

Prototype Methodology for Designing and Developing
Computer-Assisted Instruction

LINDA M. EVERS, ED.D.

Dynamics Research Corporation
60 Concord Street
Wilmington, MA 01887

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Project Officer
Policy and Procedure Guidance



ARTHUR G. DECELLES, Maj, USAF
Program Manager
Computer Resource Management
Technology Program

FOR THE COMMANDER



ROBERT J. KENT
Director
Software Design Center
Deputy Commander for Development
Plans and Support Systems

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This document describes the Electronic Systems Division (ESD) prototype methodology for designing and developing computer-assisted instruction (CAI). Application of this prototype methodology will support the transition of mission-critical computer resource (MCCR) technology, tools, and techniques. The prototype methodology describes a generic model of the steps involved in designing and developing instruction for computer-assisted delivery. Consequently, the methodology will be carefully tailored to meet the instructional and delivery-system needs of the project at hand. Target users can be divided into two categories: (1) managers of or participants in CAI development work being performed by the Government or (2) monitors of CAI work being performed by the contractor.				
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The Computer Resource Management Technology Program supports development and transition into active use of tools and techniques needed to cope with the explosive growth in Air Force systems that use computer resources. The objectives of this Program are:

- to provide for the transition to Air Force systems of computer system developments in laboratories, industry, and academia;
- to develop and apply software acquisition management techniques to reduce life cycle costs;
- to provide improved software design tools;
- to address problems associated with computer security;
- to develop advanced software engineering tools, techniques, and systems;
- to support implementation of high-order programming languages;
- to improve human engineering of computer systems; and
- to develop and apply computer simulation techniques in support of system acquisition

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Preface

The Computer Resource Management Technology (CRMT) Program Office, Software Design Center, Electronic Systems Division, USAF Systems Command, Hanscom Air Force Base, MA, sponsors development and transfer into active use technology, tools, and techniques needed to cope with the explosive growth of computer resources in mission-critical Air Force systems.

The CRMT Program was initiated to: (a) provide for the transition of computer system developments in laboratories, industry, and academia to system program offices; (b) develop and apply software acquisition management techniques to reduce life-cycle costs; and (c) provide improved software design tools.

The Program Office contracted with Dynamics Research Corporation, Andover, MA, to carry out the Automated Interactive Simulation Modeling System (AISIM) and User-System Interface Design Guidelines (USI) Technology Transfer project under Technical, Engineering, and Management Support Task Order 80047. The project's primary goal was to develop this prototype methodology. Toward that goal, computer-assisted instruction was developed for AISIM, and a computer-based job aid was developed for the Design Guidelines for User-System Interface Software; both AISIM and the Design Guidelines are CRMT Program Office products.

This project could not have been completed without the highly capable and good-humored guidance of Major Arthur G. Decelles, Computer Resource Management Technology Program Manager, and 2Lieutenant John S. Herman, Policy and Procedure Guidance Project Officer and technical representative of the contracting officer for this task. My gratitude to them.

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Linda M. Evers, Ed.D.
Project Manager

Section 1.0

Introduction

1.1 Purpose

The purpose of this document is to describe the Electronic Systems Division (ESD) prototype methodology for designing and developing computer-assisted instruction (CAI). The prototype methodology focuses on CAI for mission-critical computer resource (MCCR) personnel within the Electronic Systems Division, Systems Command, United States Air Force. Application of this prototype methodology will support the transition of MCCR technology, tools, and techniques.

The ESD prototype methodology is intended to complement the decision-making process outlined in Air Training Command Pamphlet 50-4, The CAI Decision Handbook, and to follow guidelines set forth in Air Force Manual 50-2, Instructional System Development. The prototype methodology also describes CAI-specific procedures and products as related to AFP 50-58, Handbook for Designers of Instructional Systems, MIL-T-29053B(TD), Military Specification Requirements for Training System Development, and DOD-STD-2167, Defense System Software Development. (You should have these four documents at hand while carrying out the prototype methodology.)

1.2 Scope

Because no two programs are alike, the prototype methodology describes a *generic* model of the steps involved in designing and developing instruction for computer-assisted delivery. Given the wealth of knowledge available on educational psychology and instructional design, a description of how to carry out these steps would be well beyond the scope of this document. For assistance on how to carry out the methodology, references and a list of recommended readings are provided for each phase of the model.

This document was written as a handbook for managers of the Government's in-house development efforts. It may also serve as general guidelines for a Government contractor to follow. The sponsoring or approving agency is anticipated to be a Government office in either case. Whatever the scenario, you must tailor the methodology to meet the needs of your project.

1.3 Foundation

The ESD prototype methodology for CAI design and development is built on a foundation of existing documents. As shown in Figure 1-1, the first step in the ESD approach to developing CAI calls for acquisition and review of existing documentation. All relevant programs of instruction, user's manuals, guidebooks, technical manuals, and technology transition or implementation plans must be reviewed prior to developing CAI.

If CAI is being developed to support a software tool or other system, the ideal time to analyze training requirements is while the system and its supporting documentation are being designed and developed. This approach is mandatory if training is to be embedded. Less complex systems also benefit from early analysis of training requirements because document design and contents can be developed with an eye toward meeting those training requirements.

1.4 Assumptions

This document is intended to complement ATC Pamphlet 50-4 but with special emphasis on MCCR CAI. Therefore, similar assumptions are made regarding the target audience. Namely, the target audience of this document consists of MCCR personnel "with significant knowledge of instruction and Air Force instructional procedures but minimal experience with designing and developing computer-assisted instruction," (ATCP 50-4, p. ii).

As a user of this methodology, you are assumed to have performed ISD Steps 1 through 4.4 as described in AFM 50-2 and AFP 50-58. You are also assumed to have:

- (1) Read ATC Pamphlet 50-4
- (2) Worked through its decision aids
- (3) Concluded that CAI will meet your training requirements

The prototype methodology describes a generic model of the steps involved in designing and developing instruction for computer-assisted delivery. Consequently, it is assumed that the methodology will be carefully tailored to meet the instructional and delivery-system needs of the project at hand.

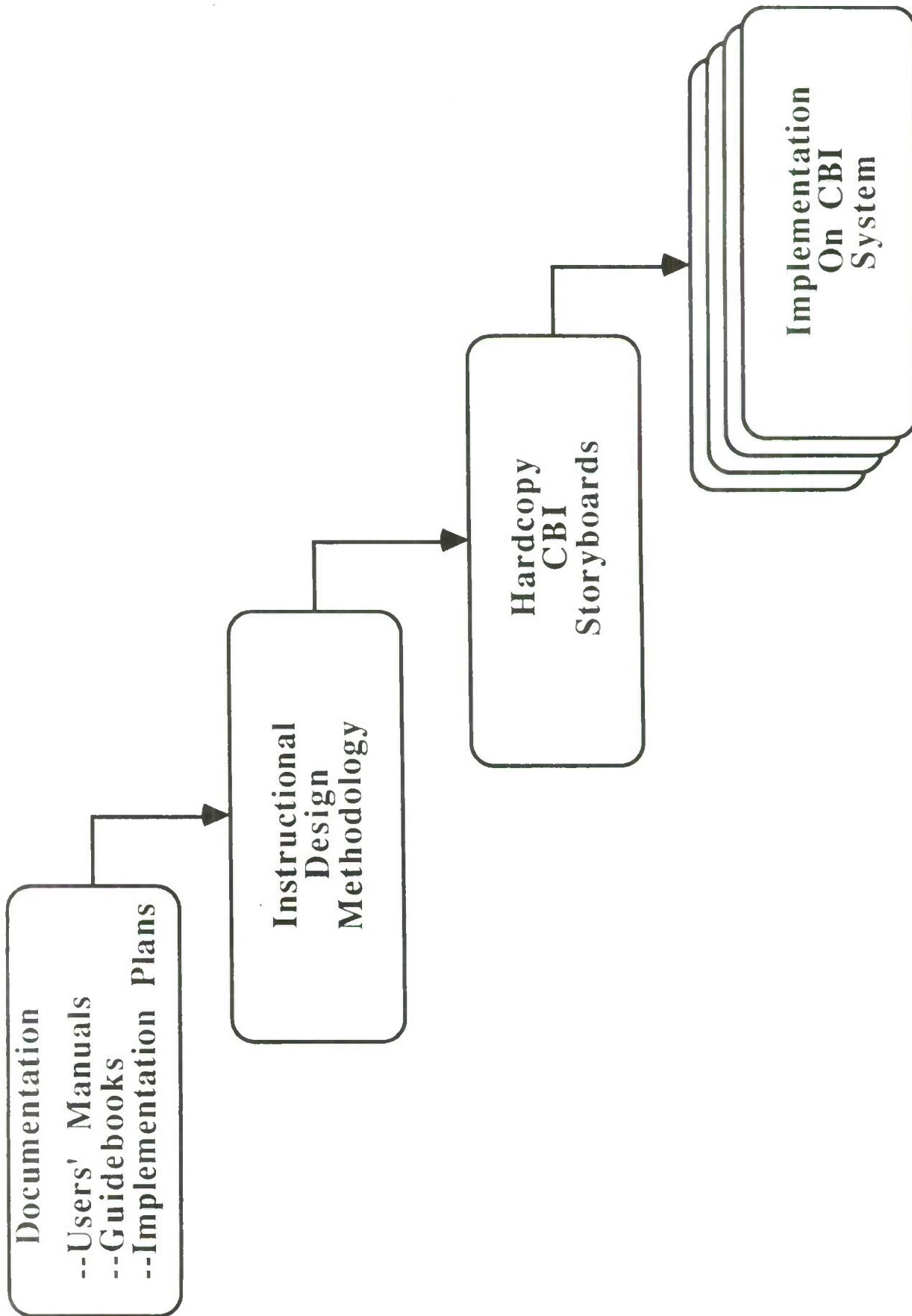


Figure 1-1. ESD Approach to Computer-Based Instruction.

1.5 Limitations

Given that the target audience is MCCR personnel, the ESD prototype methodology may not directly meet the needs of other personnel. If the prototype methodology is applied to other areas, it should be adapted accordingly.

No specific hardware/software configurations are addressed herein. General authoring system concerns are addressed, but the prototype methodology is not limited to authoring-system users.

Detailed discussions of automated job aids, on-line documentation, computer-managed instruction (CMI), and computer-adaptive testing are beyond the scope of this document. Recommended readings are listed where relevant.

This methodology is truly a prototype. As such, it serves as a starting place for revision and refinement. Advances in instructional technology and CAI lessons learned by MCCR personnel will be reflected in future iterations. Your comments and suggestions are welcome; please use the form inside the back cover of this document.

1.6 Organization

The remainder of this document is divided into six sections. Section 2.0 presents an overview of the five-phase prototype methodology. In Sections 3.0 through 7.0, the five phases are described in greater detail. Experiences of two hypothetical CAI development task managers, Lieutenants Green and Swift, are recounted to illustrate certain concepts and techniques.

The appendixes include references; recommended readings; lists of CAI-related periodicals, organizations, and conferences; sample storyboard templates; sample screen design standards; and Figure 1-3 from AFP 50-58.

Section 1

References

Air Force Manual 50-2, Instructional System Development, 31 July 1975.

Air Force Pamphlet 50-58, Handbook for Designers of Instructional Systems, Volumes I-VI,
15 July 1978.

Air Training Command Pamphlet 50-4, The CAI Decision Handbook, September 1984.

DOD-STD-2167, Defense System Software Development, June 1985.

MIL-T-29053B(TD), Military specification requirements for training system development.
June 1981.

Section 2.0

Overview of the Prototype Methodology

The Electronic Systems Division (ESD) prototype methodology for producing computer-assisted instructional (CAI) systems consists of five phases:

- Phase I, Front-End Analysis and Planning (Milestone 1)
- Phase II, Preliminary Design
- Phase III, Detailed Design (Milestones 2 and 3)
- Phase IV, Transfer and Testing (Milestone 4)
- Phase V, Implementation and Evaluation (Milestone 5)

These phases are essentially CAI-specific substeps of the ISD model described at a high level in AFM 50-2, Instructional System Development, and in greater detail in AFP 50-58, Handbook for Designers of Instructional Systems. Figures 2-1 and 2-2 illustrate the five-step ISD model and the five-phase ESD prototype methodology. Figure 1-3 in Appendix G depicts the detailed flow diagram from AFP 50-58. Note that four of the five prototype methodology phases occur within Step 4 (Plan, Develop, and Validate Instruction) of the ISD model.

ISD Steps 1 through 4.4 must first be performed to a satisfactory level of detail before initiating the phases outlined in this prototype methodology.

Because CAI is a software product, the prototype methodology also draws on some of the concepts set forth in DOD-STD-2167, Defense System Software Development. Figure 2-3 depicts the six software development phases prescribed in DOD-STD-2167. "Tailoring," or adapting guidelines to suit the project at hand, is a fundamental principle of 2167. That principle applies equally well to this handbook because no two CAI systems have the same requirements.

2.1 Phase I: Front-End Analysis and Planning (Milestone 1)

Phase I of the prototype methodology is initiated after completing the media-selection process in Step 4 of the ISD model. As with any development effort, front-end analysis and planning is critical to the success of the project. It is difficult to know when you have arrived at your destination if you did not know where you were going in the first place.

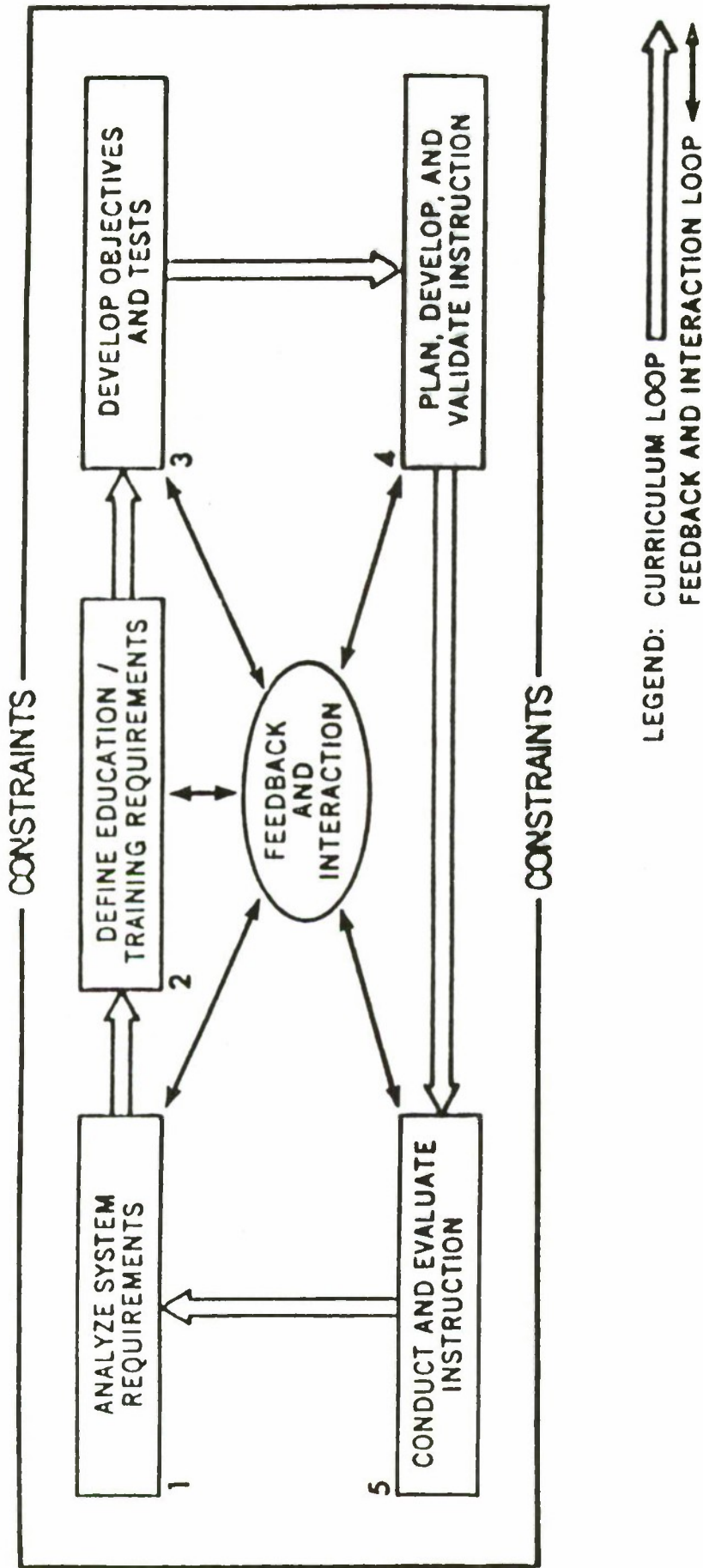


Figure 2-1. Model for Instructional System Development.

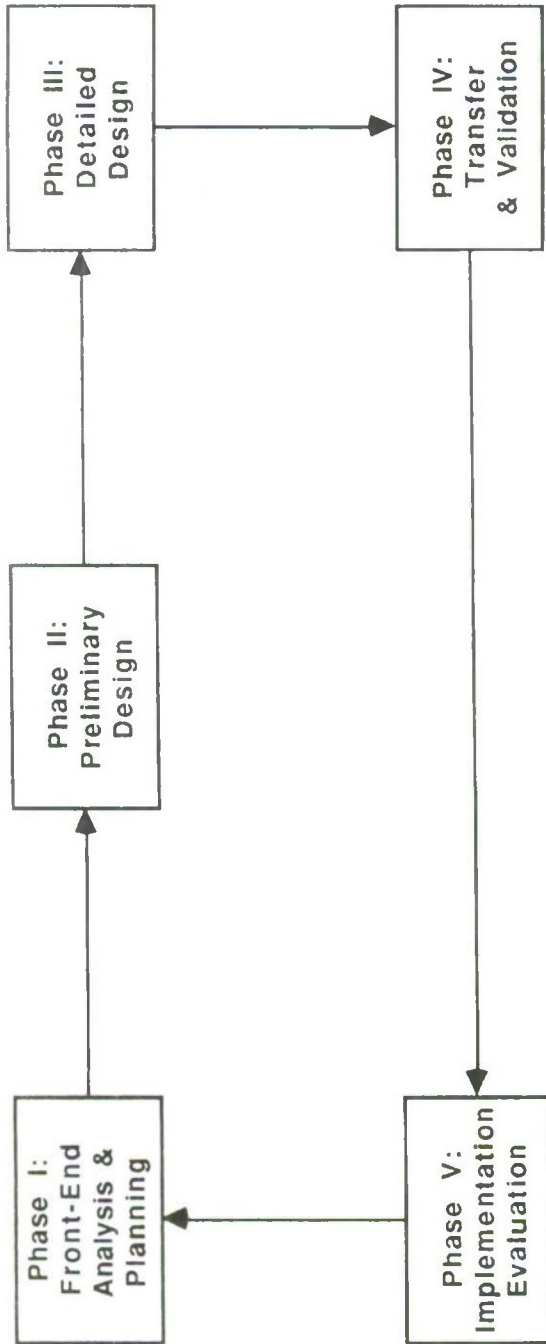


Figure 2-2. The Five-Phase ESD Prototype Methodology for CAI Design and Development.

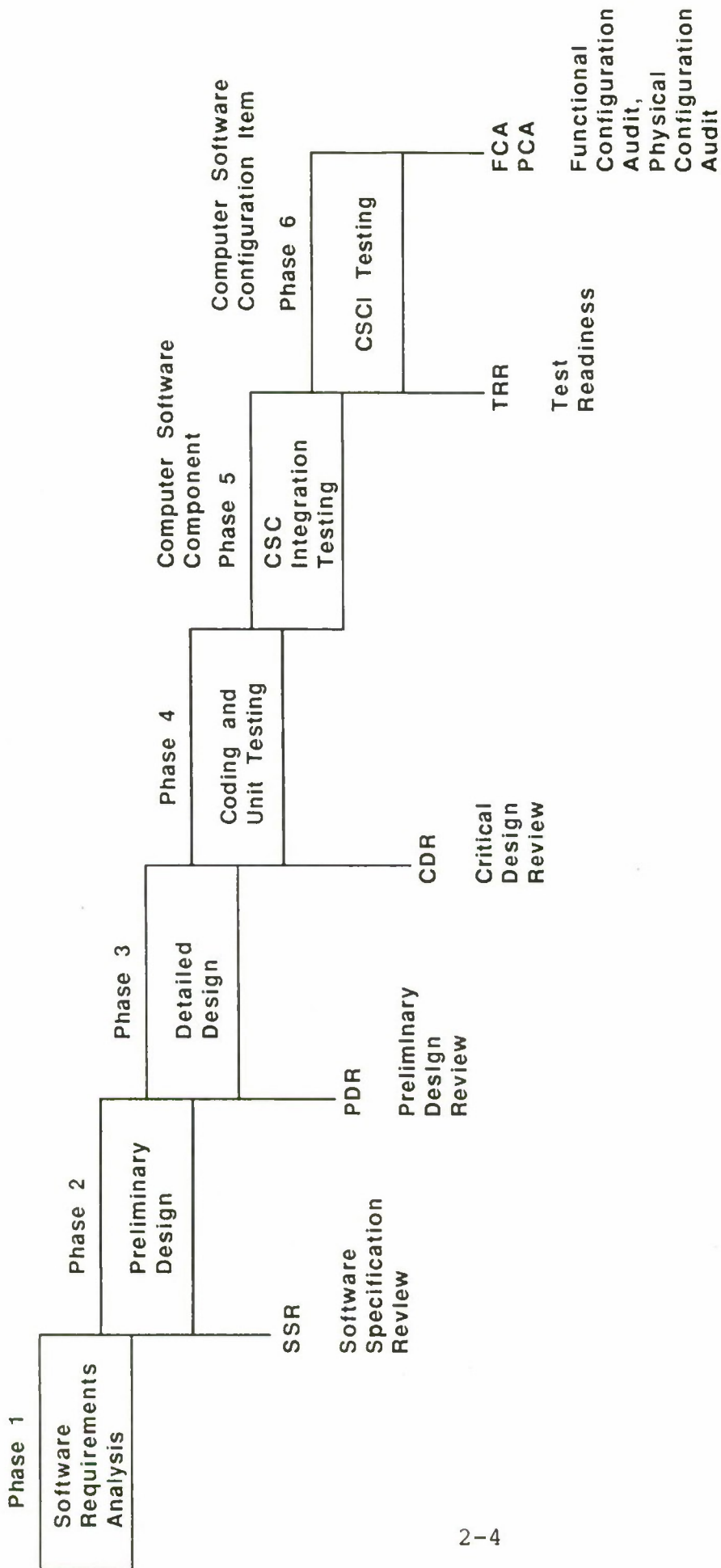


Figure 2-3. The Six-Phase DOD-STD-2167 Software Development Cycle.

Phase I begins with a reevaluation of the information you gathered or generated in Steps 1 through 3 of the ISD model. This reevaluation is performed in light of your decision to include CAI in the instructional approach. As shown in Figure 2-4, this phase ends with Milestone 1, which marks Government approval of a CAI Support Plan.

2.2 Phase II: Preliminary Design

In this phase, you expand the detailed outlines produced in Phase I. The result is a Preliminary Design Report. This report is a set of rough storyboards that focuses on the content and flow of the courseware rather than on the style and format in which the instruction will be presented. Phase II contains no *formal* milestones, although the sponsoring agency should continue to be provided visibility into the project through weekly reports and technical interchange meetings.

2.3 Phase III: Detailed Design (Milestones 2 and 3)

This phase is where the bulk of your development resources are expended. Here you expand the Preliminary Design Report to a Draft Detailed Design Report and then a Final Detailed Design Report. Milestone 2 marks Government approval of the Draft Detailed Design Report. Phase III ends with Milestone 3, which marks Government approval of the Final Detailed Design Report.

2.4 Phase IV: Transfer and Validation (Milestone 4)

In Phase IV, you will transfer the contents of the Final Detailed Design Report to the authoring system you chose in Phase I. To avoid unpleasant surprises on the part of your intended users, the courseware must be tested and debugged in this phase. It should also be validated in individual try-outs. Phase IV ends with Milestone 4, which marks Government acceptance of the courseware and of ancillary materials such as the course guide and the instructor's manual.

