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ABSTRACT

This document, fifth in a series of 11 subvolumes of a handbook prepared to provide training for educational research and development personnel in the development of instructional materials, deals with the task of planning simulation based on instructional and logistical needs. The document content is arranged according to the sequential order of the two steps involved in performing the task. Step 1, assessing simulation needs, involves (a) determining whether simulation decisions should be made for an individual or for a series of lesson units; (b) inspecting task analysis diagrams and statements of objectives for the need to provide simulation; and (c) deciding whether to simulate. Step 2, planning the type of simulation to be used, involves: (a) identifying from task analysis diagrams and from mode analysis results key properties of inputs, actions, or outputs which require simulation and recording results; (b) planning and recording the simulation of inputs, actions, and outputs; and (c) selecting a simulation plan which both meets instructional needs and does not create an unacceptable logistical burden. (PD)

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A Technology For Developing Instructional Materials

3 HANDBOOK

A. PLAN STUDY OF CRITERION BEHAVIORS

B. COLLECT AND ANALYZE DATA ABOUT CRITERION BEHAVIORS

C. SEQUENCE AND GROUP CRITERION BEHAVIORS

D. STATE CRITERION AND PREPARATORY OBJECTIVES

E. PLAN SIMULATION BASED ON INSTRUCTIONAL AND LOGISTICAL NEEDS

F. DEVELOP DIAGNOSTIC AND EVALUATIVE TESTS

G. FORMULATE INSTRUCTIONAL STRATEGIES

H. PLAN ACCOMMODATION OF INDIVIDUAL DIFFERENCES

I. DEVELOP INSTRUCTIONAL MATERIALS

J. EVALUATE INSTRUCTIONAL MATERIALS

X. INDEX

AUTHOR:

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VOLUMES IN THIS SERIES

1. USER'S MANUAL
2. ORIENTATION
3. HANDBOOK
   (eleven sub-volumes)
4. WORKBOOK
5. FINAL EXERCISES

FOREWORD

This is one of a series of eleven HANDBOOK sub-volumes which has been prepared to provide training for educational R&D personnel in the development of instructional materials.

The USER'S MANUAL, which accompanies the series, describes the role each volume is designed to play and the sequence recommended for its use in the training process. The user is, therefore, urged to read the instructions in the USER'S MANUAL before using this or any other separate volume.

ACKNOWLEDGMENTS

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U.S.O.E. sponsorship does not in any way imply official endorsement of the views expressed in this volume.

The author is indebted: to Dr. Robert Fitzpatrick for reviewing portions of the series of volumes and for informal discussions concerning several training issues; to Mrs. Zita Glasgow for the first and critical use of this volume; and, not least, to Miss Kathleen Gubala for her tireless preparation of the complex manuscript required by this HANDBOOK.

George L. Gropper
March 1973

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STEP E.1

E.1 Assess simulation needs.

E.1.1 Determine whether simulation decisions should be made for an individual lesson or for a series of lesson units.

E.1.2 Inspect task analysis diagrams and statements of objectives for logistical and/or instructional reasons for the need to provide simulation.

E.1.3 Decide whether to simulate.

STEP E.1

OVERVIEW

INPUT	ACTION	OUTPUT
Analyses of "performance" sub-steps and of "knowledge domain" terminal behaviors for each objective in a given lesson	Assess need for simulation and plan it when necessary	Plans for simulation of criterion inputs, criterion actions, or criterion outputs

E.1.1	Statements of criterion objectives on FORM D.2(1), grouped by lessons (i)	Determine the number of lessons to consider in making simulation plans (ii)	DECISION: -LESS than a lesson, -A lesson, or -MORE than a lesson as a SIMULATION unit (iii)
E.1.2	RESULTS OF -Task analysis, learning analysis, and mode analysis -Statement of objectives (iv)	Inspect for presence of criteria indicating need for simulation; assess seriousness of need (v)	Rating of need to simulate based on logistical and instructional factors (vi)
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STEP E.1

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PREVIEW OF THE NEXT SubSTEP

YOUR PRODUCT	*Decision to treat each criterion objective (and however many lessons are devoted to it) as the simulation unit.*
WHAT YOU WILL WORK FROM	(1) Statements of criterion objectives grouped by lessons.
WHAT YOU WILL DO	(1) Determine how many lessons to consider as unit when making decisions whether or not to use simulation.
FORMS YOU WILL USE	None

DESCRIPTION OF Sub-STEP	E.1.1

INPUT	ACTION	OUTPUT
Statements of criterion objectives on FORM D.2(1), grouped by lessons i	Determine the number of lessons to consider in making simulation plans ii	DECISION: -LESS than a lesson, -A lesson, or -MORE than a lesson as a SIMULATION unit iii

Job Aid Contents

CRITERIA FOR IDENTIFYING INPUTS	ACTION TO BE TAKEN	STANDARD FOR OUTPUTS	FORMS TO USE
-MATRIX: Size of appropriate unit . . . . . 6 -MATRIX: Relation of lesson to appropriate unit size 6	-MATRIX: Deciding on the appropriate unit for simulation . . . 7		

Required Materials

COMPLETED MATERIALS	STEP	COMPLETED FORMS	STEP	BLANK FORMS
		FORM D.2(1) carried forward from	D.2.2	

Sub-STEP E.1.1

JOB DIAGRAM

INPUT	ACTION	OUTPUT
Statements of criterion objectives on FORM D.2(1), grouped by lessons i	Determine the number of lessons to consider in making simulation plans ii	DECISION: -LESS than a lesson, -A lesson, or -MORE than a lesson as a SIMULATION unit iii

		SIMULATION PLANS
A single lesson covers more than one criterion objective i.a	Treat each criterion objective in the lesson as a unit ii.a	As many simulation plans as there are criterion objectives iii.a
A single lesson covers only one criterion objective i.b	Treat the entire lesson as a unit ii.b	Only one simulation plan for the one lesson iii.b
Several lessons cover only one criterion objective i.c	Treat all lessons required to cover the criterion objective as a unit ii.c	Only one simulation plan for all the lessons required to cover the one criterion objective iii.c

JOB PROCEDURES

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Identifying size of unit for simulation decisions	8
Determining simulation unit size	9

E.1.1

IDENTIFICATION MATRIX

CRITERIA FOR IDENTIFYING APPROPRIATE UNIT AS A BASIS FOR CONSIDERING SIMULATION REQUIREMENTS

APPROPRIATENESS OF UNIT	APPROPRIATE UNIT	INAPPROPRIATE UNIT
CRITERIA	*A CRITERION objective is the minimum unit to consider in making simulation plans*	*A PREPARATORY objective is below the minimum and inappropriate to consider in making simulation plans*

E.1.1

IDENTIFICATION MATRIX

CRITERIA FOR IDENTIFYING NUMBER OF LESSON UNITS TO CONSIDER IN MAKING PLANS FOR SIMULATION

NUMBER OF LESSON UNITS	LESS THAN A LESSON AS THE UNIT	A LESSON AS THE UNIT	MORE THAN A LESSON AS THE UNIT
CRITERIA	*-When a lesson exhaustively covers:* *••More than one criterion objective*	*-When a lesson exhaustively covers:* *••Only one criterion objective*	*-When a lesson does not exhaustively cover at least one criterion objective* *-i.e., when it takes two or more lessons to cover the criterion objective exhaustively*

E.1.1

DECISION MATRIX

DETERMINING WHAT THE UNIT WILL BE FOR MAKING SIMULATION DECISIONS

CONDITIONS	-A single lesson covers more than one criterion objective	-A single lesson covers only one criterion objective	-It takes several lessons to cover a single criterion objective
ACTION TO TAKE	*-Consider each criterion objective as a unit* *-Make as many simulation decisions per lesson as there are criterion objectives*	*-Consider the one criterion objective as the unit* *-Make only one simulation decision for that lesson*	*-Consider the one criterion objective as the unit* *-Make only one simulation decision for all the lessons required to cover the one criterion objective*

PREVIEW OF THE NEXT SubSTEP

YOUR PRODUCT	*A rating of the need for simulation based on both instructional and logistical considerations.*
WHAT YOU WILL WORK FROM	(1) Results for: --task analysis --learning analysis --mode analysis (2) Statements of objectives
WHAT YOU WILL DO	(1) Inspect results for presence of variables which signify the possible need for simulation. (2) Rate the need for simulation (based on these variables).
FORMS YOU WILL USE	FORM E.1(1) -- top portion -- for rating the need to simulate.

DESCRIPTION OF Sub-STEP	E.1.2

INPUT	ACTION	OUTPUT
RESULTS OF -Task analysis, learning analysis, and mode analysis -Statement of objectives iv	Inspect for presence of criteria indicating need for simulation; assess seriousness of need v	Rating of need to simulate based on logistical and instructional factors vi

Job Aid Contents

CRITERIA FOR IDENTIFYING INPUTS	ACTION TO BE TAKEN	STANDARD FOR OUTPUTS	FORMS TO USE
-MATRIX: Where simulation is used . . . . . 14 -MATRIX: What is simulated . . 15 -MATRIX: Logistical need for simulation . . 16, 17 -MATRIX: Instructional need for simulation . . . 19 -MATRIX: Degree of need for simulation . . . 20		-MATRIX: Proper assessment of need for simulation . . . 25	FORM E.1(1) SIMULATION SUMMARY OF PROCEDURES 24

Required Materials

COMPLETED MATERIALS	STEP	COMPLETED FORMS	STEP	BLANK FORMS
Decision about "unit" size for simulation assessment	E.1.1	FORM A.5(4) or FORM A.5(11)	B.5	FORM E.1(1)
		FORM D.2(1)	D.2	

Sub-STEP E.1.2

JOB DIAGRAM

INPUT	ACTION	OUTPUT
RESULTS OF -Task analysis, learning analysis, and mode analysis -Statement of objectives iv	Inspect for presence of criteria indicating need for simulation; assess seriousness of need v	Rating of need to simulate based on logistical and instructional factors vi
Indications of appropriateness of logistical factors: -Downtime -Cost -Danger iv.a	Assess degree of seriousness for normal operations or functioning v.a	Serious, average, or negligible effect on operations or functioning vi.a
Indications of appropriateness of instructional factors: -Sampling -Standardization -Manipulation iv.b	Assess degree of seriousness for conduct of training v.b	Serious, average, or negligible effect on training or instructional effectiveness vi.b

