming with
000 000 000.

Title: Memory Transfer

Author: Smith

Date: 28 Jul 77

Screen A	Screen B	Screen C	Cue	RTA	COMMANDS			Notes
:	:	:	1		000	000	000	
:	:	:	2		000	000	000	
:	:	:	3		000	000	000	
C :	:	:	4		000	000	000	
:	:	:	5		000	000	000	
:	:	:	6		000	000	000	
:	:	:	7		000	000	000	
:	:	:	8		000	000	000	
:	:	:	9		000	000	000	
:	:	:	10		000	000	000	
:	:	:	11		000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	

Figure B15. **Memory transfer – practical exercise.**

15. Identifying Slides, Projectors, and Screen Areas

It is very important that a simple system be established to identify slides, projectors, and screen areas. Since the FADER UNITS are identified on the equipment as A, B, and C, this serves as a starting point.

The area of the screen that is on the audience's left is A, B is the next screen area to the audience's right. When used, C, would be on the audience's right. If one image covers the full screen, this would also be C.

The projectors used on screen area A would also be identified as the A projection unit and would be controlled by FADER UNIT A. When stacked, the top projector is number 1. If not stacked, the projector on the audience's left is 1.

Slides are numbered in sequence in terms of the order in which they appear on the screen. If two images occur at the same time, the one on the audience's left is numbered first. If revisions are made in the presentation, the slide numbers remain the same; i.e., do not change the identification of a slide even though it is moved to a different place in the presentation. When it is moved, make the required correction on the Code Sheet.

The slides are designated in columns on the code sheet. All of the slides in the first column are in try A-1. The second column is A-2. This enables you to verify that the slides are in their proper place.

It is essential that you can accurately determine whether or not the proper slides are in the designated tray. When you are using multiple projectors, it is exceedingly difficult, if not impossible, to work around a misplacement. Just follow a simple logical system from the beginning and double check every step. A little care in getting ready can save hours later on and may well prevent embarrassment in front of your audience.

16. Impulsing a Prerecorded Tape

One of the major advantages of the ELECTRONIC MEMORY PROGRAMMER is the ease with which the final impulses are added to the prerecorded narration. With the impulses stored in the PROGRAMMER, the output of the PROGRAMMER is connected to the impulsing track of the recorder. While playing back the recording, any impulse, no matter how complex, is transferred to the tape merely by depressing the EXECUTE bar a single time.

Figure B16 displays the impulses for the first portion of the presentation used as a sample here. Figure B17 is the first page of the script. With the program in the memory, the narrative on the prerecorded tape is played back with the impulse channel in the record mode. If a 2570, 2573, or 2590 cassette recorder is used, the cord goes between the upper (output) jack on the PROGRAMMER and the EXTERNAL SYNCH INPUT jack of the recorder. Note that the first cue (000 000 000) is placed on the tape before the narration begins. In practice, we often place a series of these at the beginning of the tape to give the operator a chance to correct any projectors that might require it at the beginning of a presentation.

In this style of programming, the images are changed during the narration. Rather than changing slides between paragraphs, the image is changed to coincide with a precise word in the narration.

Impulsing – Practical Exercise

Obtain or make a prerecorded tape of this presentation and the tape containing the impulses. Load the impulses into the PROGRAMMER from the cassette or create them following Figure B16. Change cord and transfer impulses to cassette by following the script in Figure B17. Note that the PROGRAMMER is displaying the next cue. This is transferred by depressing EXECUTE as indicated by the numbers written above the words in the script. These numbers must agree.

Two points should be called to mind before concluding. First, this technique assumes that you have recorders that allow you to record on one track while listening to the other. The only AV cassette recorder that I am aware of at this time is the Wollensak. Models 2570, 2573, and 2590 are particularly suitable. The second is that it is not desirable to duplicate the control track. While duplicate narrations may be used, it is difficult to obtain reliable operation when the impulses are duplicated. One suggestion is to retain one cassette with the master audio and a second with the recorded impulses. Duplicates are made by transferring the impulses to the PROGRAMMER and impulsing the duped narration from it. It takes a little more time but pays off in reliability. There is seldom a requirement for more than one duplicate.

ARION 909 Digital Memory Programmer - Code Sheet

page 1

Title: 1121-07-05-Arion

Author: Smith

Date: 23 Jun 77

- Always start programming with RESET then STORE.

Always end programming with
000 000 000.