2.5 Phase V: Implementation and Evaluation (Milestone 5)

Phase V corresponds to Step 5 of the ISD model. Finally, you are ready to distribute the debugged, validated product. Distribution might mean mailing a magnetic tape or a set of diskettes and the accompanying course materials to learners in the field. Or, if you are conducting an on-site program or course, distribution might mean including the courseware in your plan of instruction. After distributing the product, you should evaluate the

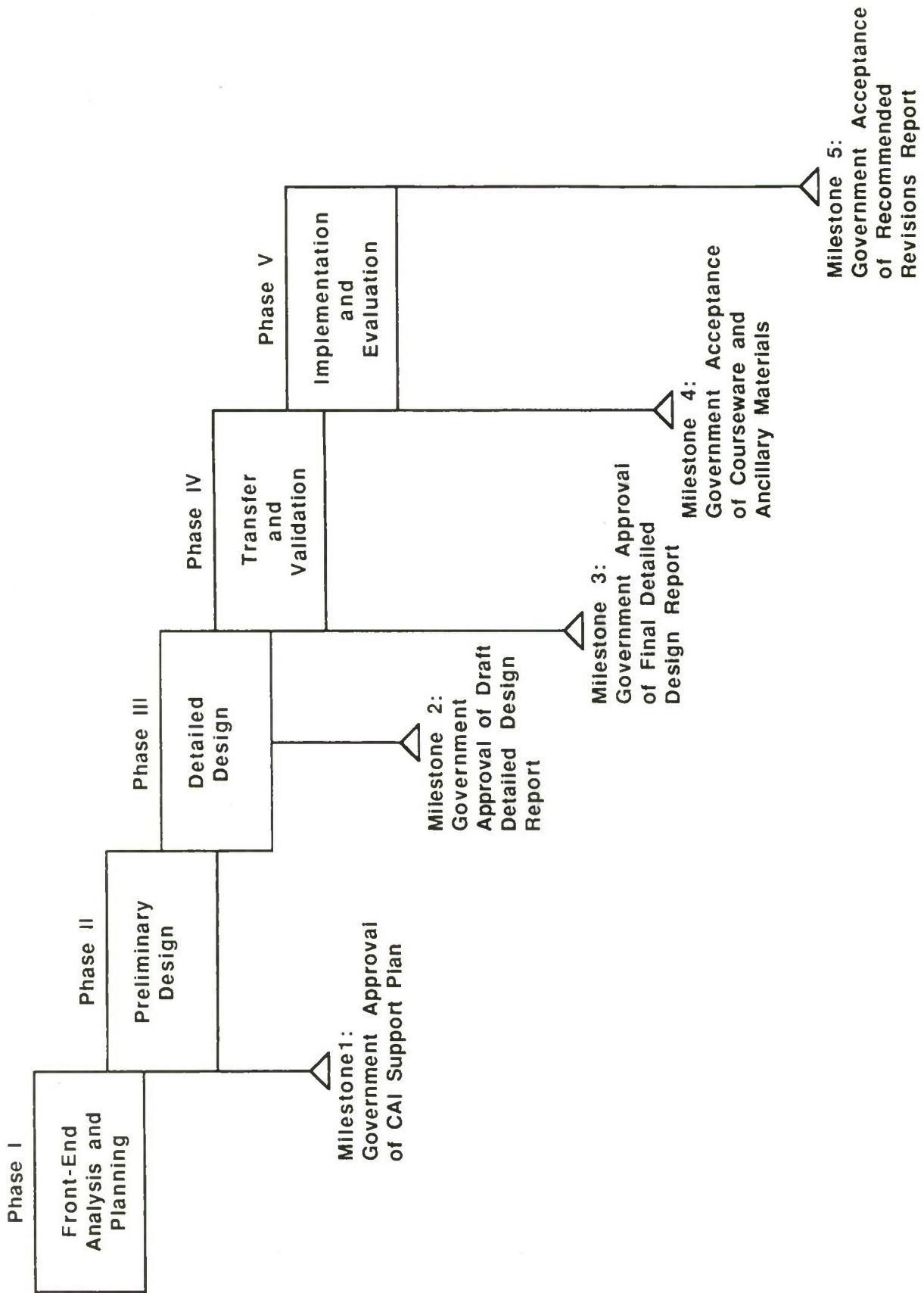


Figure 2-4. Milestones and Phases of the ESD Prototype Methodology.

courseware's effectiveness as input to future revision efforts. Results of your evaluation are documented in the Recommended Revisions Report. Government acceptance of that report marks Milestone 5, which completes your courseware development effort.

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Section 2

References

Air Force Manual 50-2, Instructional System Development, 31 July 1975.

Air Force Pamphlet 50-58, Handbook for Designers of Instructional Systems, Volumes I-VI,
15 July 1978.

DOD-STD-2167, Defense System Software Development, June 1985.

MIL-T-29053B(TD), Military specification requirements for training system development.
June 1981

Section 3.0

Phase I: Front-End Analysis and Planning

Before starting Phase I of the Electronic Systems Division (ESD) CAI design and development prototype methodology, you must first perform Steps 1 through 4.4 of the AFP 50-58 ISD model to a satisfactory level of detail. Definition of the term "satisfactory" depends on the requirements of your project.

Instructional methods and media selection issues arise as early as Step 2 (Define Education/Training Requirements) of the ISD model. Among other topics, Step 2 addresses methods for acquiring qualified personnel as well as the criteria and constraints affecting method and media selection.

If you had a strong suspicion that computer-assisted instruction might be appropriate, you would keep that in mind while carrying out Step 3 (Develop Objectives and Tests). Although computers can be powerful test administrators, greater power is obtained by spending more time on item design and construction. And more time, of course, is obtained by spending more money.

Media selection is made formally in Step 4 (Plan, Develop, and Validate Instruction). As stated in ATC Pamphlet 50-4, The CAI Decision Handbook:

When training requirements have been established and translated into appropriate training and instructional objectives, then step four of the ISD model provides for the planning of how these objectives can best be achieved. Part of this planning process is to select the appropriate medium and technique of instructional delivery, (p. I-15).

If CAI still seemed to be a feasible option, you would work through the eight decision aids in ATC Pamphlet 50-4. (While that pamphlet is focused "entirely on the interactive instructional mode called CAI" (p. I-2), many of the questions posed on the CAI decision aids worksheets could also be asked about an automated job aid or an on-line reference tool. Decision Aids 4 through 7 would be especially helpful when considering computer-assisted presentations other than CAI.)

By this point, you have worked through the decision aids, concluded that CAI is the medium of choice, and determined that sufficient resources are available to design, develop, and implement CAI properly. You are now ready

to begin Phase I of the prototype methodology. Figure 3-1 presents the eight steps in Phase I.

The input for this phase depends on why you are developing a CAI system. Your purpose may be to enhance an existing course, to provide stand-alone instruction, or to support software users with embedded training, among numerous other applications. Input could include:

- Program plan
- Program of instruction
- Course hand-out materials
- Technology implementation plan
- User's manuals
- Guidebooks and relevant standards, regulations, etc.
- Products of AFP 50-58 Steps 1 through 4.4
- Products of decision aids in ATC Pamphlet 50-2

As you execute the following steps, keep in mind that the output of this phase is the CAI Support Plan, which summarizes the information that you have reviewed and revised in Steps 1 through 7. The remainder of this section presents detailed descriptions of Phase I's eight steps.

3.1 Step 1: Review Program Plan

As discussed in Section 1.3, the ESD prototype methodology is built on a foundation of existing documentation. One of the first documents to consult is the relevant technology transition, or implementation, plan if available. A typical transition plan identifies agencies that will benefit from task products, provisions for distribution to those agencies, and expected operational and support (including training) requirements.

If your CAI system is part of the training requirements projected in the task description, you probably examined that document prior to beginning Step 1 of the ISD model. If you are enhancing existing instruction, you should have the relevant job task analysis to review.

Now, having completed Steps 1 through 4.4 of the AFP 50-58 ISD model, review the task description and any revisions to it. In your review, consider (1) the results of those steps and (2) the implications of using CAI to support the task product. As you review the task description, ask yourself questions such as:

Q1: Are the high-level system and instructional requirements still on target?

Q2: Will the tool's revisions and enhancements schedule make the cost of updating CAI unacceptable?

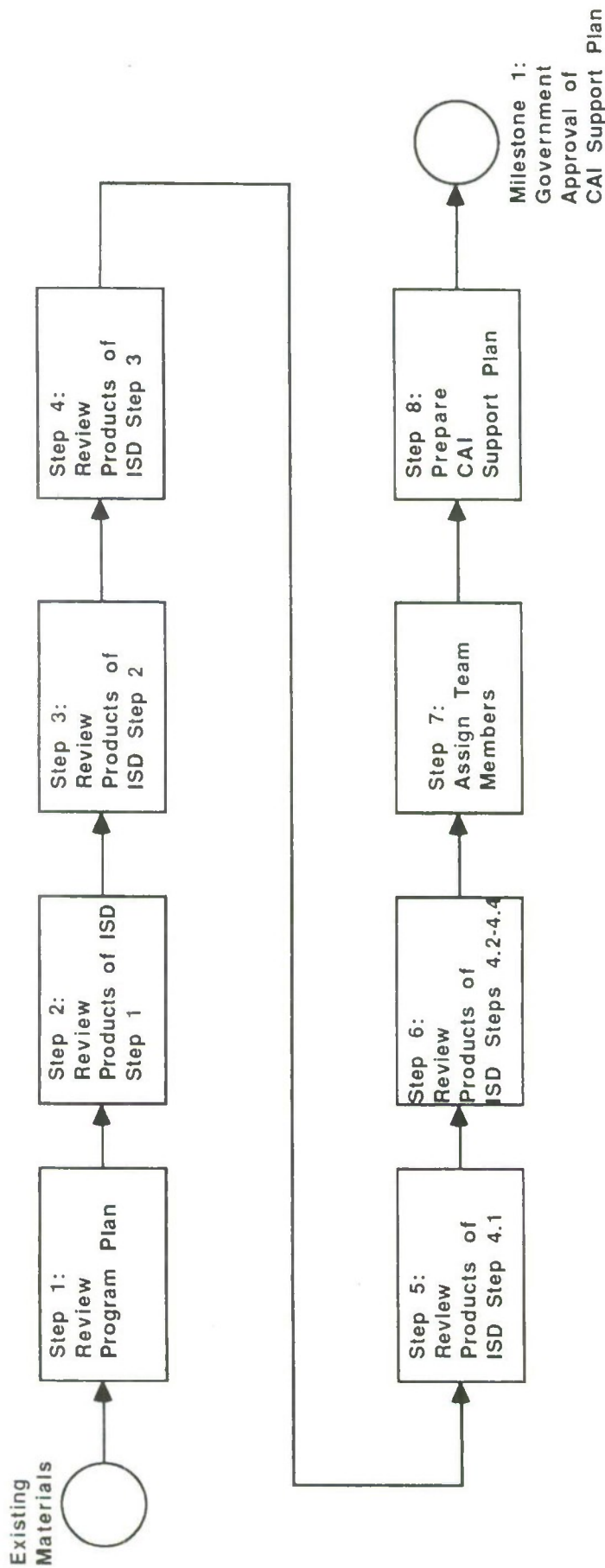


Figure 3-1. Phase I: Front-End Analysis and Planning.

- Q3:** Does the existing course need frequent revision to keep up with advances or policy changes?
- Q4:** Will the cost of CAI development, distribution, and implementation exceed the projected equipment or funding requirements?
- Q5:** Did development of the system itself take a significantly different course from that anticipated in the task description?

You answered these and similar questions during media selection. Reviewing your answers again now will either keep you on track with the original plan or will alert you to deviations from the plan that may impact your CAI effort.

3.2 Step 2: Review Products of ISD Step 1

Step 1 of the ISD process is titled "Analyze System Requirements." As described in Section 1-3 of AFM 50-2, Instructional System Development,

Analyzing system requirements primarily involves data collection....The product of this step is a definitive list of all job tasks, the equipment or materials involved with each task, the conditions under which the tasks must be performed, and the work quality requirements that must be met. For later use, data [are] also needed on frequency of performance of the tasks, safety requirements, criticality, complexity, and the difficulty of learning or teaching, (p.1-3).

At this point, you should review the list you produced for ISD Step 1 in light of your decision to develop CAI. As you review the list, ask yourself questions such as:

- Q1:** Does infrequent performance suggest that an automated job aid would be a better solution than CAI?
- Q2:** Is the list of job tasks fairly stable, or will the basis of the course keep changing, making CAI impractical?
- Q3:** Can the job tasks be adequately supported with CAI?
- Q4:** If simulation is your probable instructional approach, how critical is fidelity?
- Q5:** Can the required level of fidelity be achieved with CAI?
- Q6:** Given the capabilities of CAI authoring and management systems, will you be able to measure attainment of

work quality requirements?

Q7: Does the hazardous nature of the job make practice on a computer the best way to meet safety requirements?

You addressed questions of this nature in filling out the decision aids in ATC Pamphlet 50-4. However, more detailed answers are needed at this point.

3.3 Step 3: Review Products of ISD Step 2

In carrying out Step 2 of the ISD model (Define Education/Training Requirements), you decided instruction was needed to acquire qualified personnel. You then determined who would be trained and what training they would need, given their present skills, knowledges, and abilities.

Review the information you gathered for Step 2 in light of your decision to develop CAI:

Q1: Does the target audience include a fairly diverse group?

Q2: If so, will CAI be able to meet such diverse needs?

Q3: Does the complexity of the job tasks indicate that learners will probably need individualized remediation and interactive reinforcement?

Q4: Is this a subject area where few experienced users exist or where turnover is high?

Q5: Will user safety be a factor?

Q6: Will ease of access to CAI for refresher purposes offset lag time between training and initial performance?

Q7: Is the student population dispersed geographically?

Q8: Will on-site instruction that involves TDY be difficult to schedule for both instructors and students?

These are only a few of the issues you need to resolve in reviewing the products of ISD Step 2. Other issues will arise from the requirements of your particular situation.

3.4 Step 4: Review Products of ISD Step 3

The specific behavioral objectives produced in Step 3 of the ISD model (Develop Objectives and Tests) play a critical role in developing any instructional system. They constitute the road map you will follow to move from describing the need for instruction to having an instructional product with which to meet that need effectively.

The terrain you will cross in developing CAI is significantly more treacherous than that of traditional instructional methods. Consequently, the course's behavioral objectives *must* be well thought-out and carefully phrased. As stated in Section 2.1, it's difficult to know when you have reached your destination if you didn't know where you were going in the first place.

By this point in the prototype methodology, you should review the products of ISD Step 3 to determine how effectively CAI can meet the course objectives and administer the test items. You may decide that CAI is appropriate for a few of the objectives, but that the remainder would be met better by other methods. Or you may want to limit computer assistance to administering and scoring test items. (The latter approach involves CMI and computer-adaptive testing, which are beyond the scope of this document.)

The purpose of this phase is to prevent as many problems as possible. Your review of ISD Step 3's products is the heart of this preventive approach. Before beginning your review, it may be helpful to put the objectives in a table such as the instructional planning worksheet in Figure 1-3 of AFP 50-58, Volume III, Objectives and Tests. In reviewing the objectives generated in ISD Step 3, ask yourself CAI-specific questions such as:

- Q1: Could CAI adequately present the information the student needs to meet the course objectives as stated?
- Q2: Would you have to revise the objectives in order to stay within CAI's limitations?
- Q3: Do you know CAI's limitations well enough to answer Question 2?
- Q4: Would a few hours of a CAI consultant's services be a good investment at this time?
- Q5: If you were to revise the objectives, what impact would that have on the path laid out in the technology transition plan?
- Q6: Would students still be able to meet work quality requirements?

The same questions must be asked about the test items constructed as part of ISD Step 3. Section 4-25 of AFP 50-58, Volume III, Objectives and Tests, lists potential advantages of testing with various media. Relevant

questions to ask yourself about computer-assisted testing include:

- Q7: Would it be less expensive to administer computer-assisted testing than to test with actual hardware or software?
- Q8: Would computer-assisted testing increase student safety?
- Q9: Would the authoring system's answer-judging capacity limit learner input so that objectives attainment could not be measured?

The effect of revising test items is not as critical as that of revising course objectives. Most types of objective items can be administered and scored with CAI/CMI. Scoring subjective, or open-ended, answers requires either considerable development time or artificial intelligence, which is not yet widely available. As noted in Section 3.0, with CAI, power is time is money.

ISD Step 3.4 of AFP 50-58 calls for developing and administering survey tests to determine "what students know or can do before receiving instruction," (Volume III, Section 1-3). Results of a survey test can help you fine-tune your description of the target population as well as revise the course training requirements, objectives, and test items. Benefits of survey testing as an aid to course/instructional material design are also noted in Section 1-3 of AFM 50-2.

If no survey test was administered in ISD Step 3, giving one at this stage in the prototype methodology is advisable. You may have underestimated the target learner's incoming knowledge and skills in your earlier training requirements analysis. If so, your present plan calls for developing more instruction than the learner will need. In view of how much an hour of CAI costs to develop, reducing your development load by even one or two objectives would result in significant cost avoidance.

3.5 Step 5: Review/Revise Products of Step 4.1

Appendix G contains Figure 1-3 from AFP 50-58, Volume I, Introduction. This will be useful for you to refer to throughout your CAI system development. As shown in that figure, ISD Step 4.1 consists of three substeps:

- 1) 4.1.1 Plan Sequence of Instruction
- 2) 4.1.2 Select Instructional Methods
- 3) 4.1.3 Select Instructional Media

A high-level discussion of these three activities is presented in Section 5-2 of AFM 50-2. The following sections describe one approach to reviewing and revising the products of these three substeps.

3.5.1 Substep 5.1: Review/Expand Products of 4.1.1

Sections 3.8, 3.9, and 3.12 of MIL-T-29053B(TD), Military Specification Requirements for Training System Development, provide detailed discussions of objectives hierarchies development. The applicable data item description (DID) is UDI-H-25715, "Objectives Hierarchies Report." Note that MIL-T-29053B(TD) is targeted at upgrading an *existing* training program, although many of its prescribed procedures are common to any training development effort.

Substep 4.1.1, "Plan Sequence of Instruction," is addressed in Sections 2-3 through 2-10 of AFP 50-58, Volume IV (Planning, Developing, and Validating Instruction). These sections offer insight into how to plan the sequence of instruction and how to develop homogeneous blocks of instruction.

The product of ISD Substep 4.1.1 is a set of course objectives ordered in the optimal sequence and grouped in optimal increments. In other words, the product identifies (1) how the learner will progress from Point A to Point Z in a logical, instructionally sound fashion and (2) what bite-size chunks of information the learner will be fed en route. In reviewing this product in preparation for a CAI application, ask yourself questions such as:

- Q1: Are the chunks of information so small that they would appear trivial as CAI?
- Q2: Would backward chaining with CAI be appropriate?
- Q3: Would the authoring system unduly limit the learner's option to choose his or her own sequence of instruction within a unit or course?

If your decision to develop CAI remains firm at this point, translate the sequenced and chunked objectives into a detailed outline for each unit of instruction. These outlines are part of the CAI Support Plan you will prepare in Step 9 of this phase. They also form the basis for the Preliminary Design Report you will prepare in Step 3 of Phase II.

3.5.2 Substep 5.2: Review/Revise Products of 4.1.2

Substep 4.1.2, "Select Instructional Methods," is addressed at a high level in Section 5-2c of AFM 50-2 (see Table 5-2) and at length in Sections 4-C and 4-D of AFP 50-58, Volume IV. When you executed Substep 4.1.2, you identified one or more instructional methods, or approaches, best suited to convey the knowledges and skills at hand.

In considering CAI, you probably studied Section D of ATCP 50-4 and worked through Decision Aids 2 (or 3) and 4 of that handbook. Review your answers to those decision aids in preparation for developing the CAI Support Plan in Step 8 of this phase.

3.5.3 Substep 5.3: Review/Revise Products of 4.1.3

Substep 4.1.3, "Select Instructional Media," is the critical point for determining what medium or mix of media will be most appropriate to convey your instructional message. Section 5-2d of AFM 50-2 contains valuable guidance on the issue of media selection.

Among the statements most pertinent to CAI is the following: "It does not make sense to select a presentation medium for which adequate courseware cannot be developed and provided to the student," (Section 5-2d(2)(h)). Here the term "courseware" refers to "technical data, textual materials, and audiotapes, slides, movies, TV cassettes, and other audiovisual instructional materials," (AFM 50-2, Attachment 1). In view of the generally poor quality CAI courseware being marketed to the Government as well as to the public, prospective CAI developers should examine their instructional requirements and resources as objectively as possible before making a final commitment to this complex medium.

Chapter 5 of AFP 50-58, Volume IV, especially Section D, "The Four-Step Media Analysis Procedure" (see Figure 5-4), contains more information on media selection. See also Section 3.11 in MIL-T-29053B(TD).

A serious consideration for the Air Force CAI community is the proliferation of incompatible delivery systems. Section 5-2d(2)(i), AFM 50-2, states that "In general, it is recommended that a courseware presentation format available from only a single manufacturer *not* be selected. Courseware is more likely to remain useful if it can be presented on a variety of available equipment."

CAI hardware and software considerations are addressed at length in ATCP 50-4, but continued attention needs to be paid to the problem of integration versus duplication of USAF CAI systems. In the operations arena, at the HQ USAF level, a functional review of all projected operations computer-based programs will soon be established to assess and manage the impact of automation in operations squadrons. The purpose of this functional review process is to improve organizational coordination throughout the chain of acquisition, implementation, and maintenance.

Reviews of this nature may be established in the future for the maintenance and systems arenas. Their existence could have a significant effect on your selection and use of the computer as an instructional medium.

After reviewing the information you gathered or generated for Substep 4.1.3 and completing ATCP 50-4 Decision Aids 5 and 6, you probably realized that "the computer [is] the most complex of the tutorial media," (Section 5-17, AFP 50-58, Volume IV). In reevaluating your choice of CAI as part of your instructional system, ask yourself questions such as:

- Q1:** Is a CAI system really called for, or would other media serve as well?
- Q2:** Can a CAI system meet your graphics requirements, or would interactive video, video, slides, or some other medium convey that information more clearly?
- Q3:** Should you develop and deliver an "adequate" CAI system, or would resources be better expended on a superior non-CAI system?

If your office cannot dedicate the personnel, equipment, facilities, and funds needed to produce, deliver, and maintain a satisfactory CAI system, you should focus on other media that are less complex but equally appropriate.

3.6 Step 6: Review Products of ISD Steps 4.2, 4.3, and 4.4

Figure 1-3 of AFP 50-58, Volume I (Introduction), shows that after planning the instruction in ISD Step 4.1, you are ready to perform these steps:

- 1) 4.2 Determine Resource and Fund Requirements
- 2) 4.3 Get Resource/Fund Requirements Approved
- 3) 4.4 Obtain Required Resources and Funds

3.6.1 Step 6.1: Review Products of ISD Step 4.2

ISD Step 4.2 is titled "Determine Resource and Fund Requirements." Unless your office or group has developed CAI before, it is time to dust off your crystal ball. Estimating resource and fund requirements is never easy, but CAI development presents more than its share of black holes.

Section 3-5, AFM 50-2, calls for a "preliminary identification of resource requirements" to be conducted in ISD Step 2. Section 5-3 of that document provides guidance for your final determination of resource requirements and costs, as does Section B, Chapter 6, of AFP 50-58. See also the list of recommended readings at the end of this section of the ESD prototype methodology.

Decision Aid 7 of ATCP 50-4 is a cost-estimation worksheet that addresses the costs associated with:

- Hardware and software
- Courseware production
- Support costs
 - Facility
 - Operational support personnel
 - System maintenance

You filled in this worksheet prior to beginning Phase I. To facilitate preparation of the CAI Support Plan in Step 8, check your figures again, keeping in mind that computer-related costs can change drastically over a few months.