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E.1.2
IDENTIFICATION
MATRIX

CRITERIA FOR IDENTIFYING TYPES OF PERFORMANCE SITUATIONS ABOUT WHICH SIMULATION DECISIONS MIGHT BE MADE

PERFORMANCE SITUATIONS	Performance during: PREPARATORY PRACTICE a.	Performance during: CRITERION PRACTICE b.	Performance on: CRITERION TESTS c.
CRITERIA	-*Prior to criterion practice:* •*Practice of non-criterion behaviors designed to make practice of criterion behaviors possible*	-*During instruction or during training:* •*Practice of criterion behaviors:* *e.g., actual "performance" sub-steps* *e.g., actual "knowledge domain" terminal behaviors*	-*Following instruction or following training:* •*Test of criterion behaviors*
EXAMPLES*	1a. ENGLISH -*Choosing from four options the noun which is in the plural form* 2a. INTERPRETING RADAR DISPLAYS -*Practicing where to look for information*	1a. ENGLISH -*Given a plural noun, responding with the proper form of the verb "to be"* 2a. INTERPRETING RADAR DISPLAYS -*Practicing interpreting display indications*	1a. ENGLISH -*Given singular and plural nouns, some encountered during instruction and some not, responding with the proper form of the verb "to be"* 2a. INTERPRETING RADAR DISPLAYS -*Taking a test on a sample of display indications*

*These examples illustrate what constitutes: (a) "preparatory" practice; (b) "criterion" practice; and (c) criterion tests. The examples do not necessarily illustrate subject matter or performance areas likely to be simulated.

E.1.2

IDENTIFICATION MATRIX

CRITERIA FOR IDENTIFYING WHAT MIGHT POTENTIALLY BE SIMULATED

WHAT IS SIMULATED	CRITERION INPUTS AND THEIR PROPERTIES	CRITERION ACTIONS AND THEIR PROPERTIES	CRITERION OUTPUTS AND THEIR PROPERTIES
CRITERIA	*Properties of inputs: found on the job or found on tests which are the basis for discriminations and/or generalizations to be acquired* *-Physical properties:* *·Size, shape, color, etc.* *·Location, direction* *·Time* *-Psychological properties:* *·Conceptual, symbolic* *·Behavioral*	*Properties of actions: which are the basis for associations or action generalizations to be acquired* *-Physical properties:* *·Direction or duration of movement, etc.* *-Psychological properties:* *·Conceptual* *·Behavioral*	*Properties of outputs: found on the job or found on tests which are the basis for discriminations and/or generalizations to be acquired* *-Physical properties* *·Size, shape, color, etc.* *·Location, direction* *·Time* *-Psychological properties:* *·Conceptual, symbolic* *·Behavioral*
EXAMPLES	INPUTS PHYSICAL PROPERTIES *e.g., blip on radar screen moving in a particular direction at a particular rate* These properties form the basis for discriminations between alternative situations to be detected; therefore, if the decision to simulate were made, they would be simulated PSYCHOLOGICAL PROPERTIES *e.g., pattern of economic indicators: rate of rise or fall of unemployment, wholesale prices, cost of living, etc.* These properties form the basis for discriminations between alternative situations to be detected; therefore, if the decision to simulate were made, they would be simulated	ACTIONS PHYSICAL PROPERTIES *e.g., how far the golf club is taken in the backswing (depending on club used)* This action is associated with different conditions (how far ball is from hole and which club is used) PSYCHOLOGICAL PROPERTIES *e.g., teacher delivery of reinforcement for behavior vs. total ignoring of behavior* These actions are associated with types of student behavior	OUTPUTS PHYSICAL PROPERTIES *e.g., distillate of a chemical reaction having a distinctive color and texture* These properties form the basis for a discrimination between a correct and an incorrect result of an experiment PSYCHOLOGICAL PROPERTIES *e.g., pattern or degree of cooperation between supervisor and those being supervised* These properties form the basis for the determination of the correctness of the actions taken

E.1.2

CRITERIA FOR DETERMINING WHETHER LOGISTICAL FACTORS MAKE SIMULATION OF CRITERION INPUTS, ACTIONS, OR OUTPUTS DESIRABLE

IDENTIFICATION MATRIX

FACTORS TO CONSIDER	DOWNTIME	COST	DAMAGE/DANGER
CRITERIA	*Use of criterion inputs, actions, or outputs in training or in testing would result in:* *-Unavailability for regular operations of:* *•Personnel* *•Equipment, objects* *•Space* *•Resources (e.g., utilities)*	*Use of criterion inputs, actions, or outputs in training or in testing would result in:* *-High costs due to use or expenditure of:* *•Personnel* *•Equipment, objects* *•Space* *•Resources, materials*	*Use of criterion inputs, actions, or outputs in training or in testing would result in:* *-Physical danger or damage to:* *•People* *•Equipment, objects* *•Locations* *•Resources* *-Psychological danger or damage to:* *•People*
ROLE OF SIMULATION	To keep necessary resources available for regular operations	To keep costs of training down	To prevent danger or damage to people, things, etc.

E.1.2

EXAMPLES OF THE THREE CRITERIA FOR DETERMINING THE NEED TO SIMULATE

EXAMPLES	DOWNTIME	COST	DAMAGE/DANGER
EXAMPLES	During CRITERION PRACTICE or during TESTING *e.g., if an actual assembly line were used for training or for testing purposes, it would result in its unavailability for regular production* During PREPARATORY PRACTICE *e.g., if an actual office staff were used during training of a manager, there might be little or no productivity of the staff during that period*	During CRITERION PRACTICE or during TESTING *e.g., target practice shooting at actual naval vessels would result in prohibitive costs* During PREPARATORY PRACTICE *e.g., if students (psychology, biology) who were not yet fully trained were to use experimental animals (and use them up), this might result in needlessly high training costs*	During CRITERION PRACTICE or during TESTING *e.g., waiting on actual customers as criterion practice or for testing purposes might result in loss of customers* During PREPARATORY PRACTICE *e.g., if an actual patient were used during the preparatory training of a medical student (before he had fully learned how to perform surgery), this might result in harm to the patient*

F.1.2

IDENTIFICATION MATRIX

CRITERIA FOR IDENTIFYING THREE DEGREES OF SERIOUSNESS BASED ON EACH LOGISTICAL FACTOR

LEVELS OF SERIOUSNESS	SERIOUS	AVERAGE	NEGLIGIBLE
DOWNTIME Criteria Unavailability of: People Equipment Materials Space Etc.	-Of major consequences to normal operations or functioning; -No substitutes are available	-Of moderate consequences to normal operations or functioning; -A few substitutes are available	-Of little consequence to normal operations or functioning; -Many substitutes are available
COST Criteria Expense of using: People Equipment Materials Space Etc.	[illegible]	Moderate	Low
DAMAGE/DANGER Criteria Risk to: People Equipment Materials Space Etc.	[illegible]	Moderate	Low

E.1.2

EXAMPLES OF THREE DEGREES OF SERIOUSNESS FOR EACH LOGISTICAL FACTOR AND ASSOCIATED DEGREE OF NEED TO SIMULATE

EXAMPLES

LOGISTICAL FACTORS / DEGREE OF SERIOUSNESS	DOWNTIME	COST	DANGER/DAMAGE
SERIOUS: High Need to Simulate	e.g., *applying a computer program to a research problem* The use of an actual computer during testing or criterion practice or preparatory practice might tie up the computer, making it unavailable for other activities	e.g., *directing a TV dramatic production* Use of actual TV production facility during practice training would result in high per trainee costs	e.g., *landing a plane on a carrier deck* Use of actual carrier deck during preparatory practice might lead to serious accident or damage to carrier
AVERAGE: Medium Need to Simulate	e.g., *applying classroom management techniques* Teacher practice of classroom management techniques with an actual class might to a moderate extent take the class away from regular activities	e.g., *interviewing the public for polling purposes* The use of actual paid subjects during practice would be moderately expensive	e.g., *driving an automobile* Use of an actual auto--particularly in criterion practice or in testing--is not likely to be highly dangerous
NEGLIGIBLE: Low Need to Simulate	e.g., *threading a film projector* Practicing threading an actual projector is not likely to lead to downtime, particularly if it's not in constant use	e.g., *developing photographs* The use of actual photographs and developing liquids even during preparatory practice is not likely to result in very high costs	e.g., *performing chemistry experiments* Carrying out most experiments with actual chemicals is not likely to be dangerous

E.1.2

CRITERIA FOR DETERMINING WHETHER INSTRUCTIONAL FACTORS MAKE SIMULATION DESIRABLE

IDENTIFICATION MATRIX

FACTORS TO CONSIDER	INABILITY TO SAMPLE	INABILITY TO STANDARDIZE	INABILITY TO MANIPULATE
CRITERIA	-*Waiting for the spontaneous occurrence of inputs (and the actions associated with them) requires a long time for all relevant inputs to be sampled and used in training* -*Some inputs just do not spontaneously occur very often (yet are relevant and/or important)*	-*Waiting for the spontaneous occurrence of inputs does not guarantee their appearance with all relevant properties on the basis of which discriminations or generalizations can be made* -*Difficult to standardize training for all trainees with key properties*	-*Not possible to change or alter criterion inputs (and associated actions) in order to make learning easier* -*Not possible to present criterion inputs because they are unobservable*
ROLE OF SIMULATION	To sample otherwise unavailable relevant criterion inputs during training	To have key properties of criterion inputs adequately represented	To permit changing the nature of criterion inputs to make preparatory training easier

E.1.2

EXAMPLES ILLUSTRATING EACH OF THE THREE INSTRUCTIONAL CRITERIA FOR DETERMINING THE NEED FOR SIMULATION

EXAMPLES

EXAMPLES	e.g., *in the internship training of a medical student, it would take a long time for actual patients with rare conditions to turn up by themselves (e.g., plague) simulation of symptoms might therefore be necessary in training* e.g., *in driver training, training in the actual world might require longer training durations if it were required to wait for all possible driving situations or driving conditions to occur spontaneously (i.e., occur by themselves)*	e.g., *in training electronic troubleshooting, it might be necessary to simulate key relevant symptoms in isolation from other distractors which would otherwise occur if a criterion situation were used*	e.g., *in training radar operators to interpret display patterns, it may be necessary to contrast in a simultaneous presentation highly similar patterns which have to be distinguished. In the criterion situation, they occur only singly; therefore simulation would be needed to provide the simultaneous contrast (on one screen successively or on two separate screens)*