Screen A	Screen B	Screen C	Cue	RTA	COMMANDS			Notes
:	:	:	1		000	000	000	
:	:	:		R	000	[redacted]		
:	:	:	2		000	000	000	
:	:	:	3		000	000	000	
:	:	:	4		000	000	000	
:	:	:	5		000	000	000	
:	:	:	6		000	000	000	
:	:	:	7		000	000	000	
:	:	:	8		000	000	000	
:	:	:		R	000	[redacted]		
:	:	:	9		000	000	000	
:	:	:	10		000	000	000	
:	:	:	11		000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	
:	:	:			000	000	000	

Figure B16. **Sample program – initial impulses.**

TECHNIQUES OF UTILIZING MULTI-SCREEN PRESENTATIONS
Digi Cue Discussion for Presentation via ARION

1 2 Work unit 1121-07-05 3 "Techniques of Utilizing Multi-Screen Presentations" was initiated in response to RPR 75-16 from SAC. It requires the 4 development and demonstration of a series of control techniques of which this is the first.

The 5 Digi-Cue configuration is off-the-shelf and readily available. It is basically an add-on system. 6 The basic equipment, other than standard 7 projectors, are a special cassette recorder, a three speed dissolve control, and a Digi-Cue Programmer. Unlike many commercial systems, the Digi-Cue is used both for recording the program and also for playing it back. You do not need one device to make the program and another to play it back.

Figure B17. **Sample program – script.**

APPENDIX C: COURSEWARE DEVELOPMENT OF TEAM TRAINING PACKAGE

1. Courseware Development

Develop Task Outline.-The early development stages for the audio team coaching, television team coaching, and television-aided remedial study strategies are quite similar; i.e., all three were designed to provide instruction for a single team job. Figure C1 shows the suggested student flow from television team coaching through audio team coaching to unaided performance or task mastery. Television-aided remedial study can be used to help students master tasks if they have had difficulty during audio team coaching. Television team coaching provides a preview of tasks by presenting an overview of job sequence and team member coordination. Audio team coaching provides audio cues for performance of each job step. Television-aided remedial study provides a special visual review of individual team position performance skills.

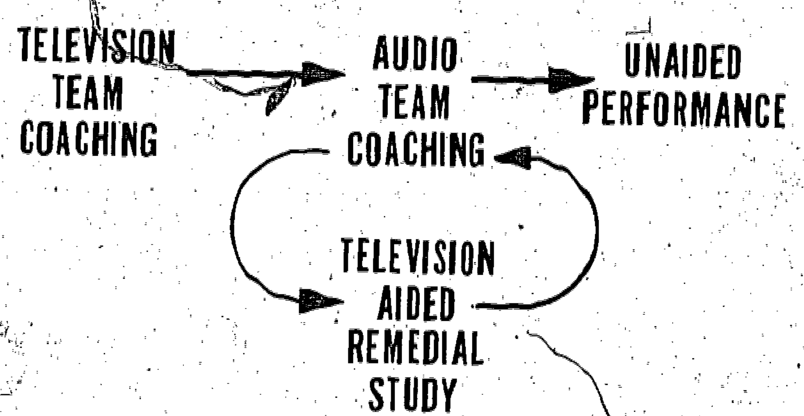

Figure C1. Suggested student flow through team training strategies.

The early development of all three instructional strategies involved the establishment of goals and objectives, and the systematic examination of the target task (i.e., the task for which training was to be developed). Analysis of the target task culminated in the production of a task outline. The task outline was used as the basis for the production of the audio and video tape strategies. This section will discuss the procedure for development of the preliminary task outline.

The three strategies discussed here were designed to be used with team tasks which required a student to follow a prescribed procedure while coordinating his activities with other team members. Although the strategies developed were oriented toward team task performance, they could be modified to teach individual tasks. For example, an airman could preview the use of the AN/PSM-6 multimeter using the television coaching strategy; then be coached through a series of practice exercises, using the audio coaching strategy; and then, if necessary, be reviewed on individual elements of the use of the multimeter, using the television-aided remedial study strategy.