3.6.2 Step 6.2: Review Products of ISD Steps 4.3 and 4.4

ISD Steps 4.3, "Get Resource/Fund Requirements Approved," and 4.4, "Obtain Required Resources and Funds," are closely tied to your particular situation. By this point, you are assumed to (1) have obtained commitments for sufficient resources and funds and (2) be ready to proceed to Step 7 of the ESD prototype methodology.

3.7 Step 7: Assign Development Team

Section II-E of ATCP 50-4 describes four approaches to CAI design and development. They include the:

- 1) Inspired programmer-author
- 2) Traditional development team
- 3) Computer-supported development team
- 4) Computer-guided author

The ESD prototype methodology is targeted primarily, but not exclusively, at the computer-supported development team. Computer-guided CAI development is becoming a reality but will not be widely available in the near future. In any case, the developer or development team needs a good understanding of the ISD process.

Depending on the size of the proposed instructional system, the CAI development team may be composed of:

- Task manager (an experienced instructional designer/developer)
- Instructional designers/developers
- Subject-matter experts (SME's)
- Graphics designer
- Technical editor

- Instructors
- Computer/authoring-system specialist
- Proofreaders
- Quality assurance testers
- Users (experienced and novice)

Ally (1985) reported that the team members for converting a 240-hour lab/lecture course into self-paced, individualized CAI fell into six categories:

- Manager
- Instructional designer
- Communication specialist
- Content experts
- Computer specialist
- Content validators

Table 3-1 presents the team members' roles. Ally also noted that ten communication channels existed among team members (see Figure 3-2). If Ally's content validators are added, at least 12 channels exist. You can readily see how communication problems might develop. Ally stated the following:

To perform their functions effectively, the team was given a one-week workshop on interpersonal skills. All team members took the workshop, which provided them with the skills to function more effectively as a team. In addition, the workshop gave members a chance to become better acquainted with each other, which brought the team closer together, (p. 28).

If your team has not worked together before, having them participate in an interpersonal communications workshop might be a good investment. Ally's group identified only one major drawback to the team approach: "The initial cost of team formation is high," (p. 30). But one experienced team can beget countless others at a fraction of the initial cost.

Francis (1979) emphasized selecting team members on the basis of CAI development skills needed rather than on roles or job positions to fill. This reduces the tendency to pigeonhole personnel and increases the likelihood of diverse contributions from each member. That, in turn, prevents boredom.

As Kearsley (1983) observed,

One of the major flaws in the [development] stage of many CBT projects is the lack of attention given to CBT training or orientation....Each member of the team should understand the basic instructional model or procedures that will be used for development and their role in the process....It is also critical that team members new to CBT be given an understanding of the capabilities and limitations of CBT and their system by studying

Table 3-1. Role of the Team Members

Team Member	Major Responsibilities	Team Member	Major Responsibilities
<i>Manager</i>	<ol style="list-style-type: none"> 1. Prepare a workplan for the Project. 2. Create a management information system for the Project. 3. Assign tasks to team members. 4. Monitor the completion of tasks. 5. Evaluate completed tasks based on quality and quantity measures. 6. Report to administrators and committees on the progress of the Project. 7. Write final and interim reports on the Project. 8. Share expertise with other team members. 		
<i>Instructional Designer</i>	<ol style="list-style-type: none"> 1. Develop a detailed Instructional Design model for courseware development. 2. Train content experts to use the Instructional Design model to design the courseware for the technologies. 3. Train instructors to use the instructional technologies. 4. Train students to use the instructional technologies. 5. Script lessons for computer-assisted instruction. 6. Coordinate the production of the learning materials. 		
			<i>(continued)</i>
			<ol style="list-style-type: none"> 7. Evaluate and revise learning materials. 8. Coordinate the content validation process.
		<i>Communication Specialist</i>	<ol style="list-style-type: none"> 1. Design a format for print materials and training manuals. 2. Proofread all manuals for typographical errors, readability, and clarity. 3. Coordinate the public relations of the Project.
		<i>Content Experts</i>	<ol style="list-style-type: none"> 1. Produce courseware using the Instructional Design model. 2. Revise courseware as recommended by the content validators, the Instructional Designer, and the Communication Specialist.
		<i>Computer Specialist</i>	<ol style="list-style-type: none"> 1. Coordinate the installation of the computer hardware and software. 2. Supervise computer programmers. 3. Establish the standards for computer-assisted instruction.
		<i>Content Validators</i>	<ol style="list-style-type: none"> 1. Review developed courseware. 2. Assist the content experts in making decisions on the content related problems.

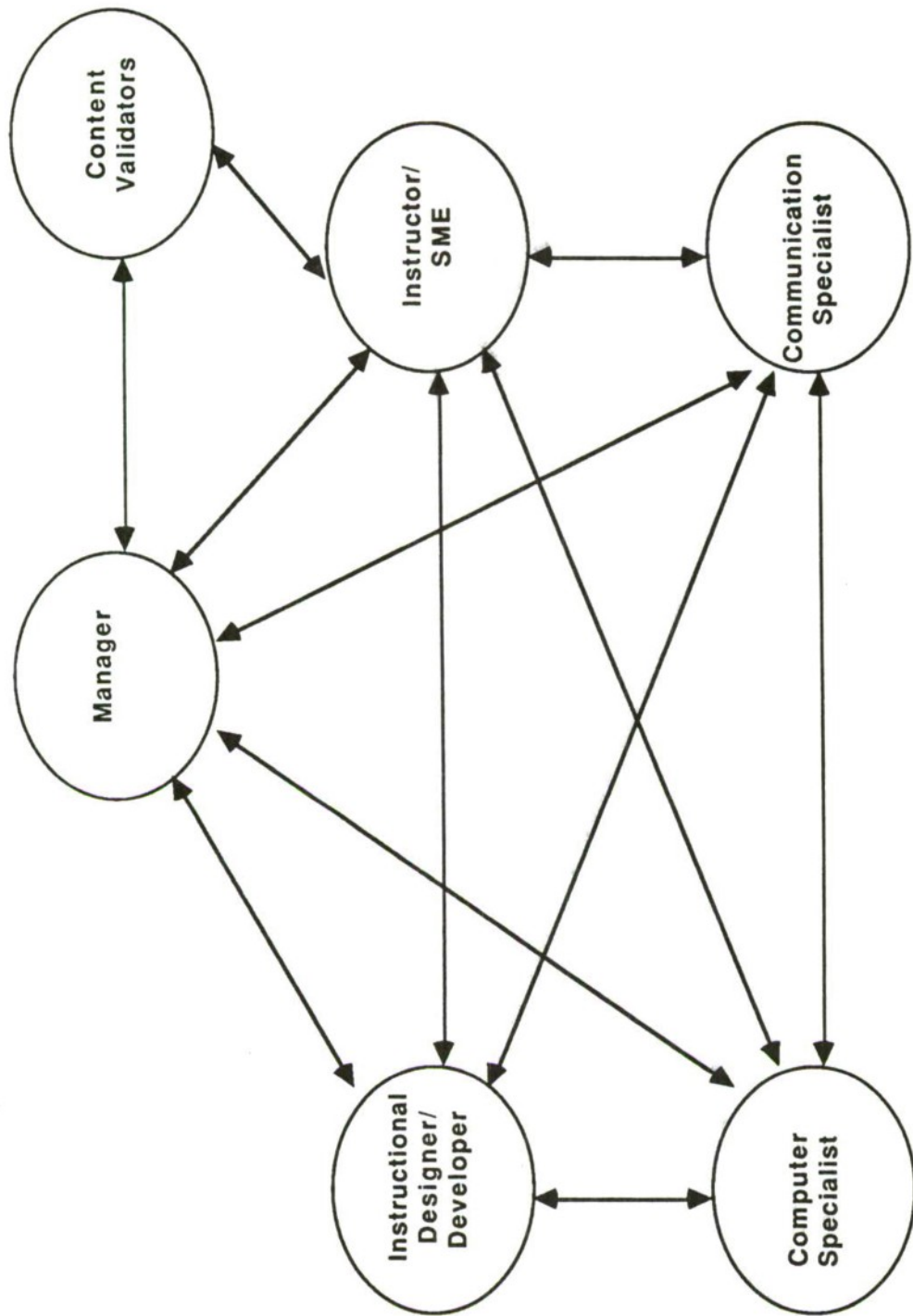


Figure 3-2. Development Team Communication Channels.

examples of courseware and, preferably, actually taking CBT courses, (p. 126).

MIL-T-29053B(TD) emphasizes SME training in every step of the ISD process. See Sections 3.4.1.3 ("SME training for operator task listings development") and 3.12.6 ("SME training for syllabi development") for examples.

The graphics designer's skills will help you avoid creating a text-heavy electronic page-turner. The technical editor and his or her legion of proof-readers will ensure that on-line and hardcopy text is concise, unambiguous, and free of grammatical and typographical errors.

Perhaps the most important contribution is made by the subject-matter expert and/or instructor. A reasonable percentage of this person's time must be committed to the team. The commitment should be in writing from the appropriate office, even if it is your own office.

Finally, the CAI task manager resembles a squadron leader preparing for a skirmish with a wily opponent: there is too much work and too much uncertainty to ever make it alone. The assignment of your development team and your ability to lead that team are obviously crucial to the project's successful completion. Try not to underestimate the former or overestimate the latter.

3.8 Step 8: Prepare CAI Support Plan

The treacherous terrain of CAI development mandates your having a clear, detailed map to follow. If you are under contract, the statement of work was your starting point. You will probably sketch in more detail through the minutes of technical interchange meetings and status reviews.

Before stepping off into the CAI design process, which often bears a strong resemblance to quicksand, prepare a detailed CAI Support Plan. The plan should contain at least three sections.

Section 1 documents the information that you have gathered, generated, and reviewed so far in ISD Steps 1 through 4.4 and ESD Prototype Methodology Phase I. Include (or summarize where possible) the results of:

- ISD Step 1: System requirements analysis
- ISD Step 2: Instructional requirements definition, including a description of target learner characteristics

- ISD Step 3: Course objectives, with the option of including the test items in an appendix
- ISD Step 4: Detailed unit outlines, instructional method and media selections, and development team member assignments

Having documented past decisions and products in Section 1, Section 2 is a straightforward management plan for carrying out the rest of the ESD prototype methodology. MIL-T-29053B(TD) sets forth the requirement for a training development support plan (TDSP). This plan, which is founded on results obtained from ISD Steps 1 and 2, forms "the basis for effective project procurement and management," with its goal being "to arrive at a method for achieving project goals (both technical and managerial) that is objective and cost-effective for the government," (Sections 3.1 and 3.2).

The TDSP includes:

- Project objectives
- Roles and responsibilities
- Program phasing and procurement strategies
- Coordination of the ISD tasks within each of the program phases
- Schedules and milestones
- Resource estimates (contractor as well as Air Force)
- Any special planning requirements

No doubt you had determined many of these earlier, at least at a high level, for funds justification. Now, having completed Phase I, you should have a much more realistic handle on schedules and milestones, resource estimates, and any special planning requirements such as adoption of pending policy changes.

Section 3 of the CAI Support plan concerns the future of your completed CAI system. Although the TDSP addresses procurement strategies, attention also needs to be paid to the transition and implementation processes. Long-term support requires a significant commitment of resources by a designated agency (Weischadle and Weischadle, 1985). This long-term support is critical for the Air Force due to the high turnover rate of personnel; technology is easily lost when its local proponent is reassigned.

Points to consider in finalizing the CAI Support Plan include:

- If you are enhancing an existing course, provide a high-level description of the overall instructional strategy for the course and identify where the CAI system will fit into that strategy.
- If you are developing instruction to support a new system or technique, provide a high-level description of the transition

strategy for the system or technique and identify where the CAI system will fit into that strategy.

- Identify the student hours, instructor contact hours, equipment, maintenance, content updating, facilities, and other resources the CAI system will require throughout the remainder of its life cycle.
- Identify the office that will be responsible for providing those resources on a continuing basis, making sure that the identified office already has agreed to or is aware of its responsibility.

3.9 Milestone 1: Government Approval of the CAI Support Plan

The primary product of Phase I is the CAI Support Plan. Approval of this plan ensures that the interested parties have roughly equivalent understandings of:

- Decisions/products to date
- What topics the CAI system will cover
- How the project will proceed from this point
- What resources the CAI system will require for the remainder of its life cycle

Milestone 1 is the first of five in the ESD prototype methodology. Each marks a critical point in the design, development, acceptance, and implementation of your CAI system. One way to manage these critical points is to:

- 1) Distribute the product (in this case, the CAI Support Plan) to concerned personnel for a 21-day review period
- 2) Examine their comments and write a report summarizing your reactions and proposed solutions
- 3) Distribute the report for a ten-day review period
- 4) Hold a status review meeting to clarify everyone's understanding and to resolve any remaining differences
- 5) Document the status review in the form of meeting minutes
- 6) Distribute the minutes to all concerned personnel

The phrase "CAI power is time is money" can be abbreviated to "Time is money" here. In order to keep your project on schedule and within budget, it is imperative that milestones be reached and passed in a timely fashion. Because the biggest obstacle (outside the development team) to this is usually

the reviewers' turnaround--or lack thereof--you must facilitate their participation.

Facilitation may involve sending them a series of memos as the review period approaches; including a self-addressed, stamped envelope with the materials to be reviewed; or meeting with each reviewer to pick up a copy of his or her comments and informally discuss the project. You will be able to judge what future facilitative efforts will be called for after you pass Milestone 1.

Section 3

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Section 4.0

Phase II: Preliminary Design

Thus far in your instructional system development effort, you have completed Steps 1, 2, 3, 4.1.1, and 4.1.2 of the detailed ISD model depicted in AFP 50-58 (see Appendix G). You have worked through ATCP 50-4's eight decision aids in executing Step 4.1.3 of the detailed ISD model and have concluded that CAI will form at least part of your instructional package.

In completing Phase I of the prototype methodology, you reviewed and revised (1) the products of AFP 50-58 Steps 1 through 4.4 and (2) your answers to the decision aids in ATCP 50-4, especially those concerning resource requirements. The end product was a CAI Support Plan, Government approval of which constitutes Milestone 1.

Now you are ready to begin the CAI preliminary design process, Phase II of the prototype methodology. Figure 4-1 presents the eight steps of Phase II. Note that four of the eight are carried out in parallel.

4.1 Step 1: Assemble Development Team

Up to this point, if you are the CAI task manager, you may have worked alone, conferring with concerned agencies, instructors, course alumni, target learners, subject-matter experts, CAI consultants, and others as needed. Phase II, however, requires participation of the CAI development team you identified in Step 7 of Phase I.

The design work you accomplish in this phase may be the result of a demanding and often difficult group problem-solving effort. The degree of participation the task manager permits his or her team to have in the decision-making process will determine the amount of time and energy expended on group problem-solving. If team members have the proper professional qualifications, then encouraging their participation and constructive feedback should result in a superior instructional product.

Management approaches to CAI development or any other project can rarely be characterized as either directive or facilitative. Instead, the task manager must adapt his or her approach to each day's demands. While a discussion of management approach is beyond the scope of this document, do not underestimate the criticality of the issue.

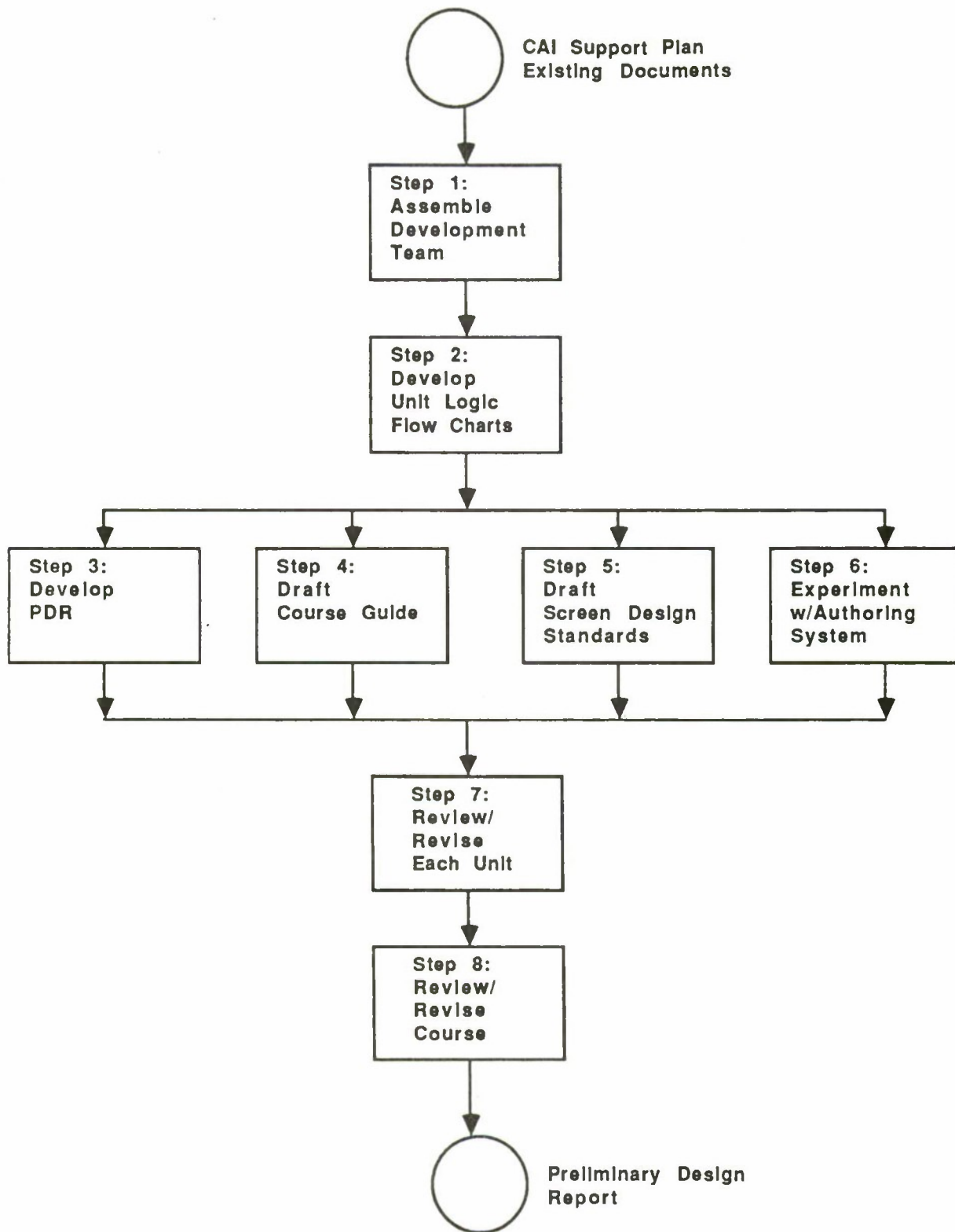


Figure 4-1. Phase II: Preliminary Design.

According to Heffernan (1985),

...the traditional software development life-cycle model identifies discrete events and phases, the logical relationships between data products, the scheduled reviews and project milestones, and the logical sequence and progression of the project through these phases. In reality, software projects are characterized by constant unforeseen changes in requirements and technical assumptions, causing a ripple effect of changes throughout other interrelated tasks, (p. 61).

Heffernan quotes author Michael Evans as saying, "Control over this process and consistency between the data products that pass from phase to phase is the critical component of the software project infrastructure." The infrastructure is the "set of management practices and methods used to integrate all the components of the project together," (p. 61).

The CAI task manager is responsible for maintaining a continuously revised, mental status report on all facets of the project. Here, the task manager is truly a knowledge engineer whose mental expert system and ability to respond to those "constant unforeseen changes" ensures a smoothly functioning instructional system. As Evans concluded,

What is most important to software quality and project productivity...is not the individual pieces that make up the project. Rather, it is the edges or interfaces between related project segments. All data developed must be traced to a changing set of requirements, and the data products are not really complete until the end of the project, (p. 61).

4.2 Step 2: Develop Unit Logic Flow Charts

As stated above, the purpose of the PDR is to sketch a visual outline of storyboard and ancillary material logic flow and content for internal review and revision. Your approach this task depends a great deal on available materials. If you are revising or enhancing an existing course, you will have a much different starting place than if you are developing instruction to support a new system. In either case, you must first review all available materials. This review is critical for helping you to avoid re-inventing the wheel.

4.2.1 Step 2.1: Review Existing Materials

Step 4.5.1 of the AFP 50-58 ISD activities and decisions flow chart calls for the instructional designer to "survey existing materials for suitability," (see Appendix G). You began this activity in 1.4.1, 1.4.11, or 1.4.13, when you conducted your initial system description/performance data collection effort.

You reviewed those data for AFP 50-58 Step 3 and again for Step 4.1, especially 4.1.1 (Plan Sequence of Instruction).

With the course objectives from AFP 50-58 Step 3.2, the detailed outlines from Phase I, and your subject-matter expert at hand, review all existing materials again now as you prepare to develop the Preliminary Design Report. Ask yourself questions such as:

- Q1:** Which materials address information learners will need in order to meet the objectives?
- Q2:** How easily will you be able to adapt materials to the instructional methods you identified in AFP 50-58 Step 4.1.2 (Select Instructional Methods)?
- Q3:** Are those materials written as a user's reference manual or as an instructional tool?
- Q4:** If the document is a user's reference manual, what new materials will have to be written to build an instructional foundation for novices?
- Q5:** Will the SME be available to support development of new materials at this time?

Once you have answered these and similar questions, you should have the clearest idea so far of how you will flesh out the detailed outlines from Phase I. You are now ready to sketch logic flow charts for each unit of CAI.

4.2.2 Step 2.2: Develop Unit Logic Flow Charts

The preliminary logic flow charts you develop in this substep are much like those for any type of system analysis and documentation. Besides helping you define unit logic flow and contents, the product of this activity can serve as your first cut at a high-level branching scheme (see Chapters 2, 3, 5, and 6 of AFP 50-58, Volume VI, for explanations and examples of four branching schemes). It may help to think of logic flow charts as the course skeleton, which you will flesh out in Step 3 of this phase.

Reviewing the common-element objectives, criterion objectives, and subobjectives you wrote for AFP 50-58 Step 3.2 would be helpful at this point. Section 3-2 of AFP 50-58, Volume III, discusses common-element objectives in detail. To reduce unnecessary redundancy, you need to identify which objectives and their supporting instructional materials will be common across two or more units. The preliminary logic flow chart is a graphic reminder of where that relationship exists across units.

For example, in executing AFP 50-58 Step 3.2, Lt Green had determined that Common-Element Objective 4.1 would be covered in Unit 2. The learner's approach he wrote for the course called for successful completion of each unit in sequence. This enabled him to focus on new objectives in Unit 3 rather than covering Common-Element Objective 4.1 again. Now, to complete this substep of Phase II, he reflects the relationship in the preliminary logic flow chart.

4.3 Step 3: Develop Preliminary Design Report

Given the foundation established with the CAI Support Plan from Phase I, this step consists of expanding the detailed unit outlines to a Preliminary Design Report (PDR), which is the major product of this phase. The Preliminary Design Report is a high-level definition of unit logic flow and content. The "report" is actually a set of rough storyboards for internal review and revision. The PDR gives your CAI development team the chance to (1) make sure everyone is on the same wavelength and (2) offer creative alternatives to the proposed approach.

The Preliminary Design Report is the bridge between the CAI Support Plan and the Draft Detailed Design Report. As such, it builds on the skeleton you constructed with the unit logic flow charts in Step 2.2 of this phase.

The objectives of this step are to (1) create rough storyboards that reflect the course logic flow and contents and (2) do so as quickly as possible. Writing text in a bulleted format:

- AISIM has five main user interfaces
- Each user interface is accessible from AISIM READY

or as a telegram:

2167 = document to be tailored to
each acquisition's requirements

will speed up this process.