E.1.2

IDENTIFICATION MATRIX

CRITERIA FOR IDENTIFYING THREE DEGREES OF SERIOUSNESS BASED ON EACH INSTRUCTIONAL FACTOR

LEVELS OF SERIOUSNESS	SERIOUS	AVERAGE	NEGLIGIBLE
"SAMPLING" Criteria Unavailability of criterion inputs for use in training	-*Some criterion inputs rarely occur;* -*Waiting for their spontaneous occurrence would require a long time*	-*Some criterion inputs occur with moderate frequency* -*Waiting for their spontaneous occurrence would require a moderate amount of time*	-*All criterion inputs occur frequently* -*Waiting for their spontaneous occurrence would require little time*
"STANDARDIZATION" Criteria Unavailability of properties of criterion inputs to be included in training	-*Waiting for spontaneous occurrence of all properties is a major problem;* -*Would seriously interfere with learning*	-*Waiting for spontaneous occurrence of all properties is a moderate problem;* -*Would moderately interfere with learning*	-*Waiting for spontaneous occurrence of all properties is a minor problem;* -*Would not interfere with learning*
"MANIPULATION" Criteria Inability to alter or present criterion inputs, actions, or outputs	-*Considerable problem in overcoming learning difficulties (regarding discriminations, generalizations, or associations)*	-*Moderate problem in overcoming learning difficulties (regarding discriminations, generalizations, or associations)*	-*Little problem in overcoming learning difficulties (regarding discriminations, generalizations, or associations)*

EXAMPLE

FACTORS TO CONSIDER	SAMPLING	STANDARDIZATION	MANIPULATION
DEGREE OF SERIOUSNESS			
SERIOUS: High Need to Simulate	e.g., *astronomer has to observe and make records of eclipses* The infrequent occurrence of eclipses makes simulation (film, animation, photographs) necessary to train the astronomer-trainee.	e.g., *a teacher has to be able to recognize social and emotional symptoms in the classroom* Training cannot wait for them all with all relevant properties present to show up by themselves. Simulation (e.g., film) allows sampling of all relevant types and all relevant properties that help identify problems.	e.g., *a medical diagnosis of a benign or malignant condition depends on being able to discriminate between highly similar appearing symptoms* It is <u>not</u> possible to manipulate conditions of actual patients. Simulation (in photographs or in print) allows wide differences to be created and gradually narrowed so that the difficult discriminations can be made.
AVERAGE: Medium Need to Simulate	e.g., *the instructional developer has to interpret various patterns of test results reflecting on the adequacy of his instructional materials* Learning to interpret results depends on being able to see the variety. In actual settings this might take a fair amount of time. Contrived (simulated) results can solve this problem.		
NEGLIGIBLE: Low Need to Simulate	e.g., *the student of a foreign language has to have practice in translating combinations of "he," "she," and "it" and the verb "to be."* These occur often enough <u>by themselves</u> in most books without the need to simulate such situations.	e.g., *developer of photographs has to be able to distinguish between overexposed and underexposed photographs.* A sample of actual photographs containing all relevant properties on which the distinction is to be made can be readily obtained and used in training or that can be standard for all trainee-developers.	e.g., *a TV repairman has to diagnose differentially between conditions which are <u>grossly</u> different in criterion situations.* There is no need to manipulate symptoms from wide to narrow differences. The gross differences themselves can readily be created and presented on an actual TV set.

JOB PROCEDURES

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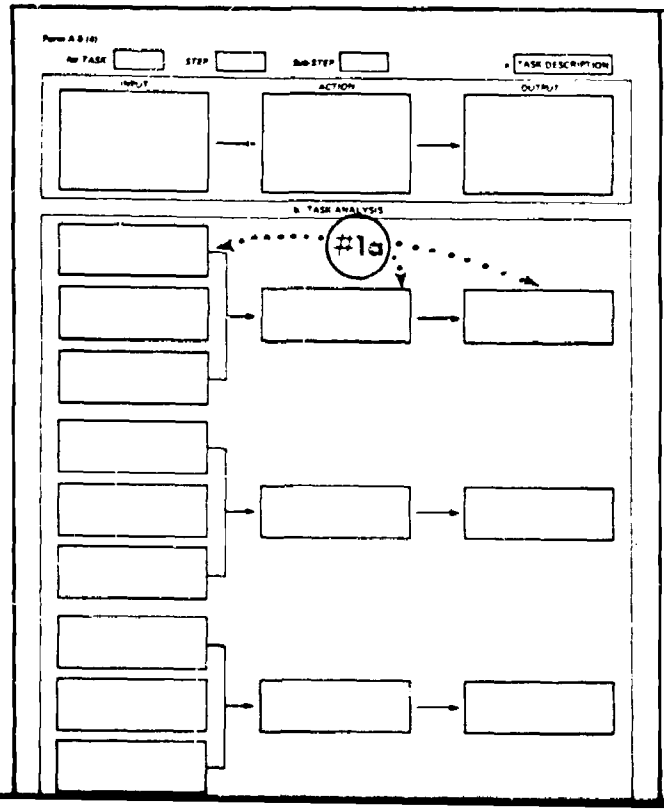
SUMMARY OF JOB PROCEDURES	24
Evaluating adequacy of assessment of need to simulate	25

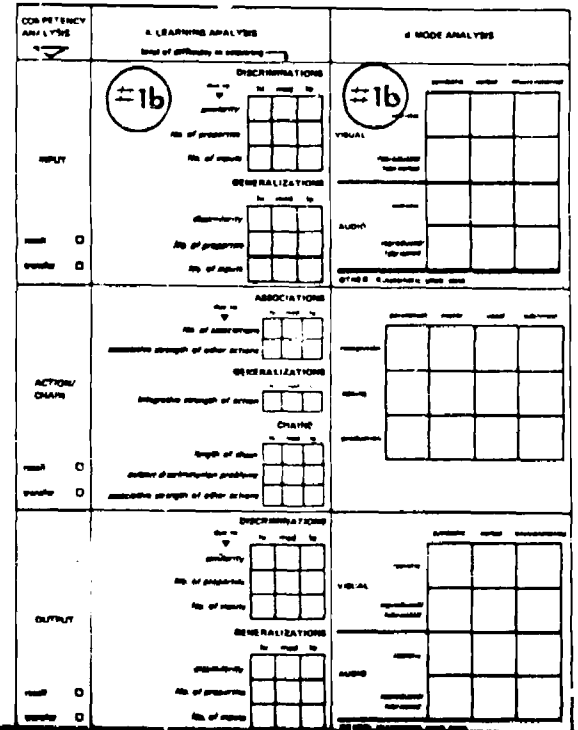
E.1.2

SUMMARY OF PROCEDURES FOR DETERMINING AND RECORDING THE SERIOUSNESS OF THE NEED TO SIMULATE

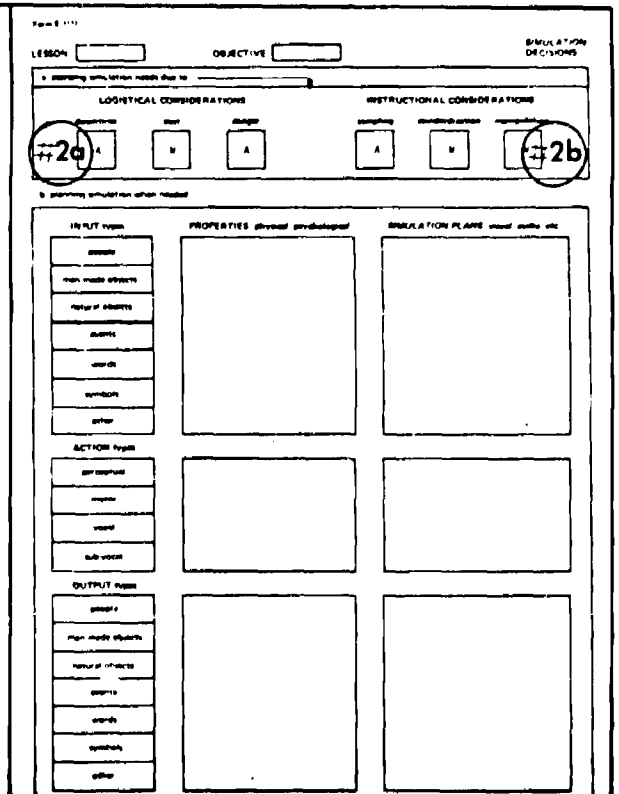
#1	#2
1a. Inspect task analysis side of Form A.5(4) or A.5(11) for logistical or instructional evidence of need for simulation 1b. Inspect learning analysis and mode analysis side of Form A.5(4) or A.5(11) for logistical or instructional evidence of need for simulation	*Using S for SERIOUS, A for AVEPAGE, and N for NEGLIGIBLE:* 2a. Record degree of seriousness of need to simulate based on logistical considerations at top of Form E.1(1) 2b. Record degree of seriousness of need to simulate based on instructional considerations at top of Form E.1(1)

Form A.5(4)





Form E.1(1)



E.1.2

CRITERIA FOR DETERMINING ADEQUACY OF ASSESSMENT OF NEED TO SIMULATE

STANDARDS MATRIX

PROPERTIES	COMPLETENESS	CROSS-REFERENCING
CRITERIA	-*An entry of:* *S for SERIOUS* *A for AVERAGE* *N for NEGLIGIBLE* •*For each logistical factor:* *Downtime, cost, danger* •*For each instructional factor:* *Sampling, standardization, manipulation*	-*Each simulation form can be stored with the task analysis form on which it is based* -*Cross-referencing is by lesson number and objective number (form containing statement of objectives also stored with the task analysis form)*