Figure C2 shows the procedure which was followed to develop a validated task outline. Each of the steps are discussed separately as follows:

Establish Goals. Instructional goals were established to guide the development of the television team coaching, audio team coaching, and television-aided remedial study strategies. The primary goal for this project was to develop materials which would allow students to achieve proficiency in team coordination for the performance of specified team tasks. In general, the goals were:

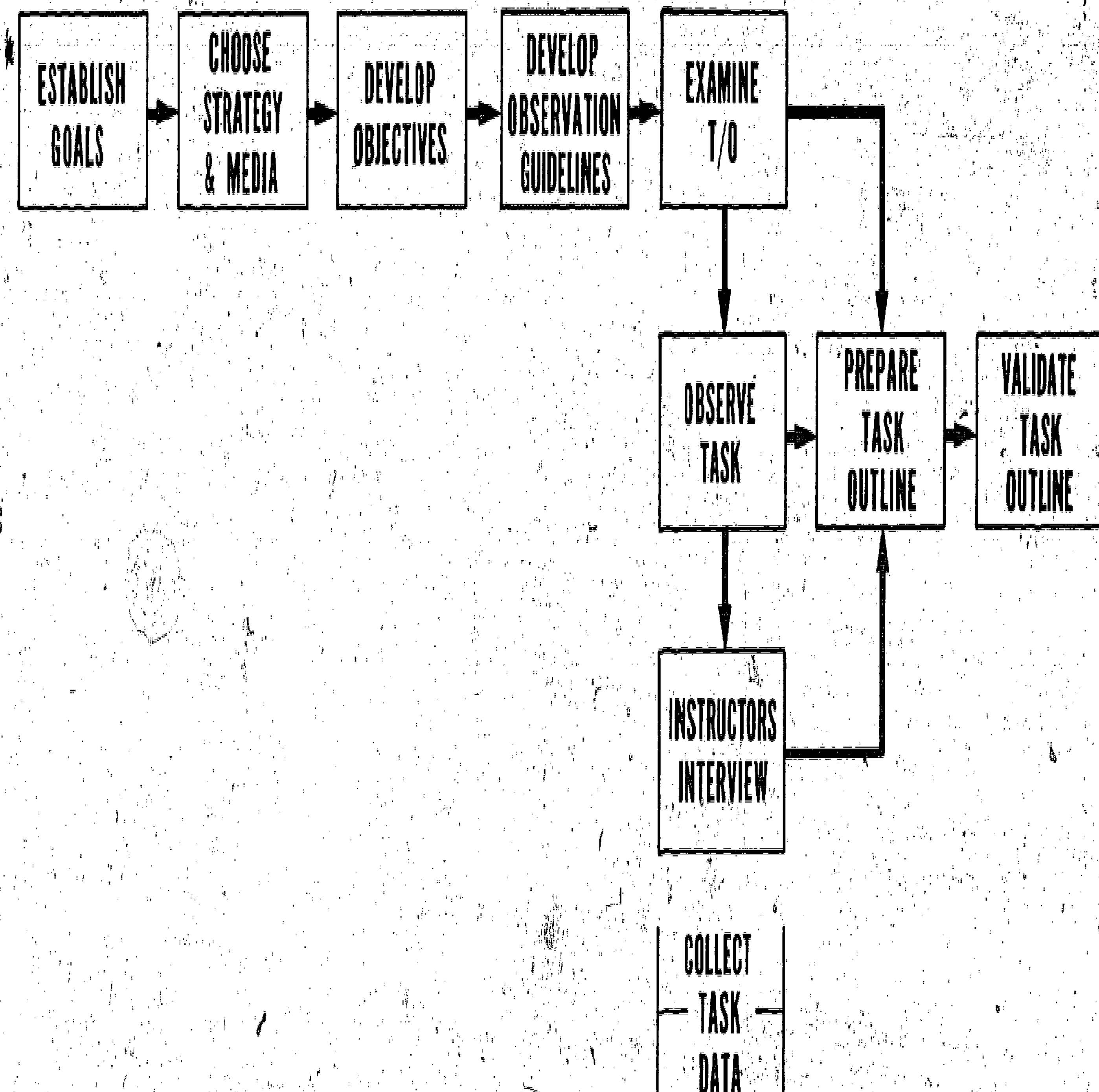

Figure C2. Task outline development and validation procedure.

1. To familiarize students with the overall organization and flow of the task prior to their first attempt at task performance.

2. To provide each team member with individualized coaching tailored to the stage of practice and team proficiency.

3. To provide remedial instruction for individual students having difficulty performing the duties of their team position.

The target task selected for development was the installation of a preloaded multiple ejection rack (MER) on the outboard pylon of the F-4D aircraft.