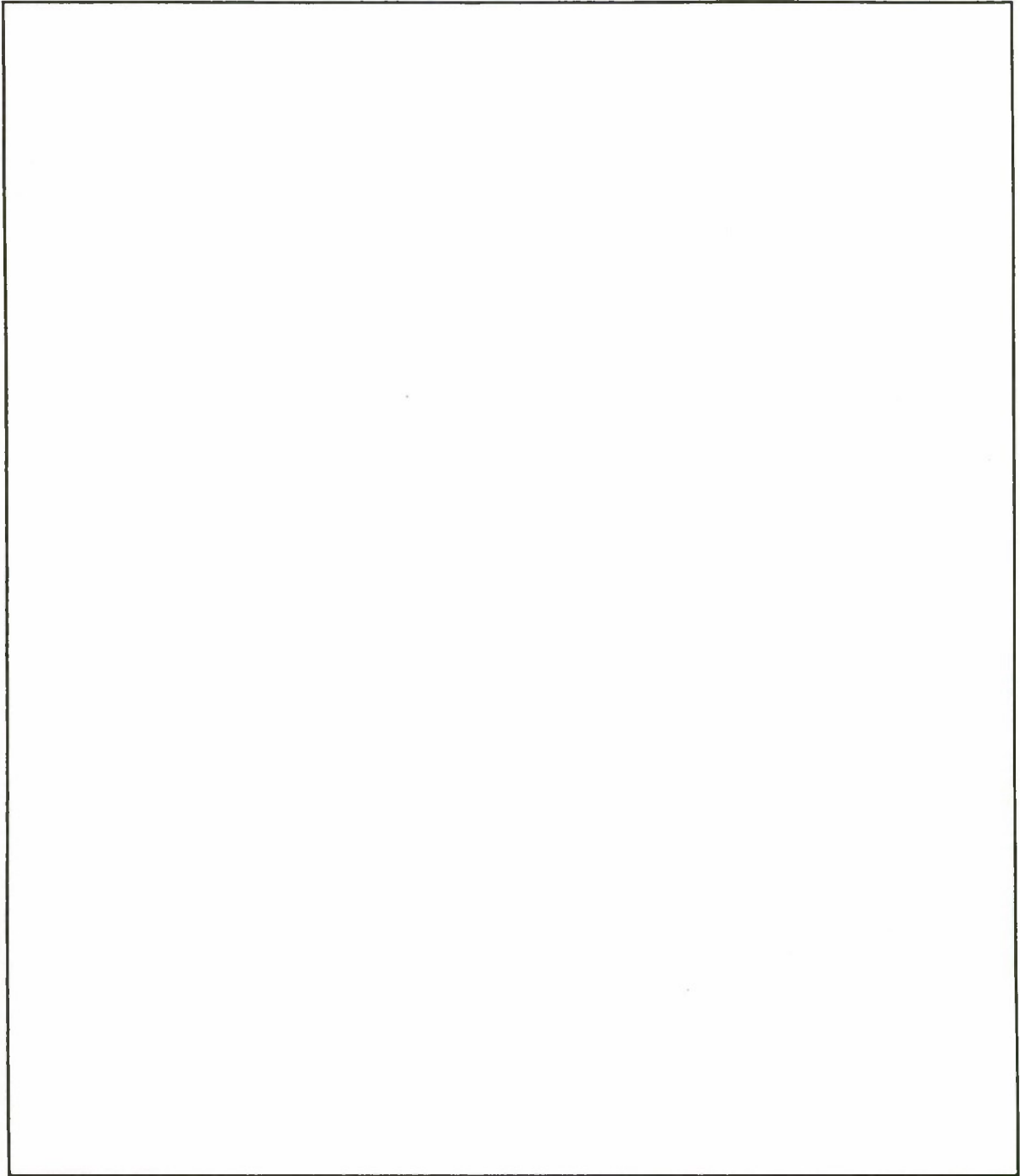
Graphics should be sketched freehand or photocopied. Placement and general content of learner-system interactions and test items should be noted without going into detail. Record your text and graphics sources for future reference.

Include all opening, menu, closing, and exit screens, one per sheet of paper. You may find it useful to indicate content that will appear in another medium (e.g., course guide, reference card, videotape) by inserting a colored sheet at the appropriate point. The form shown in Figure 4-2 appeared on blue sheets in the "About AISIM" Preliminary Design Report.

Page # _____

Module # _____ Previous Page/Screen # _____

Module Name _____ Next Page/Screen # _____



Special instructions, questions _____

Figure 4-2. Blue Sheet for "About AISIM" Course Guide Reference.

4.4 Step 4: Draft Course Guide

A natural by-product of expanding the detailed outlines to a Preliminary Design Report is the first draft of the course guide that will accompany the courseware. Whether the guide is two pages long or 200, learners should have some way of finding out what they are getting into without having to load a mag tape or insert a diskette. The "About AISIM" Course Guide's table of contents are shown in Figure 4-3. Note that "About AISIM" is a stand-alone, self-paced instructional system.

The instructor's manual is an essential component for the success of CAI systems that support an instructor-led course. Section 6-16, AFP 50-58, Volume IV, lists information recommended for inclusion in the instructor's manual. Consult with your project's assigned instructor and/or SME to determine other information to include.

4.5 Step 5: Draft Screen Design Standards

Another by-product of Phase II/Step 1 is the first draft of the screen design standards. Heck (1986) lists direction for authors, quality, consistency, and ease of maintenance as the four primary purposes of CAI development standards. Standards will also facilitate team communications in Phases III and IV. These standards should include conventions governing graphics as well as text. Graphics standards are addressed in Section 5.1.2 of this handbook.

A copy of the Design Guidelines for User-System Interface Software, ESD-TR-84-190, is available upon request from the Computer Resource Management Technology Program Office, Electronic Systems Division, Hanscom Air Force Base, MA. Although the Design Guidelines were compiled for designers of user-system interface software in defense information systems, they are an excellent resource for anyone responsible for screen design.

Screen design standards can be developed in a number of ways. One way is to tailor existing standards to meet the needs of your project. Another approach is to develop your own standards. This usually means allowing standards to evolve over the course of Phases II and III, making certain that you document them as they evolve.

While tailoring existing standards is certainly easier, the standards you begin with may have been written under constraints that your design skills, authoring system, or delivery system could have overcome. In other words, your creativity and the capabilities of your technology may be short-circuited by starting with existing standards.

If you adopt existing standards, find out what authoring system and computer they were developed for. It would also be helpful to view

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Figure 4-3. "About AISIM" Course Guide Table of Contents.

courseware developed under those standards to see exactly what they mean. If you decide to develop your own standards, research the topic first. Books, journals, conferences, authoring-system users groups, other agencies or companies, demonstrations, and commercial products are good sources of the latest experimental results, practical guidelines, lessons learned, in-house standards, bug-free examples, and free advice. See the appendixes for more information.

Whether you rely on existing standards or develop your own, they should address topics such as language, grammar, capitalization, abbreviation, and graphics conventions; basic screen types and standard screens; and screen identification and transfer data.

Sample screen design standards are presented in Appendix F of this handbook. This set of standards was developed for "About AISIM," a sixteen-hour tutorial which presently runs on an IBM-PC. Members of the development team sought information from a variety of the sources listed above, then debated and agreed upon standards as screen design issues arose. The team's technical editor was in charge of documenting, updating, and distributing each iteration of the standards as they evolved.

4.6 Step 6: Experiment with Authoring System

Although you are far from being ready to transfer storyboards to the authoring system, experimentation with the authoring system at this time could prove very helpful. Experimentation is especially valuable if (1) you are using an unfamiliar authoring system or (2) your proposed courseware design is more complex than your earlier products.

For example, Lt Swift's previous products were fairly simple drill-and-practice exercises. Now, however, she has been tasked to produce a tutorial, including detailed graphics and several levels of remediation. While she is comfortable with most of the authoring system's features, she is certain that experimenting with graphics, whether character or bit-map, and more complicated branching for remediation will prevent snafus later.

As discussed in Phase I, the question of transportability from color to monochrome or to another computer altogether (e.g., from an IBM-PC to a Zenith) may be an issue for your project. If so, you should also run computer system checks with the authoring system at this time.

Text that blinks in color may produce blanks in monochrome. Text that is blue on a color monitor may appear as an underline on a monochrome monitor. These differences are unimportant if you will be running the courseware exclusively on the color machines at your facility. However, if you plan to make the courseware available to Government or contractor personnel at other facilities, it would be wise to exclude such differences from your design.

Again, design constraints vary among authoring systems and among computer systems. Your best defense against future problems is to experiment with the authoring system's capabilities on the target computer(s) during Phase II.

4.7 Step 7: Review Each Unit

This step introduces the issue of the courseware review cycle. Good quality is built into a CAI system from ISD Step 1 onward, not simply assured in Steps 4 and 5. Regular reviews of each unit and then of the course as a whole are an important tool for building in good quality. The ESD prototype methodology includes review/revision steps in each of its five phases to emphasize the necessity of this activity. Phases I through IV address formative evaluation, while Phase V addresses summative evaluation.

Kearsley (1983) defines formative evaluation as "data collected to make decisions about revisions and improvements," (p. 107). Summative evaluation is "data collected in order to make decisions about the overall value of CBT [computer-based training]," (p. 108) or any other instructional system.

The review/revision cycle gives the team opportunities to review the material as a whole rather than in bits and pieces. It also requires the team to set and meet due dates, discuss and resolve problems, and make tangible progress toward the next milestone.

Section 6-19, AFP 50-58, Volume IV, provides information on how to conduct an internal review of the initial draft. Note the emphasis on having the reviewer identify:

- Strengths as well as weaknesses
- Specific suggestions for how to improve identified weaknesses.

Quality factors cited in DOD-STD-2167 include:

- | | | |
|---------------|-------------------|--------------------|
| • Reliability | • Portability | • Efficiency |
| • Correctness | • Maintainability | • Interoperability |
| • Reusability | • Flexibility | • Testability |
| • Integrity | • Usability | |

Not all of the "-ilities" are relevant to CAI, but they do bear consideration in your review process.

4.8 Step 8: Review/Revise Course

This step appears again in Phases III and IV. Its purpose is to emphasize integration of all parts of the system your team is developing: screen contents, both text and graphics, and ancillary materials, both the learner's and instructor's guides. Your guideposts throughout this process are the instructional objectives you devised in ISD Step 3.

The output of Phase II is the Preliminary Design Report. The PDR is a rough sketch of the proposed CAI system created for internal review and revision. This set of rough storyboards and ancillary materials determines the general shape the CAI system will take in Phase III. Its completion gets you over the first major design hurdle and prepares you for Phase III, Detailed Design.

Because its primary purpose is to facilitate internal review and revision, the PDR is not listed as a formal milestone in the prototype methodology. However, you may want your approving agency to review it informally to make sure everyone is still on the same wavelength.

Section 4

References

- Air Force Manual 50-2, Instructional System Development, 31 July 1975.
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Section 5.0

Phase III: Detailed Design

To complete Phase II, Preliminary Design, your development team sketched out a set of rough storyboards for internal review. You also began drafting two documents: (1) the course guide and any other ancillary materials or media, and (2) the screen design standards that the team will follow in Phase III. You may have also chosen and experimented with an authoring system. Consequently, the four products of Phase II were:

- 1) Preliminary Design Report (PDR), which is a set of rough storyboards
- 2) Draft course guide, instructor's manual, and other ancillary material
- 3) Draft screen design standards
- 4) Documented results of the authoring system check

Phase III, the detailed design process, is the apex of your CAI development effort. Figure 5-1 shows the nine steps of this phase.

5.1 Step 1: Expand PDR to Draft Detailed Design Report

You developed the Preliminary Design Report (PDR) for internal review purposes, although you may have had outside readers review it as well. Once the "visual outline" of the logic flow and basic content are judged satisfactory, your team is ready to add detailed content and graphics. The result is the Draft Detailed Design Report (DDDR). Step 1 is comprised of five smaller activities, which are described below.

5.1.1 Step 1.1: Review/Revise Instructional Flow and Pace

Although you reviewed the sequencing and grouping of the course objectives several times prior to and during Phases I and II, you must check the instructional flow and pace again before the course solidifies further. Section 5-17e of AFP 50-58, Volume IV, offers high-level guidance aimed at "compromises and changes in sequencing" during final media selection. Review that section again and ask yourself questions such as:

Q1: Is the flow logical and consistent?

Q2: Can the learner predict the flow from one unit to the next, or does he/she have to learn a new set of procedures for each unit?

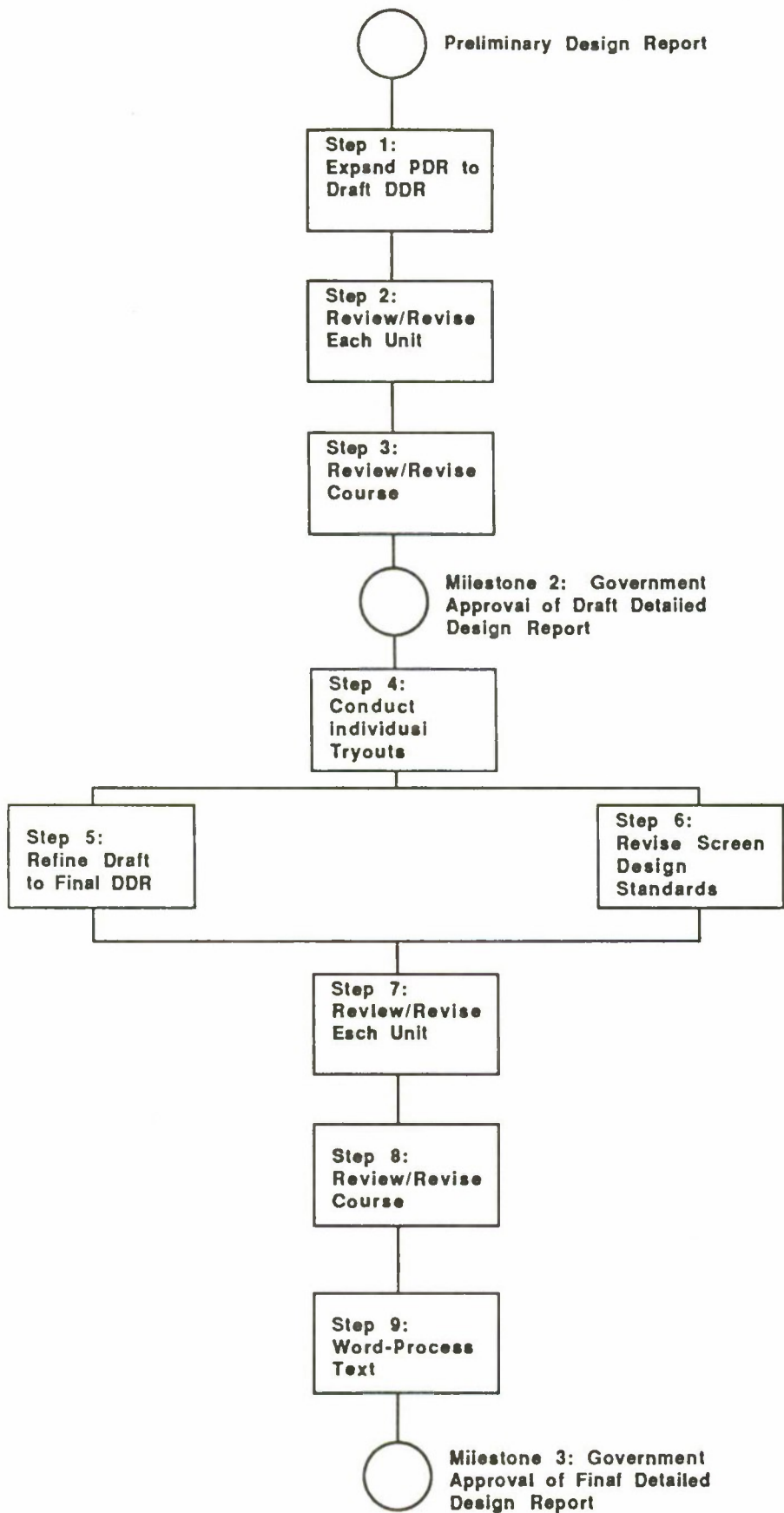


Figure 5-1. Phase III: Detailed Design.

Q3: Is the learner required to complete an inordinate number of screens between interactions or test items?

These questions do not begin to scratch the surface of the topic of instructional flow and pace. Almost any text on educational psychology or instructional design would provide further assistance. Concepts from film-making and video production, especially animation, can easily be adapted for CAI flow and pacing guidelines.

5.1.2 Step 1.2: Review/Revise Screen Designs

Brink (1986) wrote that "Thoughtful consideration of screen format and design is critical for successful CBT--perhaps equal in importance to actual course content. Poor screen design by itself can cause product failure," (p. 23). He is only one of hundreds of interface designers who continue to stress the importance of screen design. And the greater the size and complexity of your CAI system, the more important it is to document screen design decisions in a set of standards, as discussed in Section 4.5 of this handbook.

Whether you chose to develop your own set of standards or adopt an existing set for Step 5 of Phase II, you should review and revise them at this time. Much of the input for this review and revision can probably be gleaned from comments made about the PDR at the conclusion of Phase II.

As the CAI task manager, you are responsible for keeping abreast of all facets of the project. Development team communication is greatly enhanced, however, by continuing to review, revise, and distribute the screen design standards you began drafting earlier. The project's technical editor and/or graphics designer could be assigned the task of maintaining the standards, notifying all team members of changes and answering questions that may arise.

By now you have a fairly clear idea of what the menu and branching logic is, how long each branch of each unit will be, and how long the course as a whole will be. That information gives you an indication of how many landmarks and signposts the learner will be seeking. The more complex your menu and branching logic, the more guidance you will want to give the learner on each screen.

ESD-TR-84-190, Design Guidelines for User-System Interface Software, addresses user guidance in Section 4. Here, user guidance encompasses "error messages, alarms, prompts, and labels, as well as...more formal instructional material provided to help guide a user's interaction with a computer," (p. 261). Section 2 of the Guidelines, "Data Display," offers valuable rules of thumb on such topics as text, tables, and graphics display; density; and framing.

If you are using an authoring system, many screen features may be dictated to you (e.g., placement of the "back" and "exit" prompts). However,

the additional landmarks, signposts, and other evidence of learner-friendliness that you build into each screen can make a significant difference in how positively learners react to your CAI product.

Examples include placing a locational banner in the upper right corner of each screen and hardcopy page (note the top of this page). Also, learners tend to be especially uncomfortable with tests. In the introduction to a test section, tell learners how many questions they are going to be asked. Then number the questions as you present them.

Learner-friendliness is often a CAI translation of courtesies you would automatically extend in the classroom. Imagine your students' reaction if you silently distributed a reading assignment or administered an exam one unnumbered page at a time. The fact that CAI learners will take out their frustrations on the computer rather than on your person should not keep you from building in learner-friendliness.

5.1.3 Step 1.3: Add Text and Graphics

The next step in expanding the PDR into the Draft Detailed Design Report (DDDR) is to add text and graphics. Team members may have been noting text sources and sketching rough graphics as they prepared the PDR, but those activities are now the primary focus. At least two options are available.

Option 1 calls for cutting and pasting unedited text from existing materials. These materials could range from copies of the user's guide to a college textbook to notes from your interviews with subject-matter experts. You would, of course, rewrite, edit, and supplement these materials before submitting the Draft Detailed Design Report for Government approval. Use copyrighted material cautiously, even in a draft that will be rewritten and edited extensively. If you choose Option 1,

- Reference your sources, especially copyrighted ones
- Identify material that is DOD property
- If you decide to use copyrighted material, incorporate the ideas in your own wording to avoid plagiarism

Option 2 calls for assembling the same materials that you would have gathered for Option 1. The main difference is that you would rewrite and edit the text *before* transferring it to storyboards for the PDDR. The result would not be polished to the point of publication, but it would be more of a book than a set of storyboards.

To summarize the two options:

Option 1

- 1) Assemble materials
- 2) Review materials
- 3) Discuss and resolve problems
- 4) Revise flow and content
- 5) Rewrite materials
- 6) Transfer to storyboard format

Option 2

- 1) Assemble materials
- 2) Rewrite materials
- 3) SME reviews and revises
- 4) Review/revise flow
- 5) Transfer to storyboard format

Either option has benefits and drawbacks. The main advantage of Option 1 is that everyone has a clearer picture of how the course will look and flow early in the detailed design process. A review of Option 1's output will prevent you from rewriting text that may soon be deleted. A disadvantage of Option 1 is that if Steps 3 and 4 are group processes, this option can become very time-consuming.

The main advantage of Option 2 is that by creating the definitive "course document," everyone has a common departure point and reference for the remainder of the project. This course document would be convenient for the SME to review and revise, as it would be a cohesive whole rather than a conglomerate of widely different sources. A disadvantage of Option 2 is that some of the effort spent creating a course document is negated in the process of creating interactive, individualized, interesting courseware. What makes a cohesive whole on paper does not translate into CAI, unless the CAI product is to be an electronic page-turner.

Perhaps the best path lies between the two options. After your developers assemble their sources, frequently touch bases with each individual. "Management by wandering around" will help keep everyone on target. When global issues arise, either call a brief meeting or save the issues for your next weekly team meeting, depending on the nature of the problem.

Graphics for either option should be limited to freehand sketches and illustrations photocopied from either DOD property or properly referenced copyrighted sources. Label figures, tables, and other graphics by title and intended location.

Have your graphic artist and your computer/authoring-system specialist begin experimenting with graphics that appear more than once in the courseware. This will produce three results:

- 1) Speed up the graphics standardization process
- 2) Give the team a better idea of the delivery system's graphics capabilities
- 3) Start your on-line graphics library for Phase IV

5.1.4 Step 1.4: Add Interactions

Interaction is the heart of computer-assisted instruction. The computer program's abilities to judge learner answers and respond appropriately are the medium's main advantages. Therefore, lively interaction is the hallmark of a good CAI system.

Technically, "interaction" refers to any communication between user and computer. In this handbook, however, the term will refer to communications within branches that are *not* intended to measure mastery of objectives. These interactions may reinforce a point just made or provide information for a problem-solving exercise, but they are not test items.

AFP 50-58, Volume VI, is a good starting place for a discussion of interaction. Note that Volume VI is not limited to CAI. See the list of recommended readings too, as much has been written on this topic.

As you roughed out the PDR in Phase II, you noted (1) placement of interactions and (2) the contents of those interactions within each branch. One rule of thumb suggests that the learner interact with the system at least once every three full screens or once every six half-screens. More interactions are usually better than fewer, but your topic may dictate fewer, or quality may not be able to match quantity. In either of those cases, you will have devise your own rule of thumb. To complete this step of Phase III, write out fully the interactive questions, answers, and system responses that you noted in Phase II.

5.1.5 Step 1.5: Add Test Items

Section 4-4 of AFM 50-2 addresses test development. Chapters 4 and 5, AFP 50-58, Volume III, present more detailed discussions of criterion-referenced test construction and use. You probably reviewed these before writing the test items for ISD Step 3.3 and reviewing your items for Step 4 of Phase II.

Tests serve at least two purposes. First, they enable the learner and the instructor to assess self-performance. The learner is given feedback on his or her degree of mastery, while the instructor gains feedback on how well he or she communicated with the learner.

Second, from an ISD viewpoint, tests enable the instructional designer to assess system performance. Test items are the designer's single best source of information about how well an instructional system functions.

At one extreme, test items are excluded from instruction for fear of intimidating or otherwise alienating the learner. Learners, instructors (or supervisors), and designers are all denied valuable information by this approach.

At the other extreme, learners are simply throughput to monitor system performance. Adherents to this approach may improve instructional system performance at the expense of learner-friendliness. Ideally, you will be able to find a middle ground between the two extremes. It may help to recall that learners are typically more alienated by the *way* test results are communicated rather than by the fact that they are communicated.

5.2 Step 2: Review/Revise Each Unit

See Step 7 of Phase II.

5.3 Step 3: Review/Revise Course

See Step 8 of Phase II.

5.4 Milestone 2: Government Approval of DDDR

The Government's comments and recommended revisions are responded to as outlined in Section 3.9 of this handbook. Before incorporating any changes, however, conduct Step 4.

5.5 Step 4: Conduct Individual Tryouts

Once the Government has approved the Draft Detailed Design Report, have at least two or three above-average learners from the target population work through the DDDR's paper-based storyboards and ancillary materials. Granted, working through a paper-based version of a CAI system does not simulate the on-line system very closely. But learners' substantive comments and recommended revisions are easier to incorporate now rather than after the storyboards have been transferred to the authoring system. Individual tryouts are conducted with the on-line courseware in Step 8 of Phase IV or sooner, depending on learner availability.