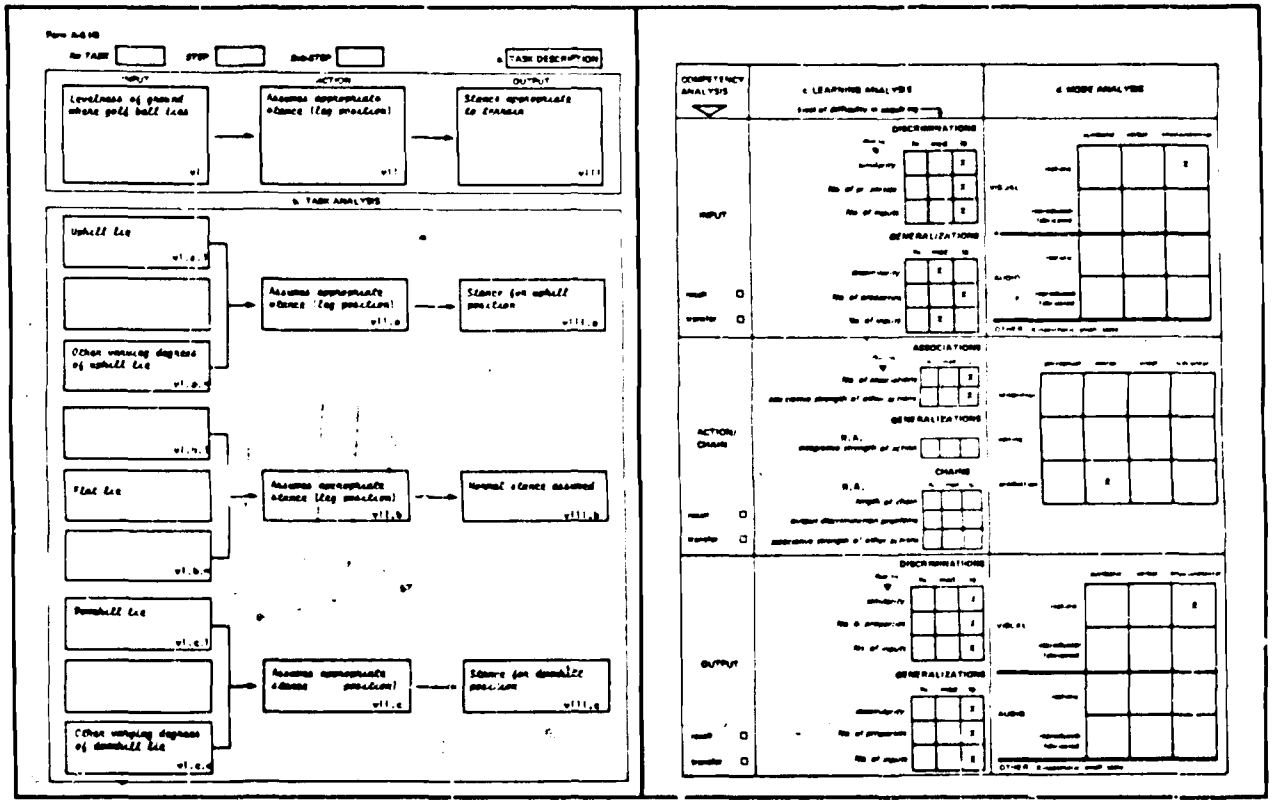
E.1.2

EXAMPLE OF RECORDING OF RESULTS OF ASSESSMENT OF SERIOUSNESS OF NEED TO SIMULATE

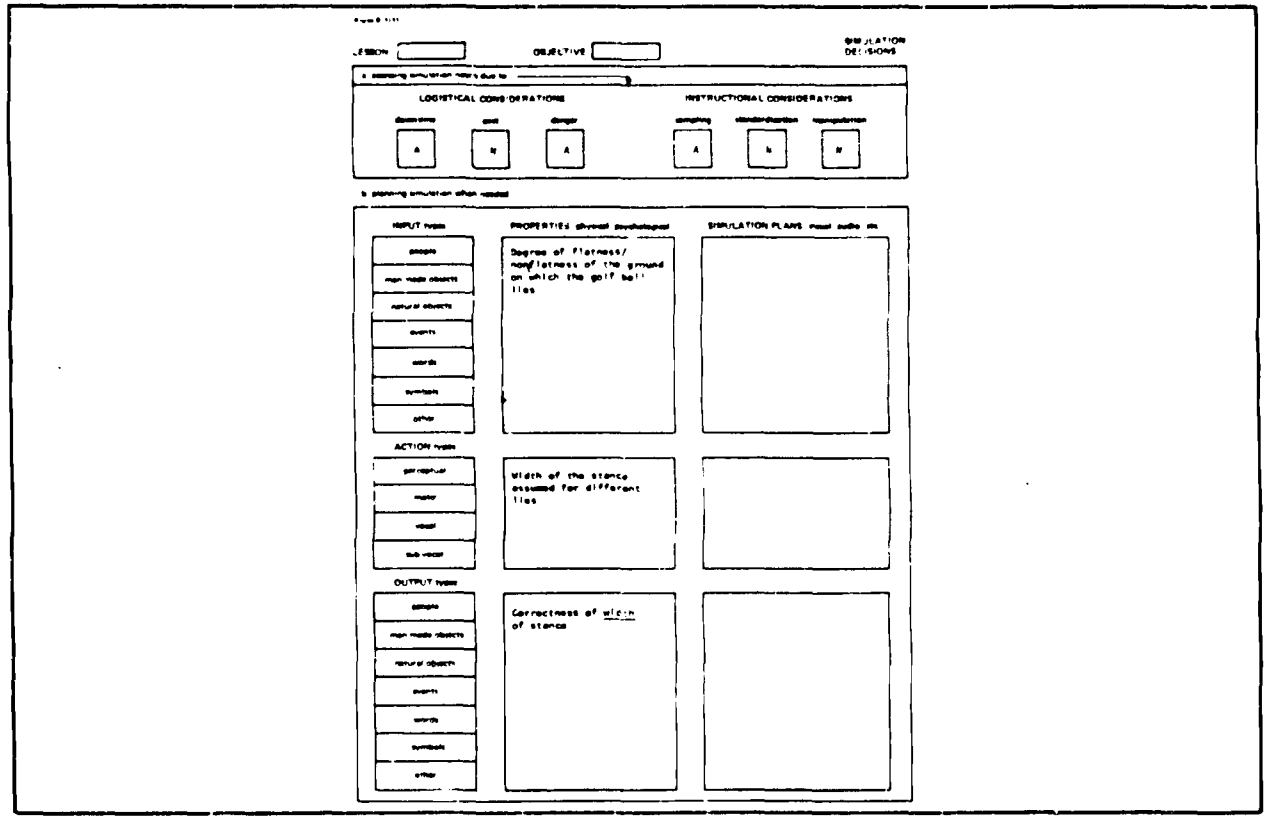
(THIS AND OPPOSITE PAGE)

EXAMPLE

FORM A.5(4)



FORM E.1(1)



PREVIEW OF THE NEXT SubSTEP

YOUR PRODUCT	*A decision whether or not to use simulation of the criterion behavior.*
WHAT YOU WILL WORK FROM	(1) Pattern of ratings (top portion of FORM E.1(1) on instructional and logistical factors indicating the need to simulate.
WHAT YOU WILL DO	(1) Decide whether to simulate based on the seriousness of the need to simulate.
FORMS YOU WILL USE	

DESCRIPTION OF Sub-STEP	E.1.3

INPUT	ACTION	OUTPUT
Pattern of ratings of need for simulation on FORM E.1(1) vii	Inspect pattern and decide whether to simulate viii	Simulation decision: yes/no ix

Job Aid Contents

CRITERIA FOR IDENTIFYING INPUTS	ACTION TO BE TAKEN	STANDARD FOR OUTPUTS	FORMS TO USE
	-MATRIX: When to simulate . . 31		

Required Materials

COMPLETED MATERIALS	STEP	COMPLETED FORMS	STEP	BLANK FORMS
		Top portion of FORM E.1(1)	E.1.2	

Sub-STEP E.1.3 JOB DIAGRAM

INPUT	ACTION	OUTPUT
Pattern of ratings of need for simulation on FORM E.1(1) vii	Inspect pattern and decide whether to simulate viii	Simulation decision: yes/no ix

Instructional Factors -Any one at A or S levels of seriouness Logistical Factors -Any one at S level of seriousness -Any two at A levels vii.a	Plan to simulate viii.a	Decision about simulation: YES ix.a
Instructional Factors -No factor at A or S Logistical Factors -No factor at S -Less than two at A vii.b	Plan NOT to simulate viii.b	Decision about simulation: NO ix.b

E.1.3

DETERMINING WHETHER TO SIMULATE OR OR WHETHER TO USE CRITERION INPUTS, ACTIONS, AND OUTPUTS

DECISION MATRIX

CONDITIONS	INSTRUCTIONAL FACTORS -Any one factor at levels •A (average), or •S (serious) LOGISTICAL FACTORS -Any one factor at level •S (serious) -Any two (or more) factors at level* •A (average)	INSTRUCTIONAL FACTORS -No factors at level A or at level S LOGISTICAL FACTORS -No factors at level S -Less than two factors at level A
ACTION TO TAKE	*PLAN TO SIMULATE*	*DO NOT PLAN TO SIMULATE*

*Judgment enters in decisions based on any of these patterns, but particularly on this pattern.

STEP E.1

COMPLETION CHECKLIST

	IDENTIFIED	PERFORMED	PRODUCED	FORMS COMPLETED
E.1.1	Size of unit for simulation plans			
E.1.2	Logistical or instructional factors suggesting need for simulation	Rated need for simulation		Top portion of FORM E.1(1)
E.1.3		Made decision whether to simulate		

STEP E.2

E.2 Plan type of simulation to be used (when needed).

E.2.1 Identify from task analysis diagrams and from mode analysis results key properties of inputs, actions, or outputs which require simulation. Record results.

E.2.2 Plan and record the simulation of inputs, actions, and outputs.

E.2.3 Select a simulation plan which both meets instructional needs and does not create an unacceptable logistical burden.