Choose Strategy and Media. The decision to utilize audio and video strategies was based on an examination of the instructional goals, the characteristics of the tasks to be learned, and the cost-effectiveness parameters (e.g., materials preparation time, student working time, equipment requirements, etc., as outlined in Air Force Manual 50-2, *Instructional Systems Development*).

The decision-making process used for selection of the optimum strategy/media combination is illustrated in Figure C3. The general procedure was to examine the types of stimuli associated with the task to be taught (e.g., visual, auditory, etc.); the required student performance (e.g., use of hand, communication with others, etc.); and the instructional goals. If the task contained substantial visual stimuli, the strategy required a visually oriented medium. If the task was largely manual, the strategy was to employ visual stimuli, together with the action of the student's hands. If the instructional goal required minimum instructor support, the strategy was to feature student-contolled or equipment-controlled presentations.

In the case of loading a preloaded MER, visual stimuli were important and students were required to work with their hands. Therefore, the appropriate instructional strategy had to incorporate visually oriented media identifying the stimuli and depicting the manual performance required of the students. However, no single strategy could satisfy all three instructional goals. Therefore, it was necessary to select a separate strategy for each goal. A visually oriented strategy was selected to familiarize the students with the overall work flow of the task. Television was selected for these uses because of low materials preparation costs. An audio-oriented strategy was selected to provide coaching to each team member during task practice. The audio strategy was chosen primarily because of the necessity of providing individualized coaching to team members performing coordinated job tasks in different locations. Finally, a television-oriented strategy was selected to provide remedial instruction to individual team members.

Develop Behavioral Objectives. The general instructional goals were converted into specific learning objectives. To assure that objectives were written to support the development of the instructional material, the following questions were asked:

1. Does the behavior described actually reflect the underlying goal which is to be achieved?

2. Has the student's behavior been described in such a way as to allow detection of the behavior when it occurs?

3. Are the conditions under which the performance is to be observed clearly specified or implied?

4. Is a standard of performance given?

Table C1 shows the program goals and the behavioral objectives developed for each of the goals. It should be noted that not all goals have objectives. In these cases it was decided that the goal statement itself was sufficiently explicit to specify its achievement. Several assumptions were made concerning the pre-requisite skills and knowledges of incoming students. These assumptions were based on the location of the material in the course. It was assumed that the students would be familiar with the aircraft, weapons, and tools (i.e., they would know the nomenclature, location, and operation of necessary equipment items). Given these assumptions and the nature of the task to be learned (i.e., a fixed procedure requiring coordination among team members), it was felt that a hierarchy of objectives was not required for the instructional segments being developed.

Develop Task Observation Guidelines. Three data sources were identified for the MER installation task and included Technical Order (TO) 1F-4C-33-1-2, direct observation of the task, and instructor interviews. The duties of each team member had to be determined and recorded. Likewise, special hazards were noted, along with any discriminations which might be required.