In keeping with ISD's iterative nature, Step 4 gives you the opportunity to gather two types of data: (1) student feedback on contents and flow of the course thus far and (2) initial system validation. Section 5-4b, AFM 50-2, states:

In developing an instructional system, the proof of quality can only be ascertained through a measurement of results in

comparison with the specific criterion objectives. Each step in instructional system development can be validated by checking student performance against the performance criteria. This is referred to as system validation. It should not be inferred, however, that the complete instructional system is developed and then tested all at once; rather, portions of it may be tested as they are produced, (p. 5-19).

Put another way, good quality is built in by frequently reviewing the material and, now that the course is taking shape, by testing it out with individuals. Section 5-4b(1) addresses individual student sampling and conducting the individual tryout. Sections 6-20 through -22, AFP 50-58, Volume IV give more detailed guidance on this topic. Stress to the learners participating in your individual tryouts that the *courseware* is being evaluated, not the learner.

5.6 Step 5: Refine Draft to Final Detailed Design Report

The Final Detailed Design Report (FDDR) is a set of hardcopy storyboards submitted on screen templates from your authoring system. Appendix E contains the screen templates used for "About AISIM." This set was intended to meet the informational requirements of most authoring systems.

The purpose of the FDDR is to incorporate and integrate valid comments, suggestions, and recommended revisions provided by the Government, individual-tryout participants, instructors, and the development team. Section 5-4 of APM 50-2 briefly describes use of individual tryout results. Sections 6-23 through -28, AFP 50-58, Volume IV, provide valuable guidelines for analyzing tryout data and making needed revisions.

This step also calls for polishing the text and graphics to their final paper-based version. Here, "polishing" means having the instructional developers refine each branch, paying particular attention to transitions, interactions, and test items. Close attention must be paid to having the course guide and any other ancillary materials accurately and consistently reflect any changes made to the courseware.

The technical editor edits each storyboard and accompanying course-guide page as the developers complete their work. The graphics designer produces final illustrations for the courseware and its ancillary materials. Later, masters of these graphics are filed by unit, then photocopied and pasted to their respective storyboards and ancillary pages during production of the Final Detailed Design Report.

5.7 Step 6: Revise Screen Design Standards

Revision of the screen design standards is critical at this point because the entire development team will be relying on them heavily over the rest of this phase as well as in Phase IV. Include any global changes that were made in Step 5 and append a set of the graphics that appear more than once. See Appendix F of this handbook for an example.

5.8 Step 7: Review/Revise Each Unit

Development team members review each unit on their own, then meet to discuss any final changes. Reviewing and revising the units in sequence promotes consistency across the course.

5.9 Step 8: Review/Revise Course

If you have access to a reviewer who has not been involved in the current development process, have him or her review the courseware and its ancillary materials. This reviewer should note inconsistencies, weak or nonexistent transitions, unnecessary redundancy, and ambiguity or other wording problems. Incorporation of this reviewer's comments should be limited to fine-tuning.

5.10 Step 9: Word-Process Text

The word-processing capabilities of most authoring systems are more cumbersome than those of programs whose main purpose is word-processing. If you have a lot of text to input, it is more efficient to enter it into word-processing files that can be transferred in Step 1 of Phase IV. Make certain that the word-processing program is compatible with your authoring system before inputting the Final Detailed Design Report storyboards. Proofreading this input is a monumental task, even with an on-line spelling-check feature.

Your computer specialist has been experimenting with and inputting graphics into the authoring system's graphics library since Step 1.3 of Phase III. He or she should now revise them to be consistent with the master graphics developed in Step 5 of this phase.

5.11 Milestone 3: Government Approval of Final Detailed Design Report

Once you reach Milestone 3, the courseware storyboards are "frozen" by Government approval. Minor spatial and color adjustments may need to be made in Phase IV, but any other changes should first meet with Government

approval. The review procedure established in Step 3.9 of Phase I should be followed here to ensure that all parties are aware of and approve of what will later appear on the computer screen and in the ancillary materials.

Section 5

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Yordy, Laura. How do you know if it's done? Guidelines for reviewing CBT courses. Data Training, August 1986, pp. 34-35.

Section 6.0

Phase IV: Transfer and Validation

To complete Phase III, Detailed Design, you expanded the Preliminary Design Report to the Draft and Final Detailed Design Reports. You also revised the screen design standards and the course guide, as well as any other ancillary materials. You may have also begun transferring storyboard text to word-processing files that you will transfer to the authoring system in this phase. The products of Phase III included the following:

- 1) Draft Detailed Design Report (DDDR)
- 2) Final Detailed Design Report (FDDR)
- 3) Revised screen design standards
- 4) Revised course materials, including the learner's and instructor's guides
- 5) Word-processing files

Your CAI development effort will begin winding down in Phase IV, especially if you are already familiar with your authoring system (or authoring or programming language). Figure 6-1 shows the six steps of this phase.

6.1 Step 1: Transfer Storyboards to Authoring System

Execution of this step varies, depending on your authoring system. As noted in Sections 4.6 and 5.1, your best defense against future problems was to experiment with the authoring system on the target computer(s) during Phases II and III. Assuming you experimented with the system sufficiently before you began designing the courseware in earnest, transferring the storyboards you produced for the Final Detailed Design Report will be fairly straightforward. Transferring a large number of screens and tracking them carefully will probably comprise most of the challenge in this phase.

If you chose to enter storyboard text into word-processing files in preparing the Final Detailed Design Report, you are a step ahead for this phase. If you decided to enter the storyboard text directly into the authoring system, you may have to contend with an inefficient word-processing program within the authoring system. In either case, this step is tedious and requires close attention to detail in order to minimize courseware bugs.

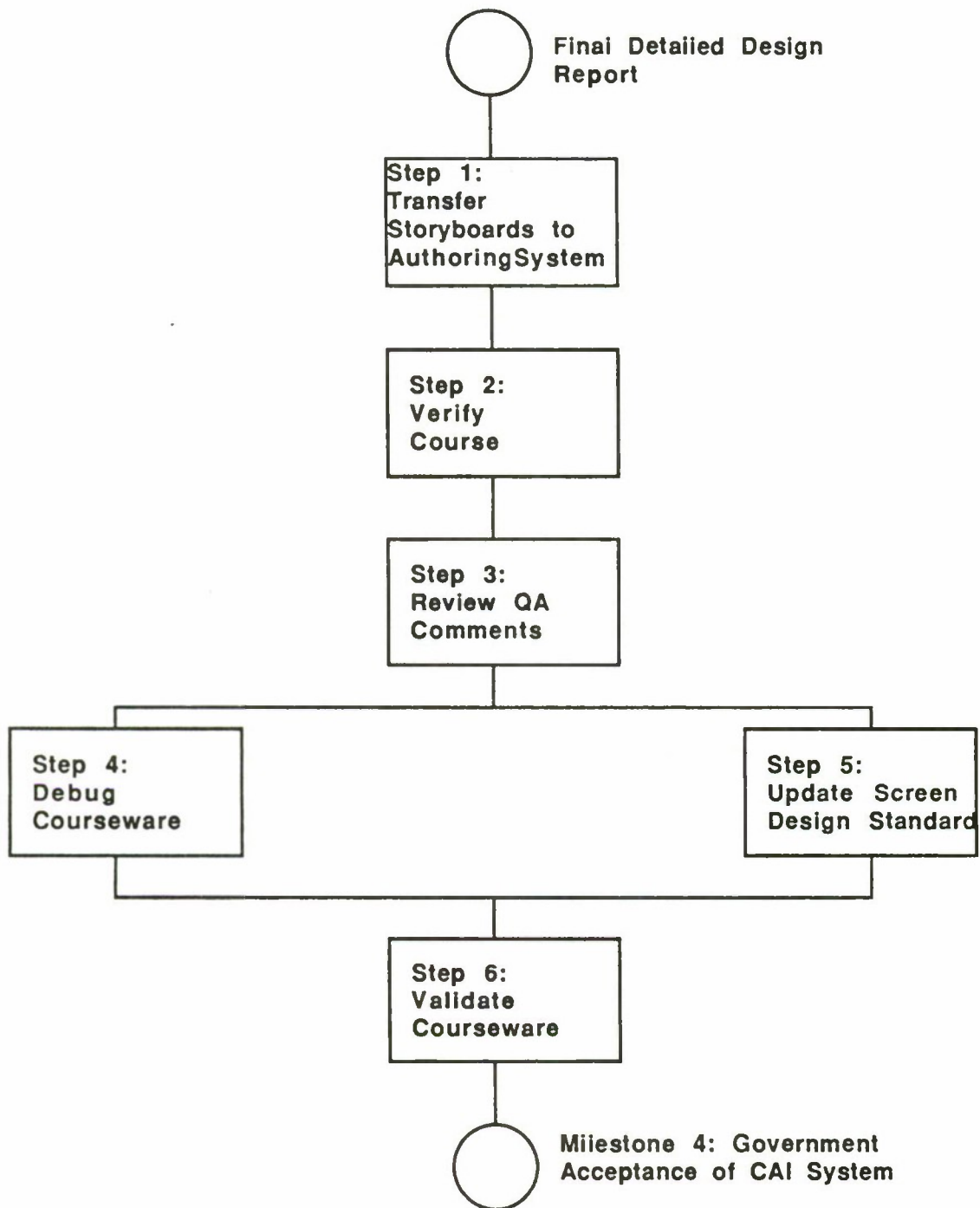


Figure 6-1. Phase IV: Transfer and Validation.

The graphics library you began building in Step 1 of Phase III should prove useful now, as you will probably be able to insert and recycle many graphics. You may need to make minor fine-tuning adjustments to the on-line text and graphics to correct spacing or other unforeseen problems.

No changes in course content should be made after Government approval of the Final Detailed Design Report, Milestone 4 in Phase III. If changes other than spatial or color adjustments are deemed necessary, those changes should first be approved by the office that approved the FDDR. After the proposed changes have been approved, all changes should be documented on a copy of the FDDR for future reference. Because this introduces so much more opportunity for inconsistency and other courseware bugs, changes to the FDDR should be avoided.

6.2 Step 2: Verify Courseware

The purpose of this step is basic quality assurance (QA), to catch and correct any typographical errors, missing elements, or improper branching before the learner discovers them. Since this prototype methodology provides opportunities for building in high quality all through the development process, Step 2 should simply be a final verification of the on-line courseware against the storyboards set forth in the Final Detailed Design Report.

As discussed in DOD-STD-2167, software quality evaluation is an ongoing process. The contractor is required to maintain records of and report each quality evaluation that is performed. The contractor must also be able to provide evidence indicating that the products meet all contractual requirements. Most importantly, these activities "shall be performed by individuals who have sufficient responsibility, authority, resources, and independence to accomplish objective evaluation of the products and activities being reviewed. The degree of independence varies with such factors as project complexity and criticality," (Section 5.8.3).

Your product may not warrant a high degree of independence in its quality evaluators. But it is important to have at least one objective person, a quality assurance tester, review the courseware at this point. The QA tester should (1) be recruited from outside your immediate group or office; (2) have a sharp eye for detail, including spelling; and (3) be painstakingly conscientious. Most competent technical proofreaders and editors meet the second and third requirements.

The QA tester checks each unit as the task manager completes his or her review of each. Ideally, at least two testers would work through each unit.

6.3 Step 3: Review QA Comments

The QA tester should have flagged any discrepancies between the directions, text, and graphics set forth in the storyboards and those that appear in the on-line courseware. Particularly important are those that create problems for the learner. Significant problems arise from incorrect branching directions and missing information, so these must be given top priority in Step 4 of this phase.

The bulk of project resources will have been expended prior to Phase IV. Consequently, you, as the task manager, have to weigh the must-change problems (such as incorrect branching or missing screens) against the nice-to-change problems noted by the QA tester.

6.4 Step 4: Debug Courseware

Correcting problems, or "debugging the program," is a normal part of every software development task. CAI is no exception. Corrections will probably also need to be made in the course guide, the instructor's manual, and any other ancillary materials so that information is consistent across media.

To begin this step, you will have determined which changes the project resources can support. One of the highest drivers in minimizing changes at this late date will probably be time. Given how long it takes to develop CAI, your intended user will not appreciate your lengthening the development schedule to make unnecessary tweaks.

Once you have identified which of the problems will be fixed, your authoring system programmer can go ahead and make those changes. To help maintain consistency, all changes should be documented on a copy of the Final Detailed Design Report storyboards. This record of changes is critical for later verifying that the problems have been corrected.

6.5 Step 5: Update Screen Design Standards

This step is more of an investment in your future CAI projects than in the one you are completing. It will be helpful to update the screen design standards at this point to reflect changes that were made in either (1) transferring the storyboards to the authoring system or (2) responding to the QA tester's comments.

No doubt you will tailor the screen design standards to meet the needs of your next project. But starting with a set that accurately reflects the final

product of *this* project will help speed up the next project's design process. This step can be completed by the technical editor while the authoring system programmer is debugging the courseware.

6.6 Step 6: Validate Courseware

Validating any instructional program means answering the question, "Does this instructional program enable learners to meet its stated objectives?" After working with an in-flight refueling instrumentation panel simulator, can a pilot properly operate the actual panel in flight? After attending a structured demonstration on how to repair a radar component, can a maintenance technician properly repair the component?

Having expended quite a few resources to develop your CAI program, you probably have a significant investment in determining whether or not it functions as intended. Since instructor/learner receptivity as well as future resource allocations may depend on the demonstrated effectiveness of this CAI program, it is definitely worth your while to validate the courseware before distributing it for implementation.

Section F, "Conducting a Validation of the Instructional System," AFP 50-58, Volume IV, describes the purpose of a small-group tryout, how to select a representative sample, and how to analyze the results for validation purposes. Whether you will conduct a small-group tryout or a series of individual tryouts depends on how the courseware will be used. If the courseware is a small-group problem-solving exercise meant to enhance an existing lecture-based course, you should conduct the validation in a small-group setting. If it is a stand-alone package that you will be sending to geographically dispersed users, a series of individual tryouts would be more appropriate.

The key to instructional program validation is the validity of the instrument you use. This brings up test-item validity and reliability, detailed discussions of which are well beyond the scope of this document. Note, though, that if a test item is not measuring the stated objective, learners will not be tested on what they have actually gained from the courseware. As a result, the courseware may appear to be invalid, but the validation instrument is actually at fault.

Before administering the courseware to a group or individual for validation purposes, make sure that your test items work as intended. Constructing a fairly large item pool to start with in ISD Step 3.3 (so you will have several to choose from and refine) and then conducting item analyses on the survey tests you administered in ISD Step 3.4 are among the activities that will help you improve item validity.

Consult the test and measurement texts listed at the end of this section for a better understanding of validation. Section 4-5 of AFP 50-58, Volume III, also discusses test validity.

Remember throughout the validation process that it is the *courseware* that is being validated, not the learner. Participants of small-group and individual tryouts are usually much more relaxed and responsive when that fact is made clear to them.

6.7 Milestone 4: Government Acceptance

Phase IV is completed upon Government acceptance of the courseware and its ancillary materials, which marks Milestone 4. The acceptance criterion stated in Section 4.2.3 of MIL-T-29053B(TD) requires that at least 85 percent of the learners shall, on their first attempt, meet the standards established for each objective. Section 6-31, AFP 50-58, Volume IV, suggests that you continue the cycle of teaching, testing, analyzing, and modifying "until it is proven that the students can perform to the level specified in the objectives and tests." Depletion of project resources might dictate an earlier cut-off point.

You will probably want to base acceptance criteria on the characteristics of the topic and learners at hand. If the topic is extremely complex and learners need only have a limited degree of familiarity with it, perhaps a 50 percent level would be sufficient. If the topic is fundamental to a specialty code's primary skill set, you might set the acceptance criterion at 100 percent.

Section 6

References

- Air Force Manual 50-2, Instructional System Development, 31 July 1975.
- Air Force Pamphlet 50-58, Handbook for Designers of Instructional Systems, Volumes I-VI, 15 July 1978.
- DOD-STD-2167, Defense System Software Development, June 1985.
- MIL-T-29053B(TD), Military specification requirements for training system development. June 1981.
- Smith, Sid and Mosier, Jane. Design Guidelines for User-System Interface Software. ESD-TR-84-190, September 1984.

Recommended Readings

- Air Force Manual 50-62, Principles and Techniques of Instruction, 1 April 1974.
- Devereux, Brian. Why didn't you tell me before? CBT the first time around. Data Training, March 1986, pp. 58-61
- Dick, Walter and Cary, Lou. The systematic design of instruction, 2nd ed. Glenview, IL: Scott, Foresman, 1985.
- O'Neil, Harold F., Jr. Issues in instructional systems development. New York: Academic Press, 1979.
- Stanley, Julian C. and Hopkins, Kenneth D. Educational and Psychological Measurement and Evaluation. Englewood Cliffs, NJ: Prentice-Hall, latest edition.
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- Yordy, Laura. How do you know if it's done? Guidelines for reviewing CBT courses. Data Training, August 1986, pp. 34-35.

Section 7.0

Phase V: Implementation and Evaluation

After passing Milestone 4, Government Acceptance of the CAI System, you are ready to implement and evaluate the courseware and its ancillary materials. Phase V is comprised of three steps, as shown in Figure 7-1.

If the developing agency is not the using agency, uncertainty may arise as to who will be responsible for executing these steps. As noted in Section 3.8 of this handbook, transitioning technology is often the weakest link in the life-cycle chain. However, if the agency that will assume responsibility for implementation and maintenance was identified in the CAI Support Plan (Section 3.8), the transition from Phase IV to Phase V should be smooth.

7.1 Step 1: Distribute Courseware

If the CAI system is to be incorporated in an existing course, distribution involves revising the syllabus to reflect the new instructional activity. If the CAI system is to be distributed in a stand-alone format to geographically dispersed learners, the logistics become more complicated. Your distribution procedures will be dictated by your situation, but be sure to record the name, office, telephone, and address of each recipient. This will facilitate future communications, especially for course update purposes.

The critical factors for either of the above scenarios involve the orientation of instructors and learners. Sections 6-9 through 6-16, AFP 50-58, Volume IV, provide guidance on preparing the instructor to implement the system. Section 6-16 lists information that is particularly useful in the instructor's manual, which you probably included in Phases II and III.

Take time to review the manual with the instructor as part of your distribution efforts. If the CAI system is a stand-alone package, the cover letter should include a point of contact for learners who may have suggestions or problems.

7.2 Step 2: Conduct Evaluation

Section 6-3d, AFM 50-2, outlines the rationale for conducting field evaluations and interpretation of results: "Properly conducted evaluation

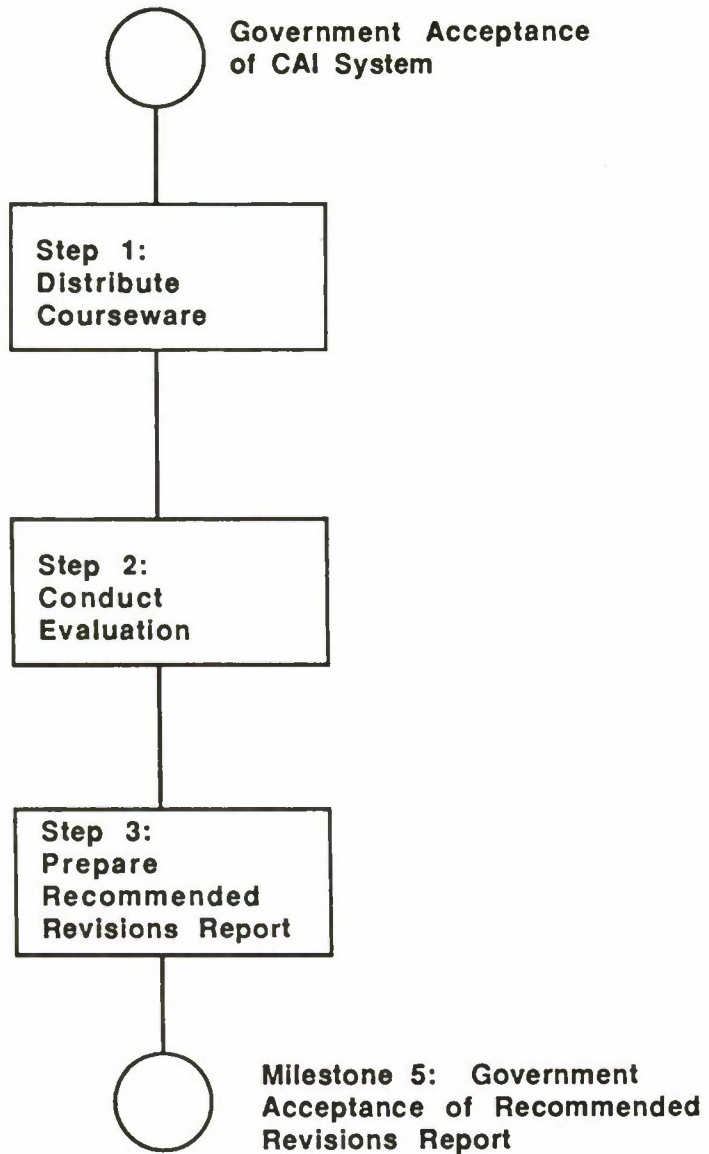


Figure 7-1. Phase V: Implementation and Evaluation.

assures a steady flow of pertinent and timely information for use in maintaining the quality and cost-effectiveness of an instructional system," (p. 6-7).

Section 6-32, AFP 50-58, Volume IV, offers high-level guidance on conducting an operational tryout and implementation. Section 6-32 of that document points out that validation occurred in a vacuum: "Instructional materials must be evaluated as an integral part of the total system. Until now, individual and small-group tryouts validated instruction in an isolated environment," (p. 6-23).

Many of the review issues you addressed for CAI system validation (Step 6 of Phase IV), should be raised again at this point. The main difference to keep in mind is that learners are participating in the course primarily to acquire job-related skills and knowledges. Meeting your evaluation requirements is a secondary consideration for instructors and learners.

7.3 Step 3: Prepare Recommended Revisions Report

The Recommended Revisions Report constitutes the final product of your CAI procurement effort. At a minimum, the report should include:

- Executive overview
- Brief course description
- Specific strengths
- Specific weaknesses
- Learners' overall rating
- Instructors' overall rating
- Evaluators' overall rating
- Recommended revisions (prioritized)
- Summary

As you write this report, remember that it will also provide input for the first product of any future courseware revision. To facilitate that effort as well as make this report as effective as possible, explain terms and acronyms fully. Also, use graphics and give examples of specific strengths and weaknesses.

7.4 Milestone 5: Government Acceptance of Recommended Revisions Report

Government acceptance of the Recommended Revisions Report marks completion of your CAI system design, development, and implementation effort. It would be helpful to debrief development team members and other participants for ideas on how to improve your collective performance next time.

Section 7

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- Zemke, Ron. The systems approach is a nice theory, but . . . Training, October 1985, pp. 103-108.

Appendix C

Periodicals

Computers & Education

Pergamon Press
Maxwell House
Fairview Park
Elmsford, NJ 10523

Data Training

38 Chauncy Street
Boston, MA 02111 (Data Training also sponsors conferences)

Educational Technology

720 Palisade Avenue
Englewood Cliffs, NJ 07632

Electronic Learning

902 Sylvan Avenue
Englewood Cliffs, NJ 07632

Government Computer News

1620 Elton Road
Silver Spring, MD 20903 (Free)

MASS High Tech Subscriptions

755 Mt. Auburn Street
Watertown, MA 02172 (Free)

T.H.E. Journal (Technological Horizons in Education)

Circulation Department
PO Box 15126
Santa Ana, CA 92705-0126 (Free)

Training

731 Hennepin Avenue
Minneapolis, MN 55403

Training News

38 Chauncy Street
Boston, MA 02111

Training & Development Journal

American Society for Training and Development (ASTD)
600 Maryland Avenue, SW
Suite 305
Washington, DC 20024

Training Technology Journal

National Security Industrial Association (NSIA)
1015 15th Street NW, Suite 901
Washington, DC 20005

Appendix D

Organizations and Conferences

Association for Computing Machinery
Special Interest Group on Computer Uses in Education (ACM/SIGCUE),
Special Interest Group on Computer-Human Interaction (ACM/SIGCHI)

ACM
11 West 42nd Steet
New York, NY 10036

Both sponsor sessions at annual ACM conferences and publish the *SIGCUE Bulletin* and the *SIGCHI Bulletin*.