STEP E.2

OVERVIEW

INPUT	ACTION	OUTPUT
Results of: -Task analysis -Mode analysis -Identification of simulation needs	Plan alternative ways to simulate and make a final selection	Cost effective simulation plan

	INPUT	ACTION	OUTPUT
E.2.1	Decision to simulate + task and mode analysis forms + simulation form FORM E.1(1) i	Identify and record relevant criterion properties on Form E.1(1) ii	Record of criterion properties requiring simulation iii
E.2.2	Reason for simulation need + task and mode analyses iv	Plan alternative types of simulation to meet simulation need v	Simulation which is either similar to or dissimilar from criterion, depending on reason for simulation need vi
E.2.3	Alternative simulation plans on Form E.1(1) vii	Assess logistical burden of implementing simulation, and select most cost effective plan consistent with instructional needs viii	Cost effective plan for simulation ix

STEP E.2

PAGE INDEX

	CRITERIA FOR IDENTIFYING INPUTS	ACTION TO BE TAKEN	STANDARD FOR OUTPUTS	FORMS TO USE
E.2.1	-MATRIX: What should be simulated . . . 42	-MATRIX: What to record . . . 43	-MATRIX: Adequacy of identification of criterion properties . . 45	FORM E.1(1) SUMMARY OF PROCEDURES . . . 44
E.2.2	-MATRIX: Nature of similarity . .54 -MATRIX: Nature of dissimilarity . .58	-MATRIX: Aim in simulation . . . 52 -MATRIX: How to produce similarity or dissimilarity in simulation . 53	-MATRIX: Adequacy of simulation plans 61	FORM E.1(1) SUMMARY OF PROCEDURES . . . 60
E.2.3	-MATRIX: Assessing logistical burden of alternative simulation plans 65	-MATRIX: Selecting the final simulation plan 69	-MATRIX: Adequacy of selection of simulation plans 71	SUMMARY OF PROCEDURES . . . 70

PREVIEW OF THE NEXT SubSTEP

YOUR PRODUCT	*An identification of the properties of the criterion behavior which require simulation.*
WHAT YOU WILL WORK FROM	(1) Task analysis forms (2) Mode analysis forms
WHAT YOU WILL DO	(1) Identify the properties of the criterion behavior which need to be simulated. (2) Record these in the middle column of FORM E.1(1).
FORMS YOU WILL USE	FORM E.1(1) -- middle column for identifying properties of criterion behavior to be simulated.

DESCRIPTION OF Sub-STEP	E.2.1

INPUT	ACTION	OUTPUT
Decision to simulate + task and mode analysis forms + simulation form FORM E.1(1) i	Identify and record relevant criterion properties on Form E.1(1) ii	Record of criterion properties requiring simulation iii

Job Aid Contents

CRITERIA FOR IDENTIFYING INPUTS	ACTION TO BE TAKEN	STANDARD FOR OUTPUTS	FORMS TO USE
-MATRIX: What should be simulated . . . 42	-MATRIX: What to record . . . 43	-MATRIX: Adequacy of identification of criterion properties . . .45	FORM E.1(1) SUMMARY OF PROCEDURES . . . 44

Required Materials

COMPLETED MATERIALS	STEP	COMPLETED FORMS	STEP	BLANK FORMS
Decision to simulate	E.1.3	Top portion of Form E.1(1)	E.1.2	Middle column of Form E.1(1)

Sub-STEP E.2.1

JOB DIAGRAM

INPUT	ACTION	OUTPUT
Decision to simulate + task and mode analysis forms + simulation form FORM E.1(1) i	Identify and record relevant criterion properties on Form E.1(1) ii	Record of criterion properties requiring simulation iii
Properties of INPUTS which form the basis for discriminations and generalizations regarding INPUTS i.a	Identify and record in INPUT row ii.a	Record of properties of INPUTS requiring simulation iii.a
Properties of ACTIONS which form the basis for associations between particular ACTIONS and particular INPUTS i.b	Identify and record in ACTION row ii.b	Record of properties of ACTIONS requiring simulation iii.b
Properties of OUTPUTS which form the basis for discriminations and generalizations regarding OUTPUTS i.c	Identify and record in OUTPUT row ii.c	Record of properties of OUTPUTS requiring simulation iii.c

JOB PROCEDURES

	page
Identifying what should be simulated	42
Properties to be recorded on simulation form	43
SUMMARY OF JOB PROCEDURES	44
Assessing adequacy of identification and recording of properties to be simulated	45

E.2.1

IDENTIFICATION MATRIX

CRITERIA FOR IDENTIFYING WHAT SHOULD BE SIMULATED

WHAT IS SIMULATED	CRITERION INPUTS AND THEIR PROPERTIES	CRITERION ACTIONS AND THEIR PROPERTIES	CRITERION OUTPUTS AND THEIR PROPERTIES
CRITERIA	*Properties of inputs: found on the job or found on tests which are the basis for discriminations and/or generalizations to be acquired* -*Physical properties:* ·*Size, shape, color, etc.* ·*Location, direction* ·*Time* -*Psychological properties:* ·*Conceptual, symbolic* ·*Behavioral*	*Properties of actions: which are the basis for associations or action generalizations to be acquired* -*Physical properties:* ·*Direction or duration of movement, etc.* -*Psychological properties:* ·*Conceptual* ·*Behavioral*	*Properties of outputs: found on the job or found on tests which are the basis for discriminations and/or generalizations to be acquired* -*Physical properties:* ·*Size, shape, color, etc.* ·*Location, direction* ·*Time* -*Psychological properties:* ·*Conceptual, symbolic* ·*Behavioral*
EXAMPLES	INPUTS PHYSICAL PROPERTIES e.g., *blip on radar screen moving in a particular direction at a particular rate* These properties form the basis for discriminations between alternative situations to be detected; therefore, if the decision to simulate were made, they would be simulated PSYCHOLOGICAL PROPERTIES e.g., *pattern of economic indicators: rate of rise or fall of unemployment, wholesale prices, cost of living, etc.* These properties form the basis for discriminations between alternative situations to be detected; therefore, if the decision to simulate were made, they would be simulated	ACTIONS PHYSICAL PROPERTIES e.g., *how far the golf club is taken in the backswing (depending on club used)* This action is associated with different conditions (how far ball is from hole and which club is used) PSYCHOLOGICAL PROPERTIES e.g., *teacher delivery of reinforcement for behavior vs. total ignoring of behavior* These actions are associated with types of student behavior	OUTPUTS PHYSICAL PROPERTIES e.g., *distillate of a chemical reaction having a distinctive color and texture* These properties form the basis for a discrimination between a correct and an incorrect result of an experiment PSYCHOLOGICAL PROPERTIES e.g., *pattern or degree of cooperation between supervisor and those being supervised* These properties form the basis for the determination of the correctness of the actions taken

E.2.1

DECISION MATRIX

DETERMINING WHAT PROPERTIES TO RECORD ON SIMULATION FORM E.1(1)

CONDITIONS	Properties of CRITERION INPUTS to be recorded	Properties of CRITERION ACTIONS to be recorded	Properties of CRITERION OUTPUTS to be recorded
ACTION TO TAKE	*Record properties of INPUTS identified in task analysis and in mode analysis which form the basis for discriminations and generalizations regarding: INPUTS*	*Record properties of ACTIONS identified in task analysis and in mode analysis which form the basis for associating a particular ACTION with a particular INPUT*	*Record properties of OUTPUTS identified in task analysis and in mode analysis which form the basis for discriminations and generalizations regarding: OUTPUTS*
EXAMPLES OF WHAT TO RECORD	e.g., *direction of current flow* To enable learner to discriminate between situations involving forward and reverse bias in a diode/battery circuit	e.g., *amount of pressure to exert in drilling a tooth* To enable learner to associate appropriate amount of pressure to exert for different types of tooth decay conditions	e.g., *specific color of a chemical solution* To enable learner to determine whether his result in an experiment is correct or not (discriminating between right and wrong color)

E.2.1

SUMMARY OF PROCEDURES FOR IDENTIFYING AND RECORDING CRITERION PROPERTIES

#1

a. Inspect task analysis diagram, learning analysis and mode analysis diagram for relevant properties of INPUTS

b. Record properties in INPUT row on FORM E.1(1)

#2

a. Inspect task analysis diagram, learning analysis and mode analysis diagram for relevant properties of ACTIONS

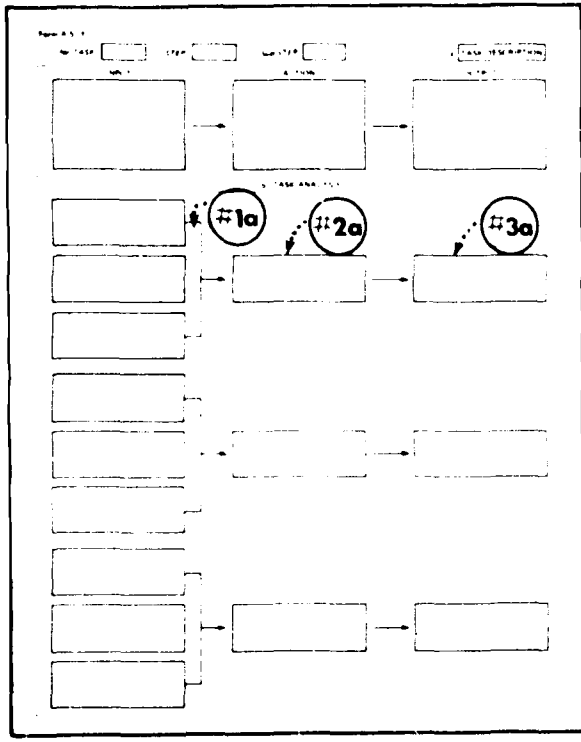
b. Record properties in ACTION row on FORM E.1(1)