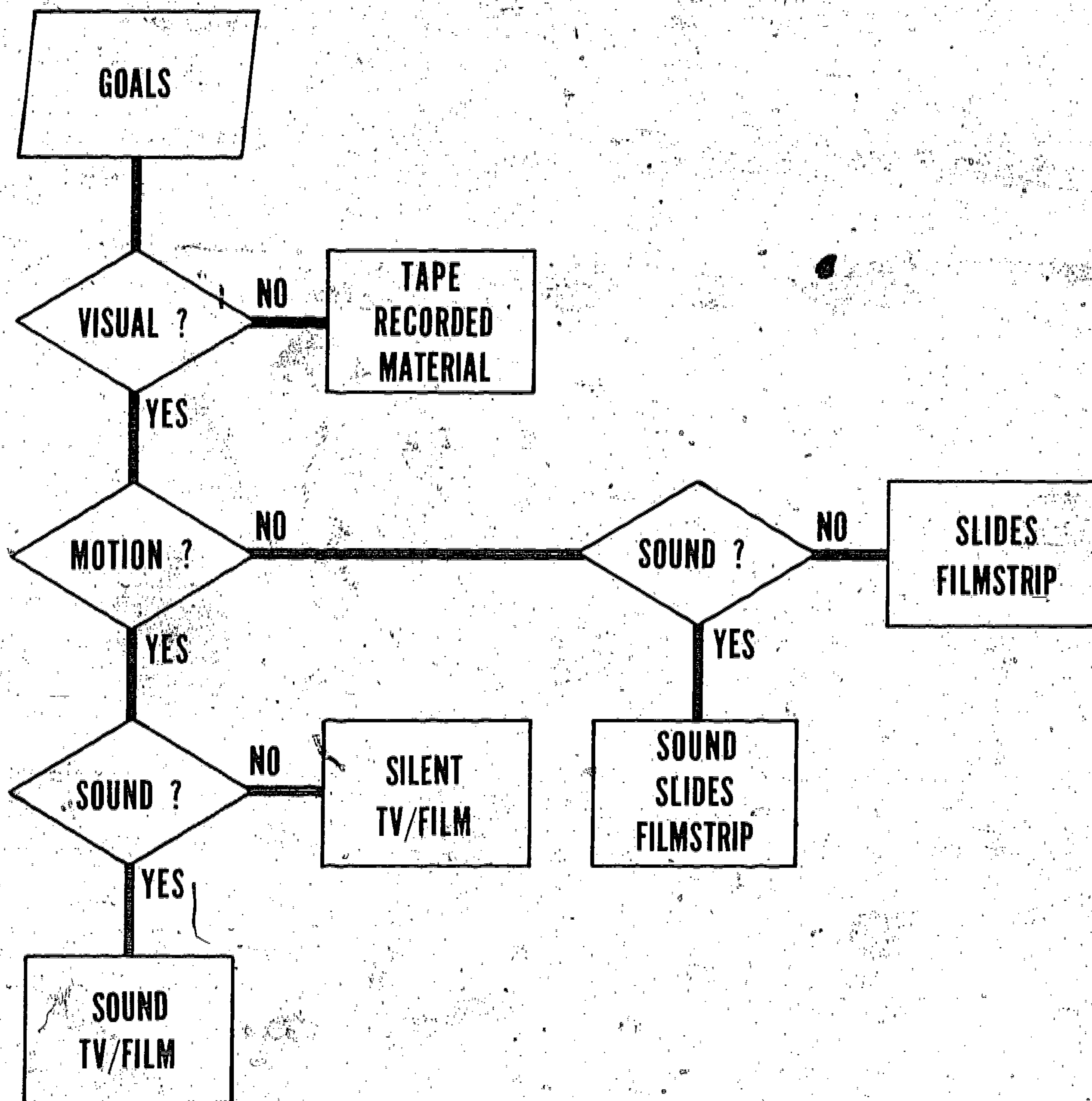

Figure C3: Sample decision tree for selecting appropriate instructional media.

Table C1. **Instructional Goals with Their Associated Behavioral Objectives**

Goal	Objective
Install preloaded MER on outboard pylon of F-4D Aircraft.	Each student team member will perform each individual step procedure with not more than a 10 percent error rate.
	The student team will perform all steps — each step in its proper sequence.
	The student team will install the preloaded MER within a specified time limit.
Achievement of proficient team member coordination.	Students will communicate only appropriate verbal instructions to one another using the proper terminology and format.
	Student teams will work together to accomplish all procedure steps without conflicting actions.
	Students will respond with only appropriate response upon completion of each task step.
Familiarize students with the task prior to their attempt to perform the task.	Student team members will make no position errors in locating equipment items.
	Students will be able to describe the sequence of tasks assigned to their team positions prior to attempting the task.
Students will receive a large amount of task support during early stages of practice.	Students will commit no more than 5 percent procedural errors in the early stages of practice.
Students will receive diminishing amounts of task support in later stages of practice.	
Remedial support will be provided for areas in which a student may have difficulty in achieving the performance criterion.	Each student team member will achieve criterion performance in the assigned team positions.

Collect Detailed Task Data. The task data collection procedure began with a review of the MER installation procedure as described in the TO. A task outline was developed from steps identified during the development of task observation guidelines. Once the observer was thoroughly familiar with the task as described in the task outline, he observed actual task performance in the Weapons Mechanic school. Task performance was video taped in order to allow reviewing a task while correcting the task outline. After observing task performance, the developer interviewed course instructors to assure accuracy in his observations and interpretations. Interviews with instructors were guided by specific questions based upon the data collected from the TO and task observations. Special care was taken to specify tolerances, stimuli needed for discriminations, and other special characteristics (e.g., position of swaybraces, positions of cockpit switches, etc.).