Greater Boston SIGCHI information:

Membership:
Mike Dean
BBN Labs
10 Moulton Street
Cambridge, MA 02238

Newsletter:
Dr. Linda M. Evers, 3E-281
Dynamics Research Corporation
60 Frontage Road
Andover, MA 01810

Association for the Development of Computer-Based Instructional Systems (ADCIS)

Gordon Hayes, Executive Secretary
158 Bond Hall
Western Washington University
Bellingham, WA 98225
(206) 767-2860

ADCIS meets annually, has a special interst group in CAI, and publishes a newsletter and the *Journal of Computer-Based Instruction*.

Association for Educational Communications and Technology (AECT)

1126 16th Street, NW
Washington, DC 20036
(202) 466-4780

AECT meets annually and publishes *Educational Communications Technology Journal*, *Journal of Instructional Development*, and *Instructional Innovator*.

Appendix D

Organizations and Conferences (cont.)

Association for Educational Data Systems (AEDS)

1201 6th Street, NW
Washington, DC 20036

AEDS meets annually and publishes the *AEDS Monitor* and *AEDS Journal*.

National Society for Performance and Instruction (NSPI)

1126 16th Street, NW
Suite 315
Washington, DC 20036
(202) 861-0777

NSPI meets annually and publishes the *Performance & Instruction Journal*.

Society of Applied Learning Technology (SALT)

50 Culpeper Street
Warrenton, VA 22186
(703) 347-0055

SALT holds numerous conferences and workshops on CAI-related topics and sponsors the *Journal of Educational Technology Systems*.

Technology in Training & Education (TITE)

Annual conference co-sponsored by Air University, the USAF Academy, and Air Training Command
March 16-20, 1987
Colorado Springs, CO 80840-5751

Lt Col Thomas S. Allman
HQ AU/XPZ
Maxwell AFB, AL 36112
(205) 293-6160 AV 875-6160

Lt Col Robert L. James
USAF Academy/DFSR
Colorado Springs, CO 80840-5751
(303) 472-4195 AV 259-4195

Appendix E

Sample Storyboard Templates

Appendix E contains storyboard templates used in developing "About AISIM," a 16-hour, stand-alone, self-paced CAI system that presently runs on an IBM-PC. Although an off-the-shelf authoring system was used, these templates were designed to meet the informational requirements of any typical authoring system. They may, therefore, be considered generic.

This set was used in preparing the "About AISIM" Final Detailed Design Report, but it would have been helpful to use it for the Draft Detailed Design Report as well. Instead, a simplified version was used for the "About AISIM" DDDR. This set was included as part of the FDDR deliverable as a key to the screens in the report.

Screen Key *

- Ⓐ All Screens
- ① Screen # = Screen ID
- ② Section = Default = 1; most authoring systems can segment lessons for item reporting
- ③ Graphics = Y (yes) or N (no); Y means bit-mapped file associated with screen
- ④ Screen Type =
 - 1 = Presentation
 - 2 = Multiple Choice
 - 3 = Matching
- ⑤ Comments = Specific information for the screen
- ⑥ Border Color = 1-8; see list of colors below. They are painted in margins.
- ⑦ Speed = Default = 3; advance display screen by full pages of text.
- ⑧ Format =
 - 1 Full page
 - 2 Top half
 - 3 Bottom half
 - 4 Right half
 - 5 Left half
- ⑨ Columns = Default =2; 80 columns, color presentation
- ⑩ Auto Advance = Y (yes) or N (no); Y advances to next frame after "Delay"; N advances frames only after student response
- ⑪ Delay = Number of seconds "Delay" before Auto Advance
- ⑫ Colors = Foreground = 1-16; see list below
- ⑬ Background 1-8; see list below

Colors:

1 = Black	7 = Brown	13 = Light red
2 = Blue	8 = Light gray	14 = Light magenta
3 = Green	9 = Dark gray	15 = Yellow
4 = Cyan	10 = Light blue	16 = White
5 = Red	11 = Light green	
6 = Magenta	12 = Light cyan	

* This key is intended to be generic and represents what most authoring systems will do.

Presentation Screen

(A)

Unit name: *
Section: *

Unit No.: *

Screen #: * (1)
Section: 1 (2)
Graphics: N (3)
Screen Type: 1 (4)

Border color: * (6)
Speed: 3 (7)
Format: 1 (8)
Columns: 2 (9)
Auto Advance: N (10)
Delay: 0 (11)

Comments: * (5)

0 1 2 3 4 5 6 7 8

<space> = continue s = stop

Foreground Color: 8 (12)

Background Color: 1 (13)

Next Screen #: *

ⓑ Presentation Screen - Unique Parameters

① Next Screen # = Indicates which destination the screen must branch to

Presentation Screen

(B)

Unit name: *
Section: *

Unit No.: *

Screen #: *
Section: 1
Graphics: N
Screen Type: 1

Border color: *
Speed: 3
Format: 1
Columns: 2
Auto Advance: N
Delay: 0

Comments: *

0 1 2 3 4 5 6 7 8

<space> = continue s = stop

Foreground Color: 8

Background Color: 1

Next Screen #: * ①

① Multiple-Choice Screen

- ① Reporting = Y (yes) or N (no); Y means record student responses on lesson diskette
- ② Number of Answers (2-6) = Number of answer alternatives
- ③ Correct Answer (A-F,0) = Anticipated "Correct" alternative or Null (0)
- ④ Go to A - F = The branching destination for each alternative

C

Multiple Choice Screen

Unit name: *
 Section: *

Unit No.: *

Screen #: *
 Section: 1
 Graphics: N
 Screen Type: 2
 Reporting: Y (1)

Border color: *
 Speed: 3
 Format: 1
 Columns: 2
 Auto Advance: N
 Delay: 0

Comments: *

0 1 2 3 4 5 6 7 8

Enter your choice (A-F) _____
 <space> = continue s = stop

Foreground Color: 8

Background Color: 1

Number of Answers (2-6): * (2)

Go to: A: * (4)

Correct Answer (A-F,0): * (3)

B:

C:

D:

E:

F:

Ⓓ Matching Screens

- ① Reporting = Y (yes) or N (no); Y means include student responses on lesson diskette
- ② Number of Correct Matches (2-6) = Number of answers
- ③ Correct Answer (A-F,0) = Anticipated correct sequence; e.g., 1=A, 2=C, 3=D expressed as "A,C,D"
- ④ Go to = Destination screen for correct answer
- ⑤ Alternative Combinations = Other anticipated sequences (not used)
- ⑥ Go to for "Alternative Combinations" = Destination screen for other anticipated sequences (not used)
- ⑦ Otherwise (Incorrect Sequences) = Default = all possible sequences not already specified in branching
- ⑧ Go to for Otherwise = Destination screen for possible sequences not already specified in branching

(D)

Matching Screen

Unit name: *
Section: *

Unit No.: *

Screen #: *
Section: 1
Graphics: N
Screen Type: 3
Reporting: Y (1)

Border color: *
Speed: 3
Format: 1
Columns: 2
Auto Advance: N
Delay: 0

Comments: *

0 1 2 3 4 5 6 7 8

Enter your answer

1 _ 2 _ 3 _ 4 _ 5 _ 6 _

Are answers OK? (y/n)

<space> = continue s = stop

Foreground Color: 8

Background Color: 1

Number of Correct Matches (2-6): * (2)

Branches

Correct Answer (A-F,0): * (3)

Go to: * (4)

Alternative Combinations: NA (5)

Go to: NA (6)

Otherwise (Incorrect Sequences): * (7)

Go to: * (8)

Appendix F

Sample Screen Design Standards

Appendix F contains the screen design standards developed for "About AISIM," a 16-hour, stand-alone, self-paced CAI system that presently runs on an IBM-PC. Appendix E contains detailed information on what each element of the screen template means.

The structure of this document is based on the skeleton of each unit (Section 1) and increasing levels of detail (Sections 2 and 3). Section 1's primary audience is the typists who will input text into word-processing files or into the authoring system's word processor. (To be efficient, the typists need quick access to explicit directions.) Section 2 is provided for the courseware developers' reference in Phases II through IV as well as for the quality assurance tester's and the authoring-system programmer's use in Phase IV. Section 3 supports activities of the courseware developers, technical editors, and reviewers in Phases II through IV.

"About AISIM"
Screen Design Standards

For more information contact:

Maida Eisenberg

x1259

or

Linda Evers

x1257

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Section 1

Basic Screen Types and Standard Screens

This section contains the three basic types of screens used in the course. It also includes samples of screens that should appear in Units 2-14.

1.1 Basic Screen Types

All story boards are either "presentation" or "interactive" screens. Each type of screen is described below and accompanied by a sample.

1.1.1 Presentation Screens

Use a presentation screen when the user does not need to make any responses. Limit text on a presentation screen to a maximum of 24 lines. Below is a sample presentation screen. Use the margin conventions indicated on the sample. Include a header in the upper right-hand corner on most presentation screens to tell the user what section of the unit he or she is in. Omit headers on screens that are section title or additional documentation screens.

PNBBOX

Presentation Screen-No-Box

Unit name: _____ Unit No.: _____
 Section: _____

Screen #: _____ Border color: _____
 Section: _____ Speed: _____
 Graphics: _____ Format: _____
 Screen Type: _____ Columns: _____
 Auto Advance: _____
 Delay: _____

Comments:

0 2 3 4 5 6 7 8

Applying the Concepts

(2) →

(10) ↓

Second, you specify the entity's parameter values with that form.

Unlike the Process Editor Interface, the DUI does not produce flowcharts or plots.

Statistics on entity behavior are presented in AISIM's output listing. Unit 14, "Obtaining AISIM Output," addresses this in detail.

(70) ↓

Step 1:
Create and Name Entity

Step 2:
Specify Entity Parameter Values

(79) ←

(22) →

<space> = continue s = stop

Foreground Color: _____ Background Color: _____
 Next Screen #: _____

- Margins
 - top - Line 2
 - bottom - Line 22
 - left - Space 10
 - right - Space 70
 - header - right justify to Space 79

1.1.2 Interactive Screens

Interactive screens include multiple-choice and matching screens. Use interactive screens for all screens where the user must answer a question or make a decision. This includes matching question, multiple-choice question, unit menu, and exit screens. Limit interactive screens to 20 lines of text. Use headers for multiple-choice and matching question screens. Omit headers for unit menu or exit screens. Sample multiple-choice and matching screens with the margins indicated on the graphic follow.

Multiple-choice

12.125

Multiple Choice Screen

Unit name: Running the Simulation with the AUI Unit No.: 12
Section: Self-Test

Screen #: 125 Border color: 8
Section: 1 Speed: 3
Graphics: N Format: 1
Screen Type: 2 Columns: 2
Reporting: Y Auto Advance: N
Delay: 0

Comments:

0 1 2 3 4 5 6 7 8

(2)

1) In the COMMSYS model, once the plots have been defined, they are viewed in which phase of the AUI?

- A. Pre-run
- B. Mid-run
- C. Post-run
- D. Mid- and Post-run

Self-Test

(11)

(20)

Enter your choice (A-D) _____
<space> = continue s = stop

Foreground Color: 8	Background Color: 1
Number of Answers (2-6): 4	Go to: A: 127
Correct Answer (A-F,0): C	B: 127
	C: 126
	D: 127
	E:
	F:

- Margins

- top - Line 2

- bottom - Line 20

- left - Space 10

- right - Space 39

- header - right justify to Space 79

Matching Screens

MA # 2.68

Matching Screen

Unit name: User Interfaces: The Framework of AISIM Unit No.: 2
 Section: Self-Test

Screen #: 68 Border color: 8
 Section: 1 Speed: 3
 Graphics: N Format: 1
 Screen Type: 3 Columns: 2
 Reporting: Y Auto Advance: N
Delay: 0

Comments:

0 1 2 3 4 5 6 7 8

Self-Test

(2) → Match the interface with its function:

1. ___ Run the simulation	A. Hardcopy (HUI)
2. ___ Document the model Processes	B. Replot (RUI)
3. ___ Design and construct the model	C. Library (LUI)
4. ___ Save models and submodels for subsequent runs	D. Design (DUI)
5. ___ View plots from different model runs	E. Analysis (AUI)

(20) →

Enter your answer
 1_ 2_ 3_ 4_ 5_
 Are answers OK? (y/n)
 <space> = continue s = stop

Foreground Color: 8	Background Color: 1
Number of Correct Matches (2-5): 1	Branches
Correct Answer (A-E,1): E,A,D,C,B	Correct: Go to: 69
Alternative Combinations: NA	Go to: NA
Otherwise (Incorrect Sequences): *	Incorrect: Go to: 70

- Margins

- top - Line 2

- bottom - Line 20

- left - Space 10

- right - Space 70

- header - right justify to Space 79

- other margins - see diagram of screen above

1.2 Standard Screens

Units 2-14 contain a number of standard screens. In addition, Units 4-14 contain standard screens related to the COMMSYS example. The table below lists these standard screens, and indicates whether they are presentation (P), multiple-choice (MC), or matching (MA) screens). The following pages contain samples of each screen and list the standards that apply to it.

<u>Standard Screen</u>	<u>Screen Type</u>
Title (Screen 1)	P
Title (Screen 2)	P
Overview	P
Unit Menu	MC
Conceptual Overview (Screen 1)	P
Conceptual Overview (Screen 2)	P
Applying the Concepts (Screen 1)	P
Applying the Concepts (Screen 2)	P
The COMMSYS Example (Screen 1)	P
The COMMSYS Example (Screen 2)	P
Unit Summary (Screen 1)	P
Unit Summary (Screen 2)	P
Additional Documentation	P
Self-test (Screen 1)	P
Self-test (Screen 2)	P
Closure	P
Exit	MC
Multiple-choice Question	MC
Multiple-choice Answer	P
Matching Question	MA
Matching Answer	P

1.2.1 Title (Screen 1)

PNOBXHB 2.2

Presentation Screen-No-Box-Horizontal-Bottom


Unit name: User Interfaces: The Framework of AISIM Unit No.: 2
Section: Introduction

Screen #: 2 Border color: 2
Section: 1 Speed: 3
Graphics: N Format: 3
Screen Type: 1 Columns: 2
Auto Advance: N
Delay: 0

Comments:

0 1 2 3 4 5 6 7 8

ABOUT



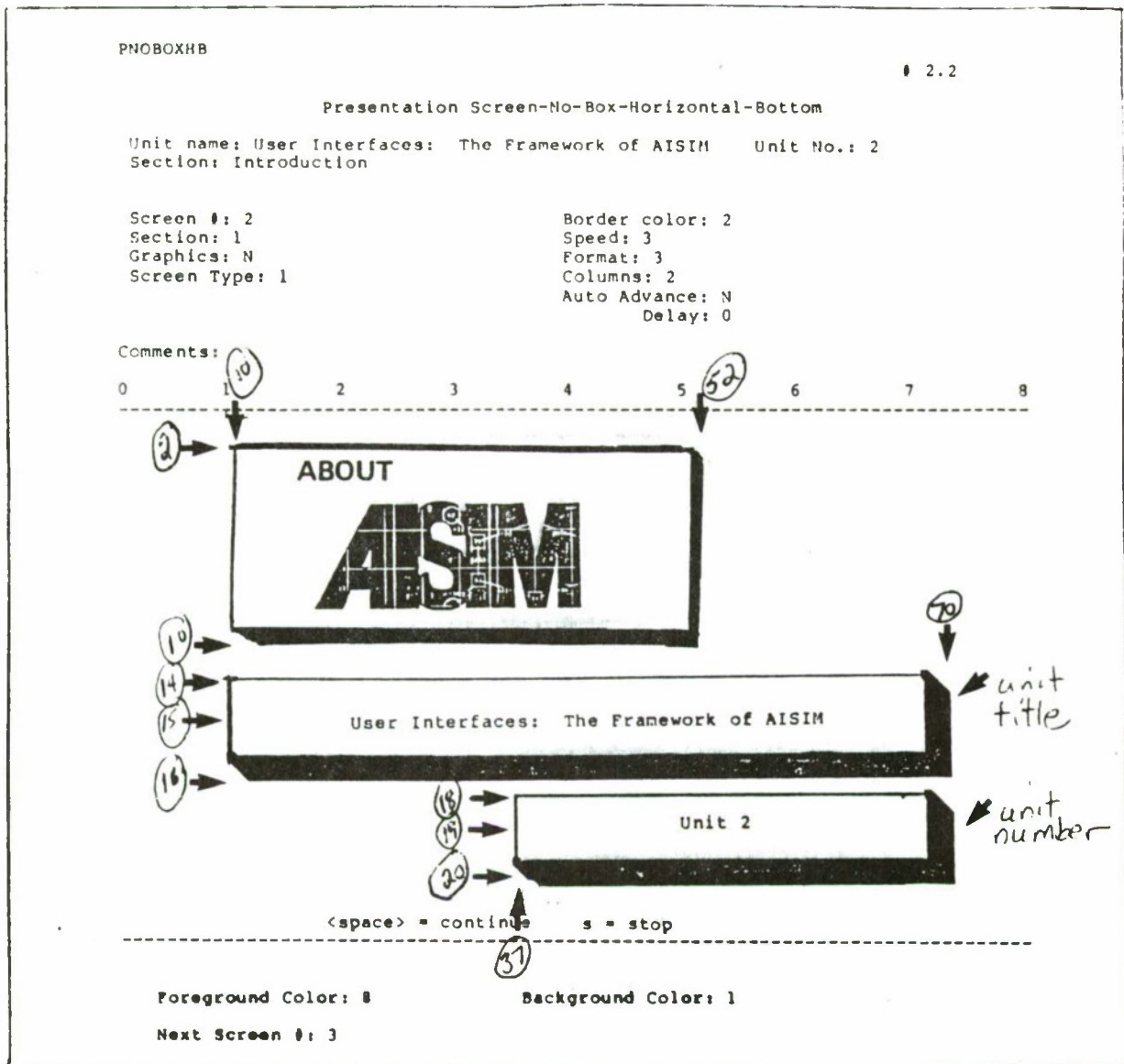
<space> = continue s = stop

Foreground Color: 8 Background Color: 1

Next Screen #: 3

- Included in every unit
- Logo in top half
- Blank bottom half
- No heading in upper right-hand corner of this screen
- Margins
 - top - Line 2
 - bottom - Line 10
 - left - Space 10
 - right - Space 52

1.2.2 Title (Screen 2)



- Included in every unit
- Logo in top half of screen
- No heading in upper right-hand corner of screen
- Type title in first box on bottom half of screen
 - Capitalize initial letters in all except prepositions, conjunctions, and articles
 - Center in box
- Type unit number in second box of bottom half on screen
 - Use number rather than word
 - Capitalize first letter in unit
 - Center in box

- Margins

top - Line 2

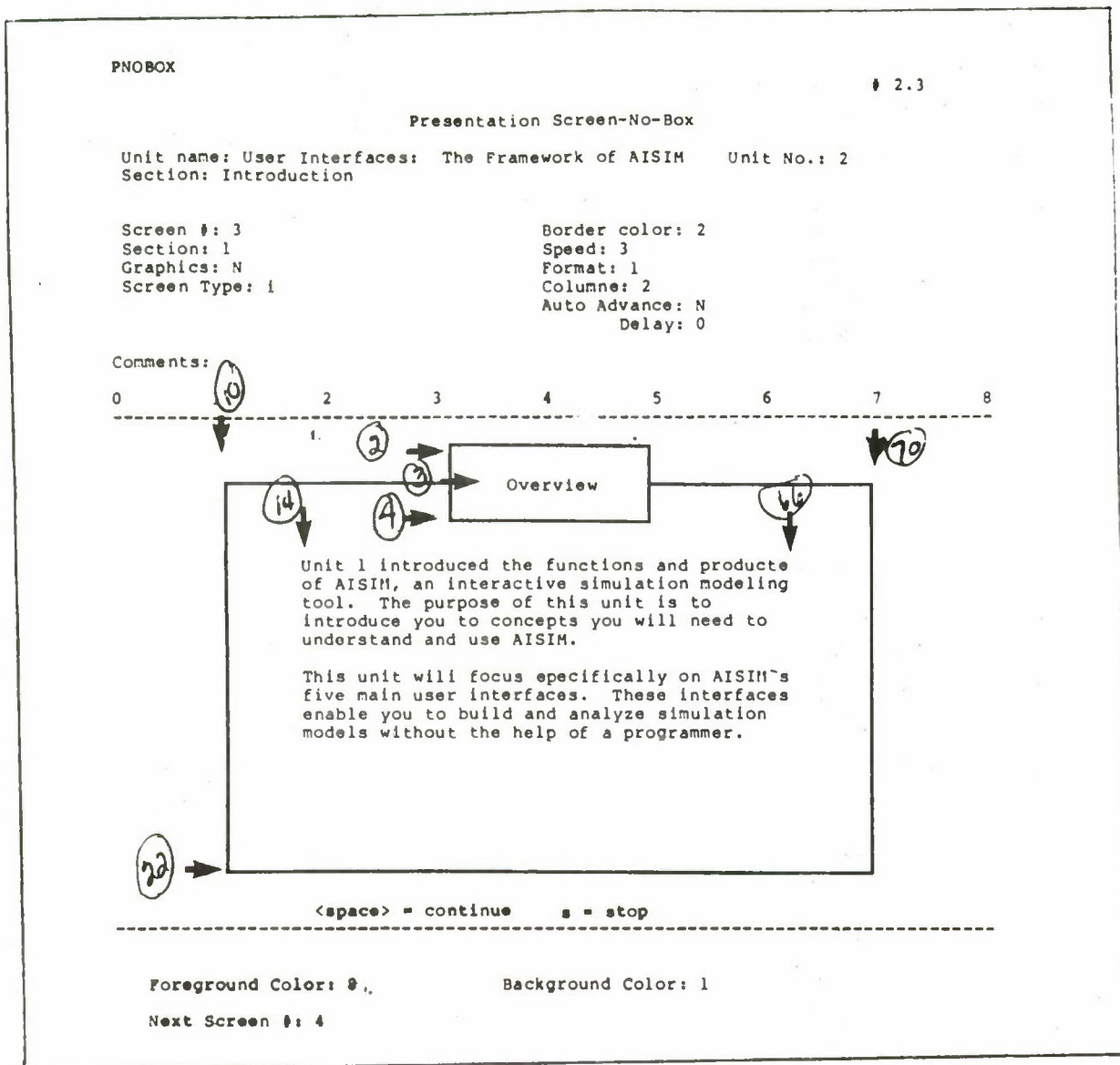
bottom - Line 22

left - Space 10

right - Space 70

other margins - see diagram of screen above

1.2.3 Overview



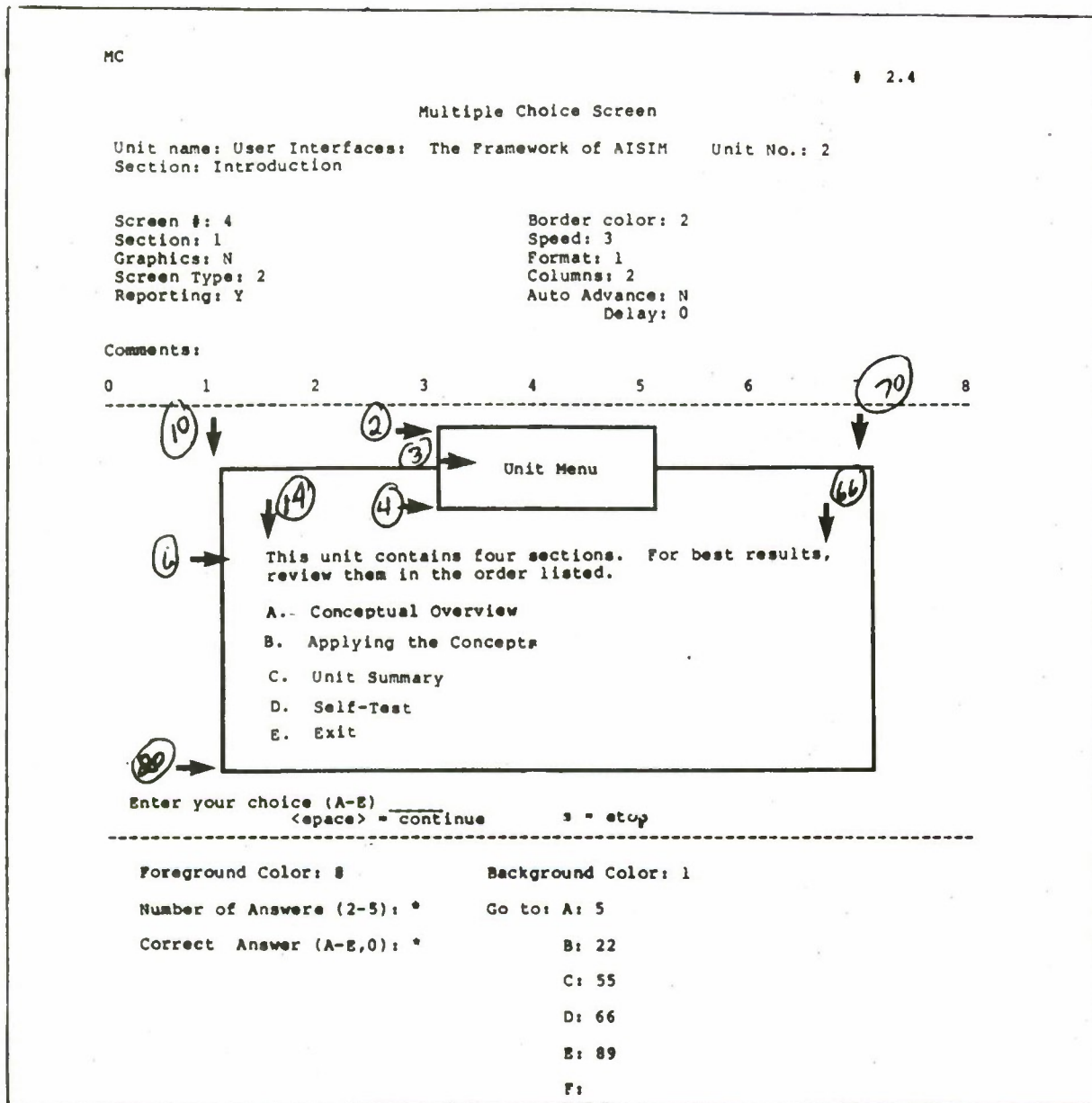
- Included in Units 2-14
 - No heading in upper right-hand corner
 - Most overviews contain the following three elements:
 - purpose of unit
 - what previous units contain
 - how the unit meets the purpose stated
 - Margins
 - top - Line 2
 - bottom - Line 22

left - Space 10

right - Space 70

other margins - see diagram of screen above

1.2.4 Unit Menu



- Included in Units 1-14
- See example for exact wording and format of first paragraph
- Skip a line and type options:
 - introduce each option with a capital letter followed by a period
 - skip a space between each option
 - capitalize initial letter of all words except prepositions and conjunctions
- Margins
 - top - Line 2