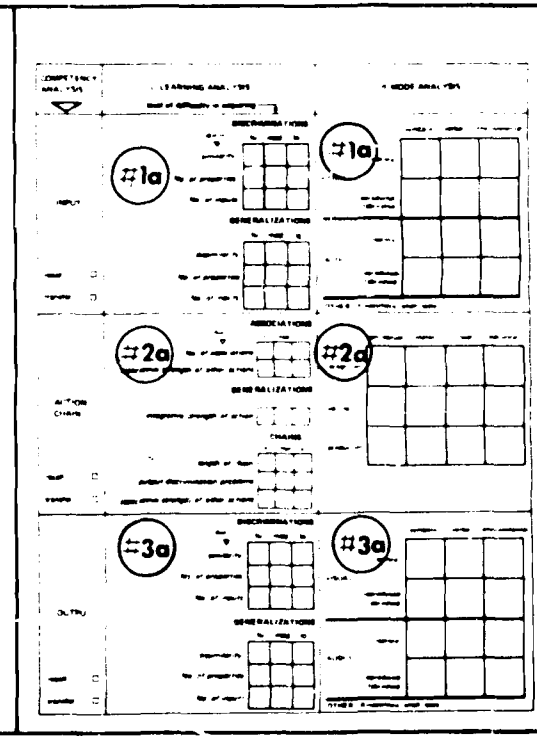
#3

a. Inspect task analysis diagram, learning analysis and mode analysis diagram for relevant properties of OUTPUTS

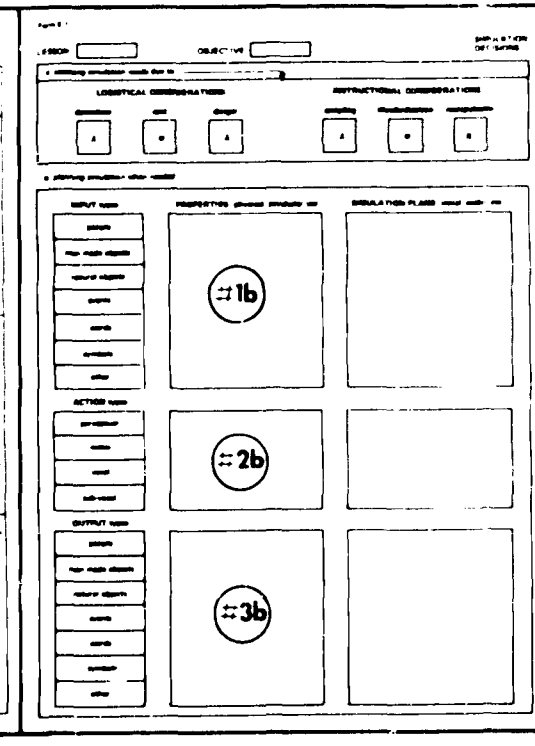
b. Record properties in OUTPUT row on FORM E.1(1)

Form A.5(4)





Form E.1(1)



E.2.1

CRITERIA FOR DETERMINING THE ADEQUACY OF THE IDENTIFICATION AND RECORDING OF CRITERION PROPERTIES

STANDARDS MATRIX

PROPERTIES	COMPLETENESS	CROSS-REFERENCING
CRITERIA	*Identification of all relevant properties on which the following depend:* *-Discriminations and generalizations regarding: INPUTS* *-Associations between INPUTS and ACTIONS* *-ACTION generalizations* *-Discriminations and generalizations regarding: OUTPUTS*	*-Each simulation form can be stored with the task analysis form on which it is based* *-Cross-referencing is by lesson number and objective number (form containing statement of objectives also stored with the task analysis form)*

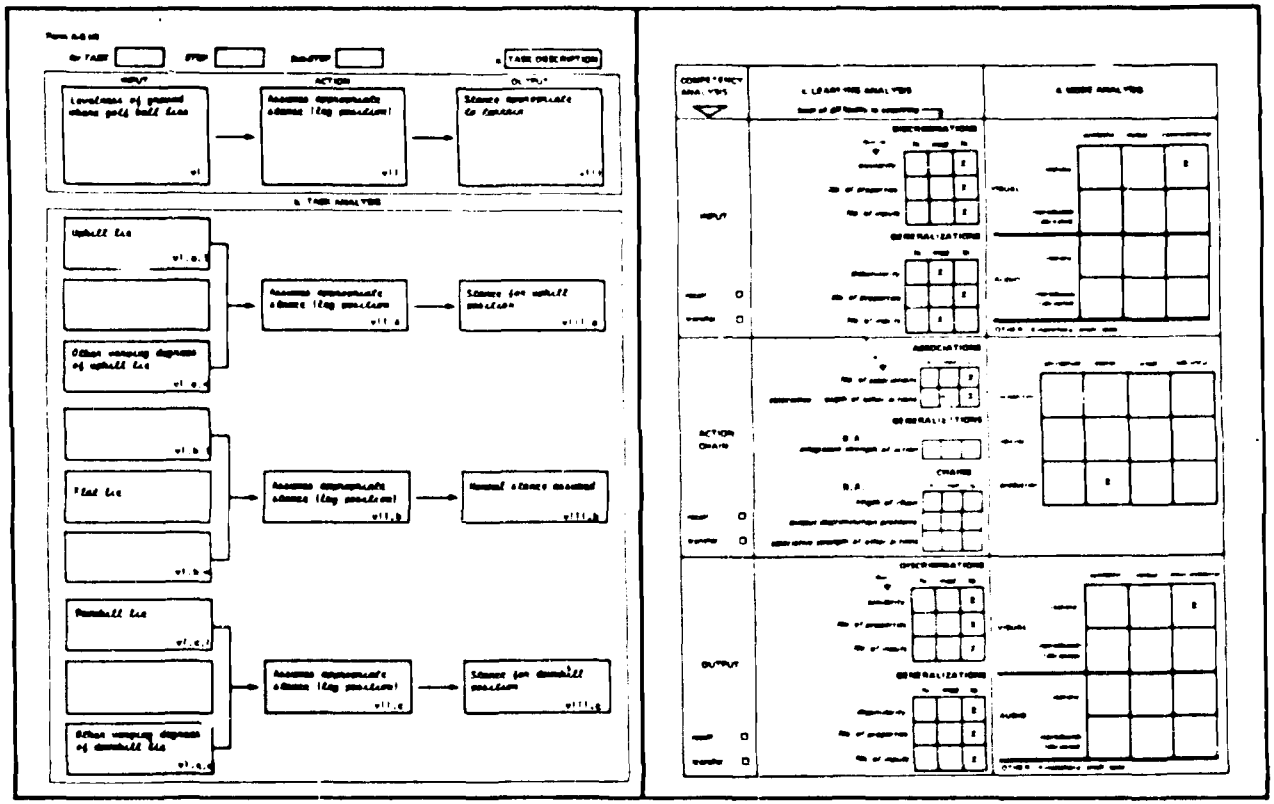
E.2.1

EXAMPLE ILLUSTRATING RECORDING OF CRITERION PROPERTIES ON FORM E.1(1)

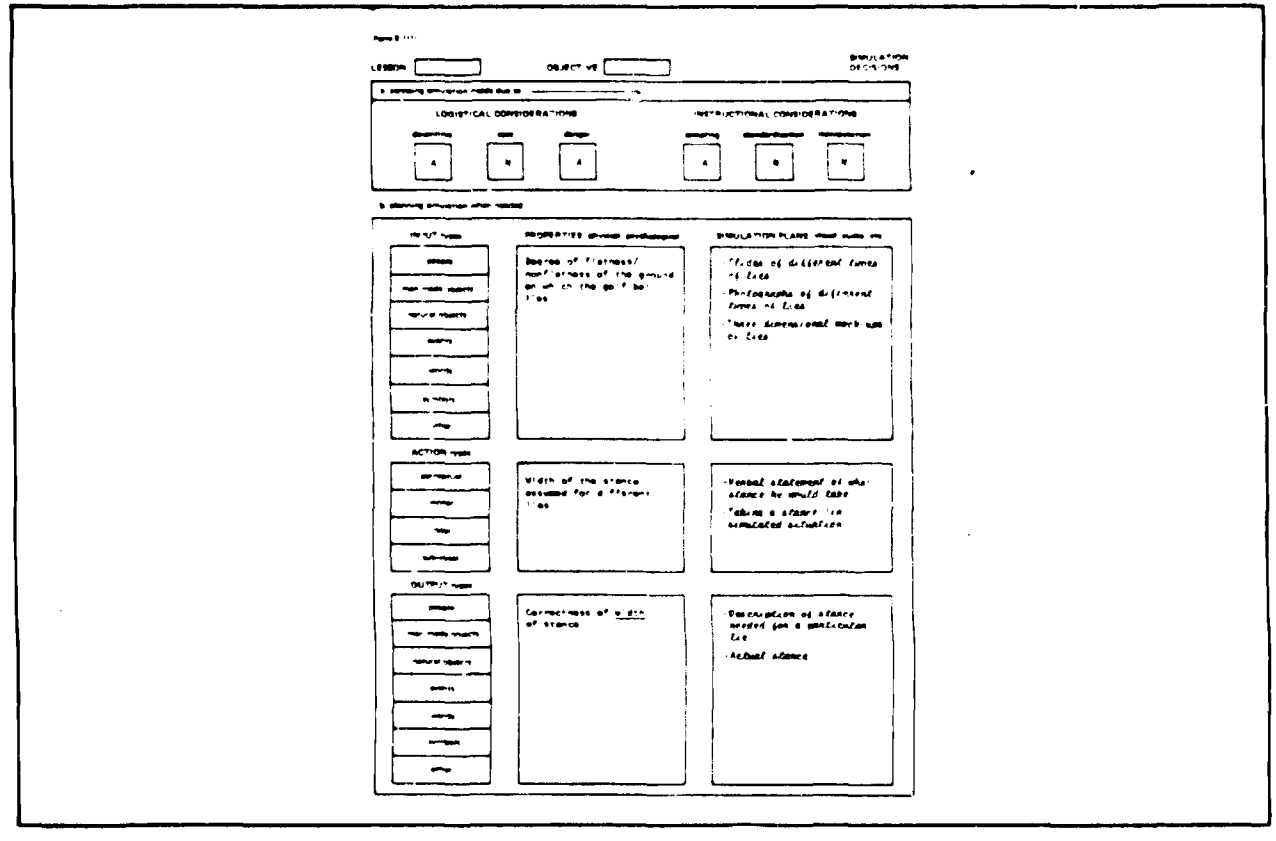
(THIS AND OPPOSITE PAGE)

EXAMPLE

FORM A.5(4)



FORM E.1(1)


LESSON
OBJECT #
LOGISTICAL CONSIDERATIONS
INSTRUCTIONAL CONSIDERATIONS
A
N
A
A
N
N
Degree of fidelity/ non-fidelity of the ground on which the golf ball lies
- Photographs of different types of lies
- Three dimensional work with lies
Width of the stance assumed for different lies
- Verbal statement of what stance he would take
Correctness of a pair of stance
- Description of stance needed for a particular lie
- Actual stance

PREVIEW OF THE NEXT SubSTEP

YOUR PRODUCT	*Alternative simulation plans all of which are capable of meeting simulation needs.*
WHAT YOU WILL WORK FROM	(1) Identified need to make simulation similar to or dissimilar to criterion behavior. (2) Task and mode analyses. (3) Properties identified as requiring simulation.
WHAT YOU WILL DO	(1) Plan alternative types of simulation to meet identified needs. (2) Record in righthand column of FORM E.1(1).
FORMS YOU WILL USE	FORM E.1(1) -- righthand column -- for recording alternative simulation plans.