2. Audio Team Coaching

Applicable Areas. Audio team coaching was designed to teach students the skills needed to successfully perform tasks which required coordination between two or more individuals. The tapes for the audio team coaching strategy provided all information required to talk each team member through a task. All cues and instructions needed for tash performance were to be provided to each team member individually. Only those instructions required for a given team position would be given to the man working in that position (e.g., team member number 1 would receive only instructions relevant to position 1, while member number 3 would receive only instructions for position number 3). This was made possible through the use of a multitrack recorder with the instructions for each team member recorded on a separate tape track. Instructions were transmitted with a small radio transmitter to the team members through receivers in earphones. However, since communication between team members was required, a single earphone was used by each student team member, thereby allowing the wearer to hear verbal commands and responses from fellow team members.

Description of Developed Materials. The audio team coaching materials consisted of three separate tapes, designed for use at different stages of the learning process. Tape 1, used early in the learning experience, was the most complete of the three. It provided preparatory cues, performance instructions, and feedback information. The preparatory cues told the trainee what he would be doing next, and prepared him to receive the information given by the team leader reading the TO, and by the coaching tape. Following the preparatory cue, detailed performance instructions were given, which told the student exactly what to do. These instructions included a description of stimuli essential for decision-making. The student was also given the verbal response with which to acknowledge completion of the step. Finally, a feedback cue was provided, to serve as a performance reinforcer (i.e., the student was told what he should have done, and what the status of the equipment should have been, with correct performance of the step). Following is an example of a typical sequence of instructions provided to a single team member.

Anticipatory Cue

"You will check canopy struts and seat pins."

Performance Instructions

"Check that canopy safety struts are installed on canopy actuating arms just aft of ejection seat in each cockpit."

"Check that forward and aft ejection seat safety pins are installed. Slide your hand along the entire length of each streamer to verify that all safety pins are properly installed."

"If the struts and pins are missing, ask for assistance from the team leader; if the struts and pins are correctly in place, call out, 'Struts and safety pins installed'."

Feedback Cue

"All safety struts and safety pins should be correctly installed."

Whenever possible, the wording used on the coaching tape coincided with the wording of the appropriate TO, even if the tape repeated the step description as read by the team leader.

The second tape in the audio team coaching package was used after the students mastered the task using tape 1. The second tape lacked most of the performance instructions, and provided students with only anticipatory and feedback cues. Tape 3 provided only feedback cues and was to be used after students had mastered each of the task steps and were familiar with the step sequence. Complete memorization of the step sequence was unnecessary, since the team leader was required to read the steps from the appropriate TO as the task was performed.

Makeup and Use of the Tape. The audio team coaching tape began with an introductory segment, which was identical for all team members. The introduction included:

1. Identification of the tape and a description of its objectives (e.g., "You will install a preloaded multiple ejection rack on the outboard pylon of the F-4D aircraft").

2. Instructions to the students about how they were to perform and how they should use the audio coaching equipment (i.e., a brief description of the strategy).

3. Special instructions about safety procedures which had to be observed.

4. Identification of the team member position to which the student was listening. If the position was not correct (i.e., team member number 2 was listening to position number 3), students were told to exchange earphones.

Figure C4 gives a graphic representation of the action of the tape during a typical coaching segment. The tape stops automatically after the first preparatory cue. Following the preparatory cue, team member number 1, the team leader, reads the first step from the TO and then restarts the tape. When the tape is restarted, performance instructions are given to each of the team members. When the last (longest) performance instruction has finished, the tape automatically stops. As each team member finishes his task, he reports verbally to the team leader. When all team members have finished, the team leader restarts the tape. The tape then provides a feedback cue, which is a statement of the required equipment status. If the equipment is not in the required status, an error has been made and the tape is stopped by the team leader until the error has been corrected. If no error was made, the tape continues to run until the next preparatory cue is given.

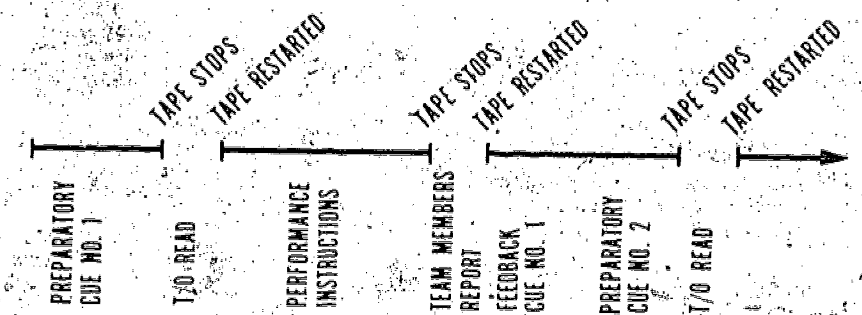

Figure C4. **Tape recorder action during typical audio team coaching segment.**

Prepare Script. The script for all team positions was written and worded to reflect the relevant sections of Technical Order 1F-4C-33-1-2 (i.e., the steps and instructions found in the TO were repeated in the tape script verbatim whenever possible). This was done to facilitate positive transfer from the learning environment to the job situation since students would eventually have to rely entirely upon information found in the TO.