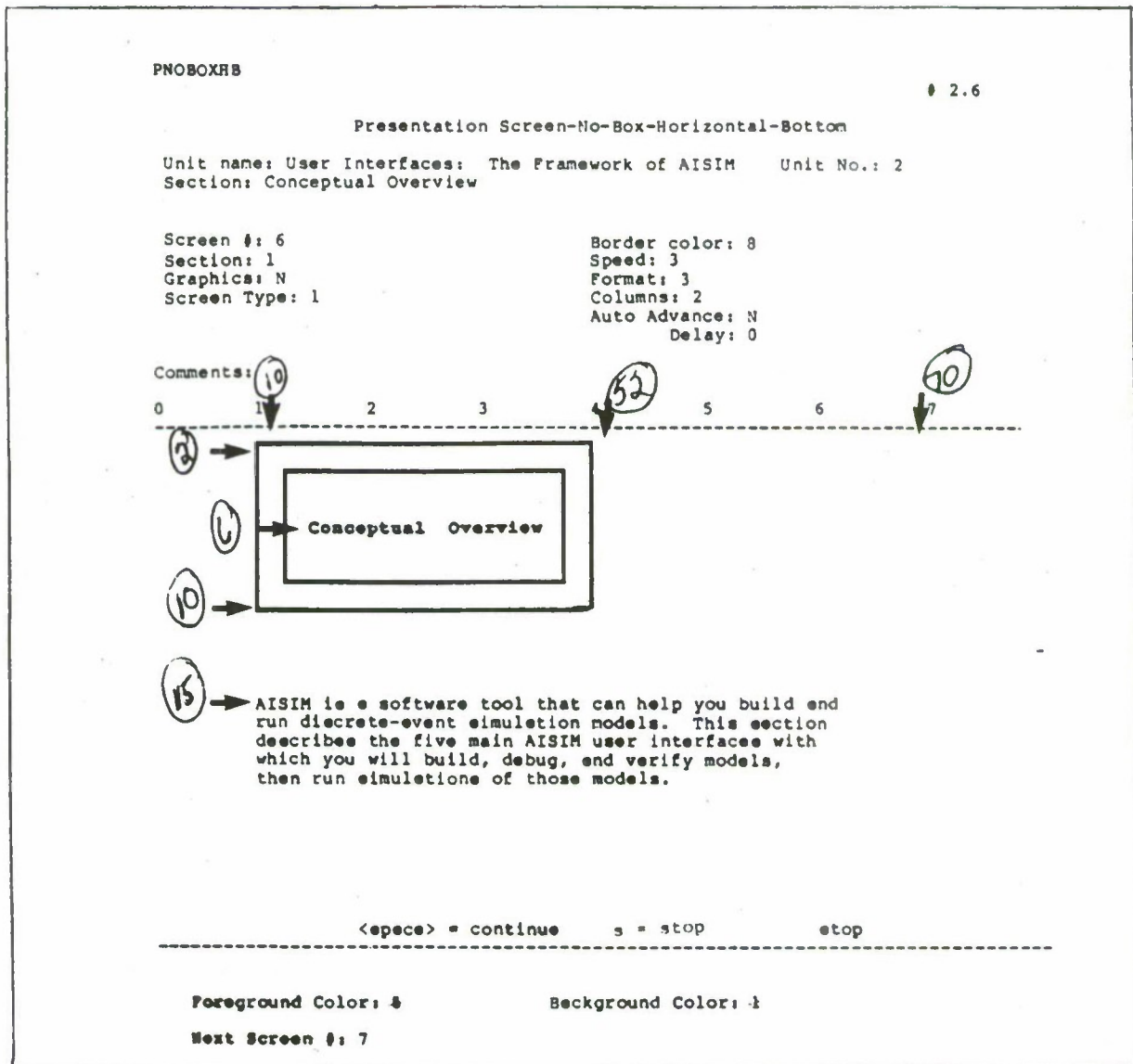
bottom - Line 20

left - Space 10

right - Space 70

other margins - see diagram of screen above

1.2.6 Conceptual Overview (Screen 2)



- Included in Units 2-14
- Follows Conceptual Overview (Screen 1)
- Repeat box and text in top half
- Margins
 - top - Line 2
 - bottom - Line 22
 - left - Space 10
 - right - Space 70
 - other margins - see diagram of screen above

1.2.7 Applying the Concepts (Screen 1)

PNOBOX # 2.22

Presentation Screen-No-Box

Unit name: User Interfaces: The Framework of AISIM Unit No.: 2
 Section: Applying the Concepts

Screen #: 22	Border color: 4
Section: 1	Speed: 3
Graphics: N	Format: 1
Screen Type: 1	Columns: 2
	Auto Advance: Y
	Delay: 0

Comments:

0 1 2 3 4 5 6 7 8

Applying the Concepts

<space> = continue s = stop

Foreground Color: 8 Background Color: 1

Next Screen #: 23

- Included in Units 2-14
- Text in box should contain Applying the Concepts
 - capitalize initial letter in each word
 - see Conceptual Overview for margins

1.2.8 Applying the Concepts (Screen 2)

```

PNOBXHB
# 2.23

Presentation Screen-No-Box-Horizontal-Bottom

Unit name: User Interfaces: The Framework of AISIM   Unit No.: 2
Section: Applying the Concepts

Screen #: 23
Section: 1
Graphics: N
Screen Type: 1

Border color: 4
Speed: 3
Format: 3
Columns: 2
Auto Advance: N
Delay: 0

Comments:
0      1      2      3      4      5      6      7      8
-----

```

Applying the Concepts

```

This section first explores the functions of AISIM's five
major user interfaces, then discusses the relationships
among them.

-----
<space> = continue   . = stop
-----

Foreground Color: 8           Background Color: 1
Next Screen #: 24

```

- Included in Units 2-14
- Follows Applying the Concepts (Screen 1)
- Repeat box from previous screen in top half
- Text in bottom half
- See Conceptual Overview for margins

1.2.9 The COMMSYS Example (Screen 1)

```

      PNOBOX
      # 10.51

      Presentation Screen-No-Box

      Unit name: Defining Entities with the DUI      Unit No.: 10
      Section: The COMMSYS Example

      Screen #: 51      Border color: 2
      Section: 1        Speed: 3
      Graphics: N       Format: 1
      Screen Type: 1    Columns: 2
                      Auto Advance: Y
                      Delay: 0

      Comments:
      0      1      2      3      4      5      6      7      8
      -----

      [ The COMMSYS Example ]

      -----
      <space> = continue  s = stop

      Foreground Color: 8      Background Color: 1
      Next Screen #: 52
  
```

- Appears in Units 4-14
- COMMSYS in all capital letters
- See Conceptual Overview for margins

1.2.10 The COMMSYS Example (Screen 2)

```

PNOBOXHB
# 10.52

Presentation Screen-No-Box-Horizontal-Bottom

Unit name: Defining Entities with the DUI      Unit No.: 10
Section: The COMMSYS Example

Screen #: 52      Border color: 2
Section: 1        Speed: 3
Graphics: N       Format: 3
Screen Type: 1    Columns: 2
                  Auto Advance: N
                  Delay: 0

Comments:
0      1      2      3      4      5      6      7      8
-----



The COMMSYS Example



You created the COMMSYS architecture in Unit 8,
"Defining Architecture with the ADE," and defined
the Processes for that system in Unit 9, "Defining
Processes with the PEI."

The last step in building an AISIM model of COMMSYS
is to define the remaining entities.

This section demonstrates how to apply the Design
User Interface (DUI), which was introduced in Unit 4.

-----
<space> = continu:   s = stop
-----

Foreground Color: 8      Background Color: 1
Next Screen #: 53

```

- Follows COMMSYS (Screen 1)
- Repeat box from previous screen in top half
- Begin text in bottom half on Line 15
- See Conceptual Overview for margins

1.2.11 Unit Summary (Screen 1)

```

PNOBOX
♦ 2.55

Presentation Screen-No-Box

Unit name: User Interfaces: The Framework of AISIM   Unit No.: 2
Section: Unit Summary

Screen #: 55           Border color: 5
Section: 1            Speed: 3
Graphics: N           Format: 1
Screen Type: 1        Columns: 2
                     Auto Advance: Y
                     Delay: 0

Comments:
0      1      2      3      4      5      6      7      8
-----

```

Unit Summary

```

-----
                <space> = continue   s = stop
-----

Foreground Color: 6           Background Color: 1
Next Screen #: 56

```

- Included in Units 2-14
- Repeat box from previous screen in top half
- Capitalize initial letter of each word
- See Conceptual Overview for margins

1.2.12 Unit Summary (Screen 2)

```

PNOBOXHB                                     2.56

      Presentation Screen-No-Box-Horizontal-Bottom

Unit name: User Interfaces: The Framework of AISIM   Unit No.: 2
Section: Unit Summary

Screen #: 56                               Border color: 7
Section: 1                                 Speed: 3
Graphics: N                               Format: 3
Screen Type: 1                             Columns: 2
                                           Auto Advance: N
                                           Delay: 0

Comments:
0      1      2      3      4      5      6      7      8
-----

```

Unit Summary

```

This unit addressed three major points.

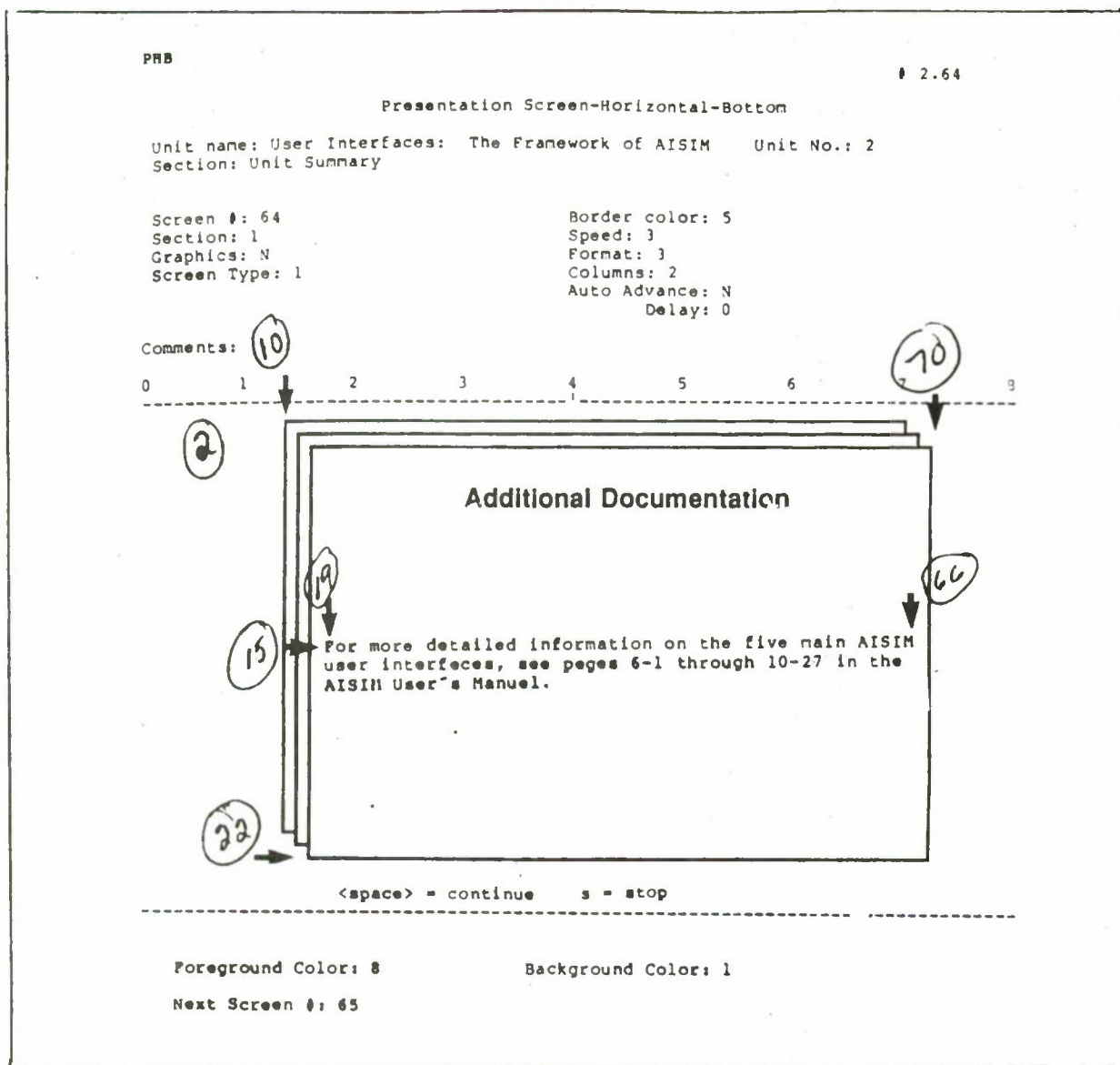
-----
      <space> = continue   s = stop
-----

Foreground Color: 3           Background Color: 1
Next Screen #: 57

```

- Included in Units 2-14
- Follows Unit Summary (Screen 1)
- Standard screen with top half as shown
- Text in bottom half as shown
- See Conceptual Overview for margins

1.2.13 Additional Documentation



- Included in Units 2-14
- Center title in box
- See example above for sample wording
- Cite the references as follows:
 - AISIM User's Manual
 - AISIM Course Guide
- Capitalize initial letter of each word in title
- Margins
 - top - Line 2

bottom - Line 22

left - Space 10

right - Space 70

other margins - see diagram of screen above

1.2.14 Self-Test (Screen 1)

```

PNOBX
# 2.66
Presentation Screen-No-Box
Unit name: User Interfaces: The Framework of AISIM Unit No.: 2
Section: Self-Test

Screen #: 66          Border color: 8
Section: 1           Speed: 3
Graphics: N         Format: 1
Screen Type: 1      Columns: 2
                   Auto Advance: Y
                   Delay: 0

Comments:
0      1      2      3      4      5      6      7      8
-----



Self-Test



-----
<space> = continue  s = stop
-----

Foreground Color: 8          Background Color: 1
Next Screen #: 67

```

- Included in Units 2-14 exactly as shown
- Center, capitalize initial letters, and hyphenate Self-Test within box as shown
- See Conceptual Overview for margins

1.2.15 Self-Test (Screen 2)

```

PNOBXHB
# 2.67

Presentation Screen-No-Box-Horizontal-Bottom

Unit name: User Interfaces: The Framework of AISIM   Unit No.: 2
Section: Self-Test

Screen #: 67
Section: 1
Graphics: N
Screen Type: 1

Border color: 8
Speed: 3
Format: 3
Columns: 2
Auto Advance: N
Delay: 0

Comments:
0      1      2      3      4      5      6      7      8
-----

          Self-Test

The following five questions in this self-test
give you the chance to assess your mastery of AISIM's
user interfaces.

For best results, answer the questions and review the
sections listed on the feedback screens.

-----
          <space> = continue   s = stop
-----

Foreground Color: 8           Background Color: 1
Next Screen #: 68

```

- Included in Units 2-14
- Follows Self-Test (Screen 1)
- Center, capitalize initial letters, and hyphenate Self-Test within box as shown
- Text below box specifies the topic covered in the unit
- See Conceptual Overview for margins

1.2.16 Closure

```

PNOBOX
# 10.50

Presentation Screen-No-Box

Unit name: Defining Entities with the DUI      Unit No.: 10
Section: Applying the Concepts

Screen #: 50      Border color: 4
Section: 1        Speed: 3
Graphics: N       Format: 1
Screen Type: 1    Columns: 2
                  Auto Advance: N
                  Delay: 0

Comments:
0      1      2      3      4      5      6      7      8
-----

Applying the Concepts


This concludes applying the concepts for "Defining
Entities with the DUI." Press the space bar to
return to the unit menu.

-----
<space> = continue      * = stop
-----

Foreground Color: 8      Background Color: 1
Next Screen #: 5

```

- Included in Units 2-14
- End the Conceptual Overview, Applying the Concepts, the COMMSYS Example, the Unit Summary, and the Self-Test with a closure screen
- Top half with box containing the name of the section
- Center text in box on top half
- Bottom half specifies the section name and the unit name. See the sample for exact wording
- See Conceptual Overview for margins

1.2.17 Exit

```

MC
# 2.89

Multiple Choice Screen

Unit name: User Interfaces: The Framework of AISIM   Unit No.: 2
Section: Exit

Screen #: 89           Border color: 5
Section: 1            Speed: 3
Graphics: N           Format: 1
Screen Type: 2        Columns: 2
Reporting: Y          Auto Advance: N
                        Delay: 0

Comments:
0      1      2      3      4      5      6      7      8
-----
Exit

You are now exiting Unit 2, "User Interfaces: The
Framework of AISIM." The next unit is
"Understanding AISIM's Modeling Constructs."

A. Return to this unit's menu
B. Exit from this unit

Enter your choice (A-B) _____
      <space> = continue      s = stop
-----

Foreground Color: 8           Background Color: 1
Number of Answers (2-2): 2     Go to: A: 4
Correct Answer (A-B,0): A,B     B: Out
                                  C:
                                  D:
                                  E:
                                  F:

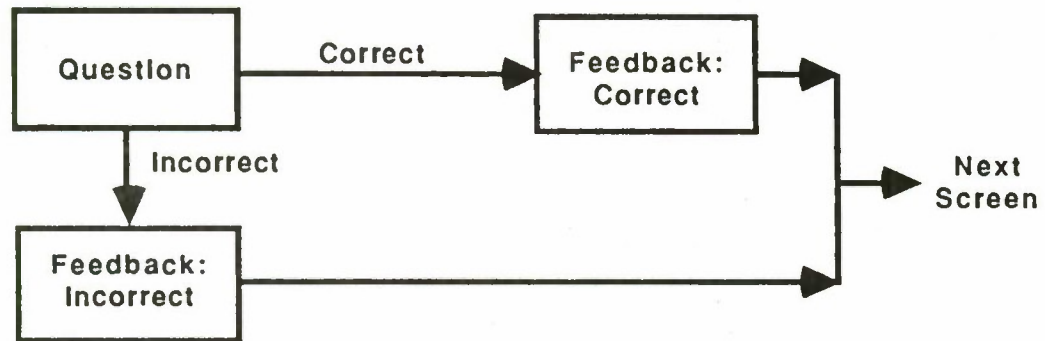
```

- Included in Units 2-14
- Center title in box and capitalize initial letter
- Use the exact text shown in the sample. Specify the unit number, title, and title of the next unit
- See Unit Menu for margins

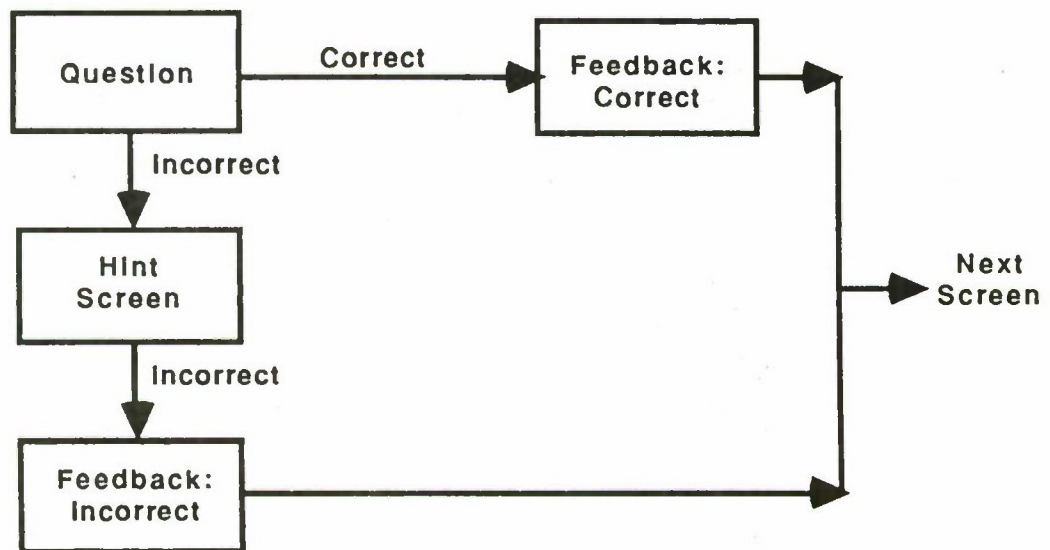
1.2.18 Questions and Answers

Two types of questions appear in this course: interactive and self-test.

Interactive questions occur in the Conceptual Overview, Applying the Concepts, and COMMSYS Example sections. Interactive questions have two answer screens: correct and incorrect. Below is a flow chart of the sequence of interactive question and answer screens:



Self-test questions occur only in the Self-test. They have three answer screens: correct, incorrect with a hint, and incorrect with a suggestion to review the material that the question tests. Following is a flow chart of the sequence of self-test questions and answers:



Both interactive and self-test questions can be either multiple-choice or matching. Following are sample multiple-choice and matching questions and answer formats with the appropriate margins indicated.