DESCRIPTION OF Sub-STEP	E.2.2

INPUT	ACTION	OUTPUT
Reason for simulation need + task and mode analyses + properties to be simulated iv	Plan alternative types of simulation to meet simulation need v	Simulation which is either similar to or dissimilar from criterion, depending on reason for simulation need vi

Job Aid Contents

CRITERIA FOR IDENTIFYING INPUTS	ACTION TO BE TAKEN	STANDARD FOR OUTPUTS	FORMS TO USE
-MATRIX: Nature of similarity . .54 -MATRIX: Nature of dissimilarity . .58	-MATRIX: Aim in simulation . . . 52 -MATRIX: How to produce similarity or dissimilarity in simulation . 53, 57	-MATRIX: Adequacy of simulation plans 61	FORM E.1(1) SUMMARY OF PROCEDURES . . . 60

Required Materials

COMPLETED MATERIALS	STEP	COMPLETED FORMS	STEP	BLANK FORMS
Identification of why simulation is needed	E.1.2	Middle column in FORM E.1(1)	E.2.1	Right-hand column in FORM E.1(1)

Sub-STEP E.2.2

JOB DIAGRAM

INPUT	ACTION	OUTPUT
Reason for simulation need + task and mode analyses iv	Plan alternative types of simulation to meet simulation need v	Simulation which is either similar to or dissimilar from criterion, depending on reason for simulation need vi
Simulation Needs: -To sample criterion situation -To standardize criterion situation -To manipulate inputs (otherwise unobservable) iv.a	Plan to make simulation situation and criterion situation as nearly alike as possible v.a	Plans for simulation aiming for identity in: -Mode -Type and number of properties -Realism vi.a
Simulation Needs: -To alter (manipulate) criterion situation iv.b	Plan to make simulation situation and criterion situation different from one another v.b	Plans for simulation aiming for difference in: -Mode -Type and number of properties -Realism vi.b

BACKGROUND INFORMATION

	page
Determining how to simulate so as to meet instructional goals	52
How to produce similarity between simulation and criterion standards	53-56
How to plan for deviations in similarity between simulation and criterion situation	57
Nature of dissimilarity between simulation and criterion situation	58

E.2.2

DETERMINING HOW TO SIMULATE SO THAT INSTRUCTIONAL GOALS CAN BE MET

DECISION MATRIX

GOALS	INSTRUCTIONAL GOALS 1. To sample criterion inputs that would otherwise not occur often enough or soon enough--on a spontaneous basis 2. To standardize properties of criterion inputs presented during training 3. To manipulate (i.e., present) criterion inputs (which otherwise might be unobservable) LOGISTICAL GOALS 1. To avoid downtime that would occur from use of criterion situations 2. To avoid high costs that would result from use of criterion situations 3. To avoid danger/damage that would result from use of criterion situations	INSTRUCTIONAL GOALS 1. To manipulate (i.e., alter) criterion inputs or actions in order to make learning easier -Adding or subtracting properties -Changing the number of inputs (e.g., subtracting) -Changing degrees of properties
ACTION TO TAKE	*Strive for SIMILARITY between:* *Simulated and criterion INPUTS* *Simulated and criterion ACTIONS* *Simulated and criterion OUTPUTS*	*Arrange for DISSIMILARITY between:* *Simulated and criterion INPUTS* *Simulated and criterion ACTIONS* *Simulated and criterion OUTPUTS*
OUTCOME	Makes transfer from simulated practice to performance in criterion situation possible	Makes learning during preparatory practice easier

E.2.2

DETERMINING HOW TO PRODUCE SIMILARITY OR DISSIMILARITY BETWEEN SIMULATED AND CRITERION SITUATIONS

DECISION MATRIX

CONDITIONS	Instructional or logistical need to produce SIMILARITY between simulated and criterion situations	Instructional need to produce DISSIMILARITY between simulated and criterion situations
ACTION TO TAKE	-*Make properties of simulated inputs, actions, or outputs:* *as nearly identical as possible with criterion inputs, actions, or outputs* •*Identity of mode* •*Identity in number and type of properties* •*Identity in realism*	-*Change properties of criterion inputs, actions, or outputs:* •*Change in mode* •*Change in number of properties* •*Change in realism* •*Making the simulated and the criterion situation different*
SEE EXAMPLES ON PAGES	55	56

E.2.2

IDENTIFICATION MATRIX

CRITERIA FOR IDENTIFYING SIMILARITY BETWEEN SIMULATED AND CRITERION INPUTS, ACTIONS, OR OUTPUTS

TYPE OF SIMILARITY	Similarity in MODE of inputs, actions, or outputs	Similarity in NUMBER AND TYPE OF PROPERTIES of inputs, actions, or outputs	Similarity in DEGREE OF REALISM of inputs, actions, or outputs
CRITERIA	*Simulated mode is made as nearly identical with criterion mode* *INPUT/OUTPUT MODE* *Visual/audio/etc.* *-Verbal/non-verbal* *-Physical/conceptual/behavioral* *ACTION MODE* *-Recognition/editing/production* *-Perceptual/motor/vocal/sub-vocal*	*The number and types of properties built into simulation is as nearly identical with those in criterion situation* *INPUT/OUTPUT PROPERTIES* *-Physical properties:* *•Size, shape, color, etc.* *-Psychological properties:* *•Conceptual, symbolic* *•Behavioral* *ACTION PROPERTIES* *-Physical properties:* *•Direction, duration, etc.* *-Psychological properties:* *•Conceptual/behavioral*	*Simulated and criterion situations share the same degree of realism* *INPUT/OUTPUT REALISM* *-Realism of:* *•Objects* *•People* *•Events* *Actual vs. reproductions* *ACTION REALISM* *-Physical realism* *-Psychological realism*
EXAMPLES OF SIMULATION WHICH IS SIMILAR TO THE CRITERION	INPUT MODE *-Criterion input:* *•Spoken French (to be understood)* *-Simulated input:* *•Recorded French (tape)* Mode of inputs is similar; inputs are both oral/audio ACTION MODE *-Criterion action:* *•Spoken reply in French* *-Simulated action:* *•Records reply on tape* Mode of action is similar: producing an oral reply	INPUT PROPERTIES *-Criterion input:* *•Shape and color of type of leave (to be identified)* *-Simulated input:* *•Color photograph of leaf* Simulation presents the two key properties ACTION PROPERTIES *-Criterion action:* *•Names the type of leaf* *-Simulated action:* *•Names the type of leaf* The manner of identification is the same	REALISM OF INPUTS *-Criterion input:* *•Customers at sales counter* *-Simulated input:* *•Actors at sales counter* Simulation involves "live" people REALISM OF ACTIONS *-Criterion action:* *•Tells customer what he wants to know* *-Simulated action:* *•Tells actor what he wants to know* Both involve "live" performance

E.2.2

EXAMPLES OF SIMULATION VARYING IN THE DEGREE OF SIMILARITY TO THE CRITERION:
SAME CRITERION EXAMPLE USED THROUGHOUT, I.E., "TEALHER USE OF CONTINGENCY MANAGEMENT TECHNIQUES"

EXAMPLES

DEGREE OF SIMILARITY		HIGH		MEDIUM		LOW	
		CRITERION	SIMULATION	CRITERION	SIMULATION	CRITERION	SIMULATION
MODE	Inputs	Desirable student behavior	*Actors displaying desirable behavior*	Desirable student behavior	*Actors displaying desirable behavior*	Desirable student behavior	*Verbal description of desirable student behavior*
	Action	Delivers verbal praise	*Actors displaying desirable behavior*	Delivers verbal praise	*Writes on paper--what she would say*	Delivers verbal praise	*Writes on paper--what she would say*
	Outputs	Change in student behavior	*Change in behavior of student actors*	Change in student behavior	*Verbal feedback is provided*	Change in student behavior	*Verbal feedback is provided*
		Simulation preserves visual mode of inputs/outputs and verbal/production mode of actions.		There is a deviation in mode of action and of output.		Visual/nature of input/output is changed; oral action is changed to writing.	
NUMBER/ TYPE OF PROPERTIES		CRITERION	SIMULATION			CRITERION	SIMULATION
	Inputs	Student does not exceed previous number of minutes of work for which he was reinforced. Student says he has improved.	*Live actors; identical durations used*			Student does not exceed previous number of minutes of work for which he was reinforced.	*Live actors; identical durations used*
	Action	Withholds reinforcement (ignores)	*Withholds reinforcement or says she would withhold*			Withholds reinforcement (ignores)	*Withholds reinforcement or says she would withhold*
	Outputs	Disappointed look in student	*Disappointed look in student*			Disappointed look in student	*Disappointed look in student*
		Key property of duration is adequately simulated; it is the basis for the discrimination when to reinforce and when not to.				The key property of student pleading has been omitted.	
DEGREE OF REALISM		CRITERION	SIMULATION	CRITERION	SIMULATION	CRITERION	SIMULATION
	Inputs	Desirable student behavior	*Actors displaying desirable behavior*	Desirable student behavior	*Film of students exhibiting desirable behavior*	Desirable student behavior	*Still photographs or verbal description of desirable student behavior*
	Action	Delivers verbal praise	*Actors displaying desirable behavior*	Delivers verbal praise	*Talk out loud (giving verbal praise)*	Delivers verbal praise	*Talk out loud (giving verbal praise)*
	Outputs	Change in student behavior	*Change in behavior of student actors*	Change in student behavior	*Change in student behavior*	Change in student behavior	*Change in student behavior*
		Simulation is "live," similar to criterion.		Film simulation departs from realism of "live" situation.		Simulation is a marked departure from "live" situation.	