Record the Script. The script sections associated with each team position were recorded separately on a single track of a 4-track tape. The narrative for each of the four team positions was recorded on its respective tape track for each task step before proceeding to the next step. This procedure assured that there would be adequate tape for the longest of the four narrations.

3. Television Team Coaching and Remedial Study

Description of Television Team Coaching Materials. These materials consisted of a videotape presentation of an entire team task. A typical television team coaching videotape began with an introductory segment consisting of an identification of the videotape and a description of its objectives (e.g., "You will view the installation of a preloaded multiple ejection rack (MER) on the outboard pylon on the F-4D aircraft"). The remainder of the tape showed each of the steps necessary to accomplish the objective. Whenever critical task elements occurred (i.e., difficult, dangerous, or otherwise exceptionally important steps), the videotape highlighted these elements by focusing upon the critical aspects of performance. As a step was shown, it was verbally described on the audio track of the videotape. Special instructions, comments, and warnings were also provided.

Television team coaching videotapes could be viewed by individual students or by entire teams. Each student viewing the presentation followed the procedure in a copy of the appropriate TO, which provided him with the opportunity to associate the TO procedure with a visual representation of the task. The only limitations on the number of students who could simultaneously observe a presentation were the size and number of the television monitors and the number of copies of the TO available. For maximum usefulness, the tape had to be viewed by a single student to allow reversing and replaying of tape segments as desired. A nondistracting viewing environment was essential.

Description of Televison-Aided Remedial Study. This strategy was intended for use by students who found difficulty in achieving the specified performance criteria. The strategy was designed to provide students with a detailed review of the procedures associated with a single team position.

For this strategy, the focus of the videotape was on the behaviors of a single team member (e.g., a tape of the actions for team member Number 3 showed the step-by-step activities required of that team member). If other team members were performing, their tasks were briefly described on the audio portion of the tape.

Television aided remedial study has the same advantages as television team coaching in terms of accuracy, repeatability, and flexibility. The tape begins with an identifcation segment which specifies the tape's objectives (e.g., "You will review the behavior sequence of load team member Number 3 during the installation of a preloaded multiple ejection rack on the outboard pylon of the F-4D aircraft"). The remainder of the videotape shows the steps necessary to accomplish the objective. Difficult, dangerous, or otherwise exceptionally important steps are emphasized.

4. Videotape Production

The videotape script consisted of two parts, camera directions and audio script. The scene description, camera location, camera motion, etc., were determined by studying the task outline. In addition, instructor personnel were questioned about the task to assure that all appropriate activities would be recorded on tape. There were two categories of scenes to be taped. The first consisted of showing team members performing their duties. These scenes were taped during actual task performance and did not require special staging or interruption of on-going activities. The second category of scenes consisted of those which required special set ups (e.g., close-ups of special features, such as sway brace settings, switch positions, etc.). The two categories of scenes were recorded at different times and combined later to form the finished videotape.

An audio script was also written for each scene. Wherever possible, the audio script followed verbatim the relevant sections of Technical Order 1 F-4C-33-1-2. This was done to facilitate transfer of training to the work situation in which students would have to rely on information found in the TO.

A backpack portable television camera and half-inch videotape recorder were used. The cameraman carefully followed the shooting script to be certain that all necessary activities were recorded. However, unexpected movements by team members and the presence of stray light which would shine directly into the camera lens made it necessary to deviate slightly from the shooting script. Nevertheless, the activities which were designated in the script were recorded as directed. Careful attention was given to noting all errors in task performance as they occurred so that they could be eliminated from the final tape.

The taping of the special set ups was accomplished with the portable backpack television camera. The special sequences included close-ups, stills, and special staging effects (e.g., a finger pointed to parts of the ejection rack as they were named). The cameraman carefully followed the shooting script to assure that all necessary elements were recorded. Errors in recording were noted for later removal from the finished videotape. The two tapes were combined to form the final videotape.

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