Multiple-choice:Question

NIC

0 12.125

Multiple Choice Screen

Unit name: Running the Simulation with the AUI
Section: Self-Test

Unit No.: 12

Screen #: 125
Section: 1
Graphics: N
Screen Type: 2
Reporting: YBorder color: 8
Speed: 3
Format: 1
Columns: 2
Auto Advance: N
Delay: 0

Comments:

0 1 2 3 4 5 6 7 8

----- Self-Test -----

② → 1) In the COMMSYS model, once the plots have been defined, they are viewed in which phase of the AUI?

- A. Pre-run
- B. Mid-run
- C. Post-run
- D. Mid- and Post-run

Enter your choice (A-D) _____
<space> = continue s = stop

Foreground Color: 8

Background Color: 1

Number of Answers (2-6): 4

Go to: A: 127

Correct Answer (A-F,0): C

B: 127

C: 126

D: 127

E:

F:

- Number each question
- Start question at Line 2
- Skip a line after the question
- Identify each option with capital letter followed by a period
- Capitalize initial letter of first word in each choice
- Skip a line between choices
- Margins
 - top - Line 2
 - bottom - Line 20
 - left - Space 10
 - right - Space 39
 - header - right justify to Space 79

Presentation:Answer to Multiple-choice

PVR # 12.126

Presentation Screen-Vertical-Right

Unit name: Running the Simulation with the AUI Unit No.: 12
 Section: Self-Test

Screen #: 126 Border color: 8
 Section: 1 Speed: 3
 Graphics: N Format: 4
 Screen Type: 1 Columns: 2
Auto Advance: N
Delay: 0

Comments: (10) 0 2 3 (39) 4 (47) 5 (59) 6 7 (89)

(2) → 1) In the COMMSYS model, once the plots have been defined, they are viewed in which phase of the AUI? Self-Test

A. Pre-run
 B. Mid-run
 C. Post-run
 D. Mid- and Post-run

Correct

(43) ↓ The answer is C. Although the PLOT command is valid in the mid- and pre-run phases, the COMMSYS model has no logical stopping point.

(70) ↓

<space> = continue S = stop

Foreground Color: 8 Background Color: 1

Next Screen #: 129

- Use Presentation-Vertical-Right screens for answers to multiple-choice questions
- Put questions on the left half of the screen, and answers on the right half
- Put "Incorrect" or "Correct" in center of box . Capitalize initial letter of "Incorrect" or "Correct"
- Skip a line after box
- Do not use quotation marks around the letter of the answer. Skip two spaces and begin explanation of answer. Keep left margin an 43
- Margins

top - see diagram of screen above

bottom - Line 20

left - Space 10

right - Space 70

other margins - see diagram of screen above

Matching:Questions

```

MA
# 2.68

Matching Screen

Unit name: User Interfaces: The Framework of AISIM Unit No.: 2
Section: Self-Test

Screen #: 68          Border color: 8
Section: 1           Speed: 3
Graphics: N          Format: 1
Screen Type: 3       Columns: 2
Reporting: Y         Auto Advance: N
                    Delay: 0

Comments:
0      1      2      3      4      5      6      7      8
-----
                                           Self-Test

Match the interface with its
function:

1. ___ Run the simulation          A. Hardcopy (RUI)
2. ___ Document the model        B. Replot (RUI)
   Processes
3. ___ Design and construct      C. Library (LUI)
   the model
4. ___ Save models and          D. Design (DUI)
   submodels for
   subsequent runs
5. ___ View plots from different E. Analysis (AUI)
   model runs

Enter your answer
1_ 2_ 3_ 4_ 5_
Are answers OK? (y/n)
<space> = continue    s = stop
-----

Foreground Color: 8          Background Color: 1
Number of Correct Matches (2-5): 1          Branches
Correct Answer (A-E,1): E,A,D,C,B          Correct: Go to: 69
Alternative Combinations: NA                Go to: NA
Otherwise (Incorrect Sequences): *          Incorrect: Go to: 70

```

• See multiple-choice question for margins

Presentation:Answers to Matching

P

† 2.69

Presentation Screen

Unit name: User Interfaces: The Framework of AISIM Unit No.: 2
Section: Self-Test

Screen #: 69 Border color: 8
Section: 1 Speed: 3
Graphics: N Format: 1
Screen Type: 1 Columns: 2
Auto Advance: N
Delay: 0

Comments:

0	1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---	---

Self-Test

Match the interface with its function:

1. E Run the simulation	A. Hardcopy (HUI)
2. A Document the model Processes	B. Replot (RUI)
3. D Design and construct the model	C. Library (LUI)
4. C Save models and submodels for subsequent runs	D. Design (DUI)
5. B View plots from different model runs	E. Analysis (AUI)

Correct

The answers are as shown.

<space> = continue s = stop

Foreground Color: 8 Background Color: 1

Next Screen #: 72

- Use Presentation screens for answers to matching questions
- See multiple-choice answer for margins

Section 2

Identification and Transfer Information

This section explains the information listed above and below the screen on each story board. Some of this information identifies the story board itself, including its unit, section, page, etc. The rest provides directions for transferring it onto the authoring system.

2.1 Unit Number

```

PNOBOXHB
                                                    2.2
                Presentation Screen-No-Box-Horizontal-Bottom
Unit name: User Interfaces: The Framework of AISIM   Unit No.: 2
Section: Introduction

Screen #: 2                Border color: 2
Section: 1                 Speed: 3
Graphics: N                Format: 3
Screen Type: 1             Columns: 2
                           Auto Advance: N
                           Delay: 0

Comments:
0       1       2       3       4       5       6       7       8
-----
  ABOUT
  AISIM

  User Interfaces: The Framework of AISIM
  Unit 2

  <space> = continue   s = stop

Foreground Color: 8                Background Color: 1
Next Screen #: 3
  
```

- Appears in the directions above every screen. Also appears on the title screen at the beginning of each unit

2.2 Unit Title

```

PNOBOXHB
2.2

Presentation Screen-No-Box-Horizontal-Bottom

Unit name: User Interfaces: The Framework of AISIM Unit No.: 2
Section: Introduction


Screen #: 2
Section: 1
Graphics: N
Screen Type: 1

Border color: 2
Speed: 3
Format: 3
Columns: 2
Auto Advance: N
Delay: 0

Comments:
0 1 2 3 4 5 6 7 8
-----

```

ABOUT



User Interfaces: The Framework of AISIM

Unit 2

```

-----
<space> = continue s = stop
-----

Foreground Color: 8
Background Color: 1

Next Screen #: 3

```

- Use participial phrase (a verb ending in "ing") whenever possible. For example:
Introducing the AISIM Interfaces
- Keep title exactly the same throughout the unit in top screen directions, Unit Menu, Exit screen, and references to it in other units and the course guide
- Capitalize initial letter in each word except prepositions, conjunctions, and articles. For example:
Introducing the AISIM Interfaces

- Designate unit with a number, not a word. For example:
Unit 2
- Use consistently in top screen directions and all references
- Center in box provided on unit title screen

2.3 Section Name

PHB # 2.14

Presentation Screen-Header-Title

Unit name: User Interfaces: **The Framework of AISIM** Unit No.: 2
 Section: Conceptual Overview

Screen #: 14 Border color: 8
 Section: 1 Speed: 1
 Graphics: N Format: 1
 Screen Type: 1 Column: 1
 Auto Advance: 1
 Delay: 0

Comments:

0 1 2 3 4 5 6 7 8 9

Conceptual Overview

```

graph TD
  VAX[VAX VMS] --> AISIM[AISIM READY]
  AISIM --> DUI[DUI]
  AISIM --> AUI[AUI]
  AISIM --> RUI[RUI]
  AISIM --> HUI[HUI]
  AISIM --> LUI[LUI]
  
```

Once you have built a model in the DUI, you run a simulation of that model's performance with the Analysis User Interface (AUI). You can control the run and view its results by issuing commands in this user interface.

<space> = continue s = stop

Foreground Color: 8 Background Color: 1
 Next Screen #: 15

- Section name appears in directions above screen
- Abbreviate section name as a header in upper right-hand corner of most screens.
 Right justify header to Space 79
- Use consistently in directions above screens, headers, and all other references to section name.
- Include the following sections in Units 2-14
 - Introduction
 - Conceptual Overview
 - Applying the Concepts

The COMMSYS Example (Units 4-14)

Unit Summary

Self-test

2.4 Screen Number, Next Screen Number, and Go To

```

PNOBOXHB
0 2.2

Presentation Screen-No-Box-Horizontal-Bottom

Unit name: User Interfaces: The Framework of AISIM Unit No.: 2
Section: Introduction


Screen #: 2
Section: 1
Graphics: N
Screen Type: 1

Border color: 2
Speed: 3
Format: 3
Columns: 2
Auto Advance: N
Delay: 0

Comments:
0 1 2 3 4 5 6 7 8
-----

```

ABOUT



User Interfaces: The Framework of AISIM

Unit 2

```

-----
<space> = continue s = stop
-----

Foreground Color: 9
Next Screen #: 3
Background Color: 1

```

- Screen Number

Enter screen number in the space provided at top of the page
Number all screens in a unit consecutively, starting with 1

- Next Screen Number

Most screens go directly to the next number (screen 2 follows screen 1) Enter the number of the next screen in the space provided at the bottom of the page.

• Go To

All unit menu, multiple-choice question, matching question, and exit screens can branch to multiple screens. For these screens, list each possibility and under what circumstances the first screen would branch to it. For example:

```

MC
                                     12.125

Multiple Choice Screen

Unit name: Running the Simulation with the AUI      Unit No.: 12
Section: Self-Test

Screen #: 125          Border color: 8
Section: 1             Speed: 3
Graphics: N           Format: 1
Screen Type: 2        Columns: 2
Reporting: Y          Auto Advance: N
                       Delay: 0

Comments:
0      1      2      3      4      5      6      7      8
-----
                                           Self-Test

1) In the COMMSYS model, once
the plots have been defined,
they are viewed in which
phase of the AUI?

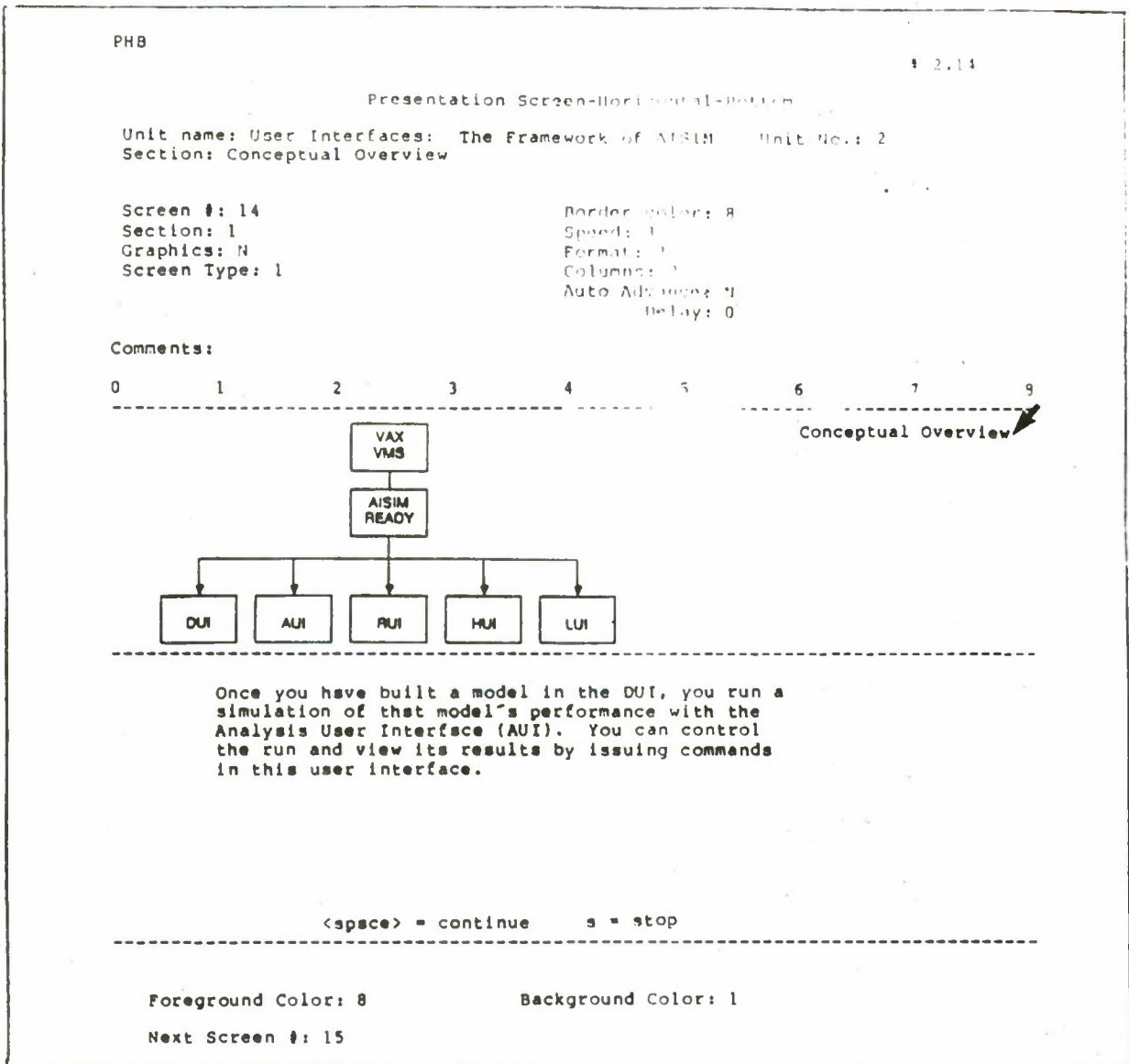
A. Pre-run
B. Mid-run
C. Post-run
D. Mid- and Post-run

Enter your choice (A-D) _____
      <space> = continue      s = stop
-----

Foreground Color: 8          Background Color: 1
Number of Answers (2-6): 4   Go to: A: 127
Correct Answer (A-F,0): C    B: 127
                              C: 126
                              D: 127
                              E:
                              F:

```

2.5 Header



- The header indicates which section the screen appears in. It sometimes appears in an abbreviated form. For example:

Applying Concepts

- Place header on line 1, in the upper right-hand corner, right-justified to Line 79
- Use consistently throughout units and course guide

- Headers *do not* appear on screens with unit or section titles. For example:

PHOBOXHB # 2.2

Presentation Screen-No-Box-Horizontal-Bottom

Unit name: User Interfaces: The Framework of AISIM Unit No.: 2
 Section: Introduction

Screen #: 2 Border color: 2
 Section: 1 Speed: 3
 Graphics: N Format: 3
 Screen Type: 1 Columns: 2
 Auto Advance: N
 Delay: 0

Comments:

0 1 2 3 4 5 6 7 8

no header here

User Interfaces: The Framework of AISIM

Unit 2

<space> = continue s = stop

Foreground Color: 8 Background Color: 1

Next Screen #: 3

Section 3

General Language, Grammar, and Graphics Conventions

This section presents and illustrates general language, grammar, and graphics conventions used throughout "About AISIM."

3.1 Acronyms/Abbreviations

- For first reference to an item in each section, use the complete title followed by the acronym in parentheses. For example:

Analysis User Interface (AUI)

- The following acronyms are standard throughout this courseware:

Communications System (COMMSYS)

Production System (PRODSYS)

Automated Interactive Simulation Modeling System (AISIM)

3.2 Punctuation

- Put a comma or a period inside the closing quotation marks. Semicolons, colons, question marks, and exclamation points follow the closing quotation marks unless the mark is logically part of the quoted material. For example:

The rule of thumb is "Like dissolves like."

The "solute," NaCl, dissolves in the "solvent."

- Do not hyphenate words

3.3 Lists

- Use bullets for lists of items that are not sequential. For example:

The cafeteria menu for Tuesday includes:

- Asparagues with Hollandaise sauce and almonds
- Sirloin steak
- Peanut butter and jelly sandwiches

- Use numbers for sequential or step-by-step lists. For example:

To run the copy machine do the following in order:

- 1) Turn on the machine
- 2) Put in paper
- 3) Select the number of copies desired
- 4) Press "Start" button

- For both lists
 - Skip a line between stem and first item of multiple-choice questions
 - End stem in colon if it is an incomplete sentence
 - Make items in a list either all incomplete sentences or all complete sentences

3.4 Numbers

- Use digits if the number:
 - Is ten or more
 - Refers to a specific value on the screen. For example:

See Line 3 in the table

- Spell out the three words for a whole number if the number:
 - Begins a sentence
 - Counts something, as opposed to measuring it. For example:

Answer all four questions

Refers to something that already contains a digit. For example:

Two 3-sided figures

Is a large number, and the digit is cumbersome. For example:

3 billion, not 3,000,000,000

Refers to an approximation rather than an exact count or measure. For example:

The system contains over one hundred elements.

3.5 Word Conventions

- Use the following words consistently:
 - unit (not module or lesson)
 - section (not branch)
 - user interface (not interface)
 - construct (not concept)
 - issue (not use) a command
 - enables (not allows)
 - run (not execute)

3.6 General Style Guidelines

- Use the active voice whenever possible. In the active voice, the subject performs the action the verb represents. For example:

The cat clawed its way up the balloon.
- Use the passive voice to emphasize the receiver of the action or when the doer of the action is unimportant or unknown. For example:

The balloon was damaged.

- Whenever possible, write in the present tense, not the past
- Use the second person ("you") when addressing the student. Never use "let's" or "we"
- Use simple subject-verb-object sentences. Avoid introductory adverbial clauses unless the content of the clause requires special emphasis. For example:

The force is 4 when the mass is 2.

- Define a new term the first time it appears in the unit
- Use terms and definitions consistently throughout the course. If several terms can be used interchangeably, choose one and stick with it. List synonyms when you introduce and define that term.
- Compound adjectives are hyphenated when the first adjective modifies the second adjective and both precede the noun:

A red-clay brick (a brick made of red clay) is not the same as a red, clay brick (a green brick that is painted red)

- Avoid slang and jargon
- Avoid or "in other words," or "and so on"
- Do not use contractions. Write "cannot" instead of "can't"
- Use the indicative mood to show a fact. For example:

2 and 2 are 4

- Use the subjunctive to show something that may or may not happen. For example:

If 2 and 2 were 5

- Like/As
Use "like" before a noun or pronoun. Use "as," "as if," and "as though" before phrases or clauses. For example:

This looks like water.

The reaction went as it should.

The electron behaves as if it were a cloud.

- Which/That

Use "that" whenever the following phrase further defines a subject. A "that" clause contains essential information and is not set off with commas. For example:

The lawn mower that is broken is in the garage.

Use "which" whenever the phrase that follows contains supplementary or incidental information. "Which" clauses are set off by a pair of commas. For example:

The lawn mower, which is broken, is in the garage.

If the lawn mower that is broken is in the garage, whereas the lawn mower that is working is in the yard, then the reader needs to know that the lawn mower is broken in order to know which of several lawn mowers is being discussed. The information in the clause restricts or limits the subject. Use "that " if the only lawn mower that is in question is in the garage and, which incidentally, happens to be broken, use "which."

3.7 Graphics

PHB # 10.18

Presentation Screen-Horizontal-Bottom

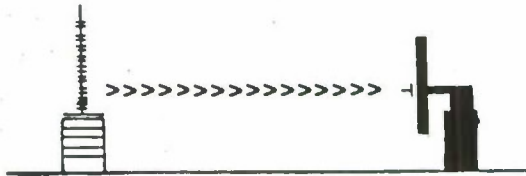
Unit name: Defining Entities with the DUI Unit No.: 10
 Section: Conceptual Overview

Screen #: 18 Border color: 8
 Section: 1 Speed: 3
 Graphics: N Format: 3
 Screen Type: 1 Columns: 2
Auto Advance: N
Delay: 0

Comments:

0 1 2 3 4 5 6 7 8

Conceptual Overview



The Resource, Item, Action, Load, and Scenario entities will be defined for COMMSYS, which was introduced in Unit 4.

<space> = continue s = stop

Foreground Color: 8 Background Color: 1
 Next Screen #: 19

- Use any graphic representing a particular system or event consistently throughout the course
- Draw graphics neatly
- For the Final Detailed Design Report, text in graphics should be typewritten, not handwritten
- Use both upper- and lower-case letters, not all upper-case
- Use the following text margins on screens with graphics:
 left - Space 10
 right - Space 70

3.8 AISIM Color Scheme Conventions

Use the following color scheme conventions for all "About AISIM" screens. (These combinations were chosen for optimal legibility by a group of viewers.)

3.8.1 Text

All screens with text should have:

- Bright white foreground
- Dark black background

3.8.2 Color Border

Each unit section is color-coded. Every screen in any given section has the same border color. Each section of a typical "About AISIM" unit is listed below, followed by the color assigned to it. The number represents the authoring system's code for each color available in the system. Note that we assigned blue and green to two sections.

Section	Color	Code Number
Opening screens (up to the unit menu)	Blue	2
Menu	White	8
Conceptual Overview	Green	3
Applying the Concepts	Brown	7
COMMSYS Example	Blue	2
Unit Summary	Green	3
Self-test	Magenta	6
Exit	Red	5

3.8.3 Highlighting

Based on the group's review, use yellow for all highlighting in graphics.

Appendix G

Figure 1-3 from AFP 50-58, Volume I

This figure has been referenced throughout the ESD Prototype Methodology.

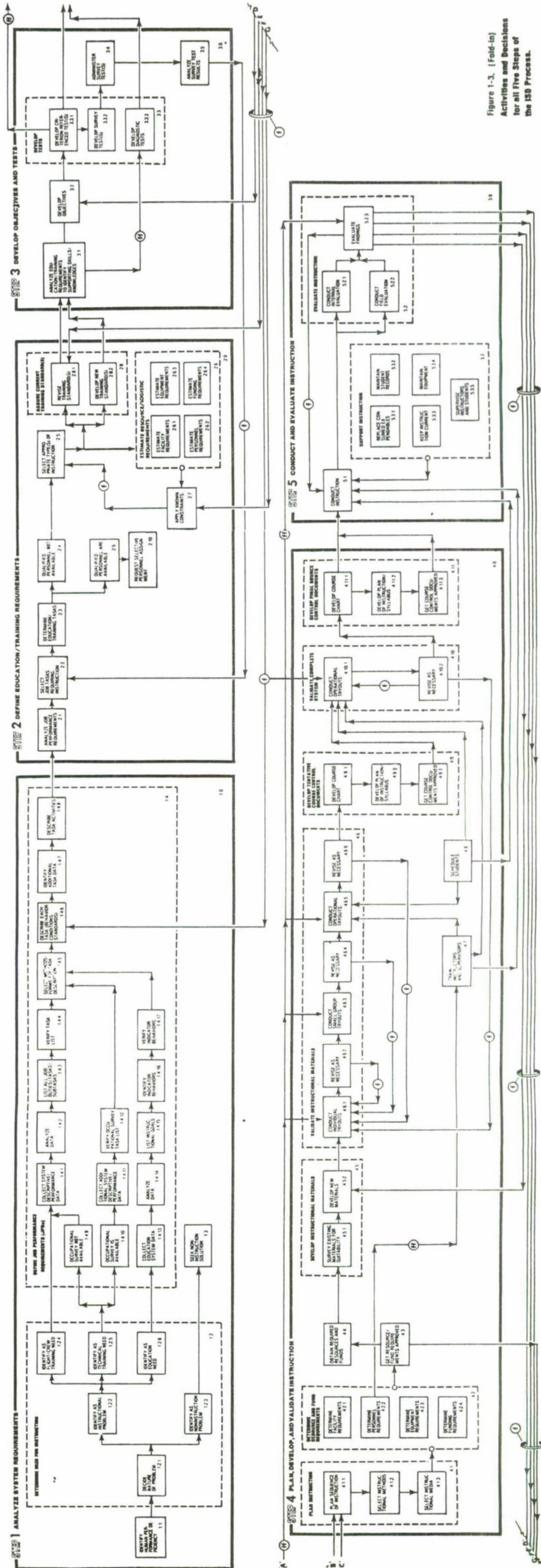


Figure 1-3. (Fold-in) Activities and Decisions for all Five Steps of the ISD Process.