E.2.2

EXAMPLES INDICATING DIFFERING DEGREES OF DEVIATION BETWEEN SIMULATED AND CRITERION SITUATIONS

EXAMPLES

TYPE OF DEVIATION	MORE ACCEPTABLE SIMULATION	LESS ACCEPTABLE SIMULATION
Deviation in MODE	Criterion action: *Handling (at the production level) radioactive materials*	
	Simulated action: *Editing or critiquing the handling by another (live or on film) of the radioactive materials*	Simulated action: *Selecting (recognition practice) which of two ways to handle radioactive materials*
	Editing or critiquing comes closer to the criterion than merely selecting from options. (However, in "preparatory" practice, recognition practice can play a useful role.	
Deviation in NUMBER/TYPE OF PROPERTIES	Criterion input: *Performance of a symphony: Direction of sounds of choirs and balances*	
	Simulated input: *Stereo recording*	Simulated input: *Monophonic recording*
	The stereo recording will more faithfully reproduce directionality and balance and allow discriminations about both of them to be made.	
Deviation in DEGREE OF REALISM	Criterion input: *Facial expression of customer (student, employee)*	
	Simulated input: *Film of facial expressions of customers*	Simulated input: *Animated film showing facial expressions of customers*
	The animated version (deviating in realism) might either caricature facial expressions or fail to provide adequate (e.g., subtle enough) cues which form the basis for discriminations and decisions about the customer's mood.	

E.2.2

DECISION MATRIX

DETERMINING THE DIRECTION TO TAKE WHEN IT MAY BE UNAVOIDABLY NECESSARY TO DEVIATE FROM SIMILARITY BETWEEN SIMULATION AND CRITERION SITUATIONS

CONDITIONS	Plans to deviate from criterion MODE	Plans to deviate from criterion NUMBER OR TYPE OF PROPERTIES	Plans to deviate from criterion DEGREE OF REALISM
ACTION TO TAKE	*Select mode which:* *-Attempts to preserve key properties* *-Is a high strength substitute that is functionally equivalent, i.e., allows discriminations, generalizations, or associations to be acquired* *•A concrete verbal description vs. an abstract description simulating a visual object*	*Plan deviation from number or type of properties:* *-Which represents the least deviation:* *•Keeps as many properties present* *•Keeps the types of properties as close as possible to criterion* *-Is a high strength substitute that is functionally equivalent, i.e., allows discriminations, generalizations, or associations to be acquired*	*Select degree of realism which:* *-Preserves key properties* *-Is a high strength substitute that is functionally equivalent, i.e., allows discrimination, generalizations, or associations to be acquired*
EXAMPLES	e.g., teacher training Criterion action: *Orally delivering verbal praise as reinforcement* Simulated action: *Writing what she would say when delivering verbal praise* The content of what is said is the key property here, and simulation is functionally equivalent to criterion; while oral practice would be ideal, the description used is not critical	e.g., botany Criterion inputs: *Leaves to be identified on basis of size, color, shape* Simulated inputs: *Black and white photographs and verbal description of color* Key properties (size and shape are ideally simulated); color is identified in words, making it possible to distinguish between types of leaves	e.g., teacher training Criterion inputs: *Children exhibiting problem behavior (which the teacher has to manage)* Simulated inputs: *A film of problem behavior* The film allows a realistic representation of key properties that determine which management technique to use

E.2.2

CRITERIA FOR IDENTIFYING DISSIMILARITY BETWEEN SIMULATED AND CRITERION INPUTS, ACTIONS, OR OUTPUTS*

IDENTIFICATION MATRIX

TYPE OF DISSIMILARITY	Dissimilarity in MODE of inputs, actions, or outputs	Dissimilarity in NUMBER AND TYPE OF PROPERTIES of inputs, actions, or outputs	Dissimilarity in DEGREE OF REALISM of inputs, actions, or outputs
CRITERIA	*Simulated mode is made as nearly dissimilar to criterion mode*	*The number and types of properties built into simulation is as nearly dissimilar to those in criterion situation*	*Simulated and criterion situations have dissimilar degrees of realism*
	INPUT/OUTPUT MODE	*INPUT/OUTPUT PROPERTIES*	*INPUT/OUTPUT REALISM*
	-Visual/auditory/etc. -Verbal/non-verbal -Physical/conceptual/behavioral	-Physical properties: •Size, shape, color etc. -Psychological properties: •Conceptual, symbolic •Behavioral	-Realism of: •Objects •People •Events -Actual vs. reproductions
	ACTION MODE	*ACTION PROPERTIES*	*ACTION REALISM*
	-Recognition/editing/production -Perceptual/motor/vocal/sub-vocal	-Physical properties: •Direction, duration, etc. -Psychological properties: •Conceptual/behavioral	-Physical realism -Psychological realism

*See Section H on "STRATEGIES" for ways in which simulation should be systematically and purposefully designed to be dissimilar.

	INPUT MODE	INPUT PROPERTIES	REALISM OF INPUTS
EXAMPLES OF SIMULATION WHICH IS DISSIMILAR TO THE CRITERION	-Criterion input: •Verbal description of difference in speed of air above and below an airplane wing -Simulated input: •Animated representation of difference in speed Concrete visual mode used in preparatory practice, replacing the more abstract verbal of the criterion situation	-Criterion input: •French spoken at a conventional, natural rate -Simulated input: •Deliberately slowed down rate of speech	-Criterion input: •Heating of bimetal bar closes circuit and bell rings -Simulated input: •Animated version shows flow of current Use of non-realism to present a usually unobservable phenomenon
	ACTION MODE	ACTION PROPERTIES	REALISM OF ACTIONS
	-Criterion action: •States the consequences of the difference in air speed above and below the wing -Simulated action: •Points to where the pressure is greater (above or below the wing)	-Criterion action: •Responds to the meaning of the word (gives the English equivalent) -Simulated action: •Selects which of the two French words means the English equivalent Recognition responding used instead of production	-Criterion action: •Describes what he sees occurring in the demonstration -Simulated action: •Describes what he sees represented Has different phenomenon to describe

JOB PROCEDURES

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Assessing adequacy of simulation plans	61
FORM E.1(1) for use in making simulation plans	63-64

E.2.2

ILLUSTRATION SUMMARIZING PROCEDURES FOR PLANNING ALTERNATIVE FORMS OF SIMULATION TO MEET INSTRUCTIONAL GOALS

#1

a. Inspect top part of FORM E.1(1) for type of instructional need for simulation

b. Inspect task analysis, learning analysis, and mode analysis on FORM A.5(4) for INPUTS

c. Inspect key properties of INPUTS recorded on FORM E.1(1)

d. Plan alternative types of simulation of INPUTS in right-hand column of FORM E.1(1)

#2

a. Inspect task analysis, learning analysis, and mode analysis on FORM A.5(4) for ACTIONS

b. Inspect key properties of ACTIONS recorded on FORM E.1(1)

c. Plan alternative types of simulation of ACTIONS in right-hand column of FORM E.1(1)

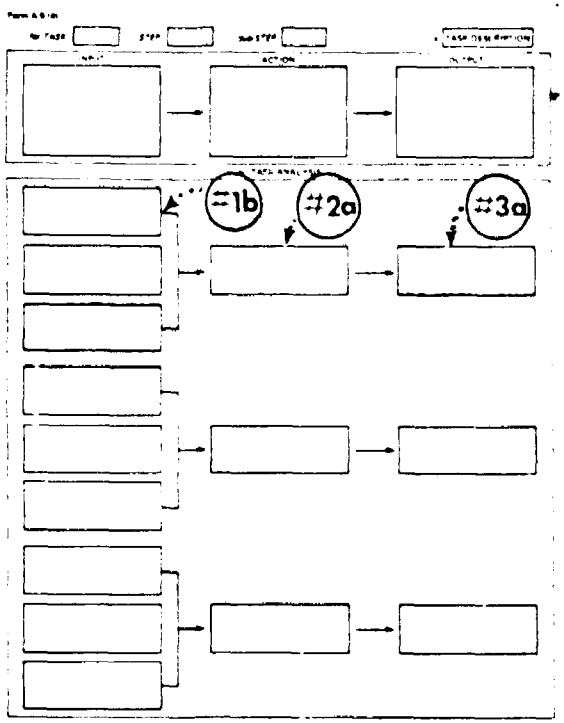
#3

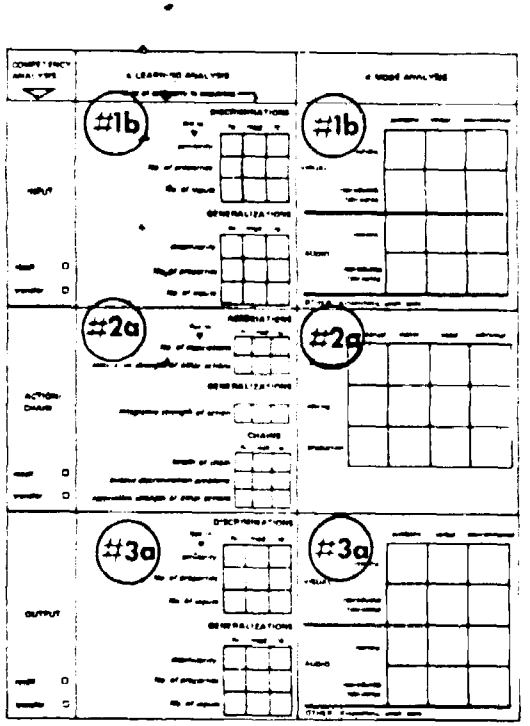
a. Inspect task analysis, learning analysis, and mode analysis on FORM A.5(4) for OUTPUTS

b. Inspect key properties of OUTPUTS recorded on FORM E.1(1)

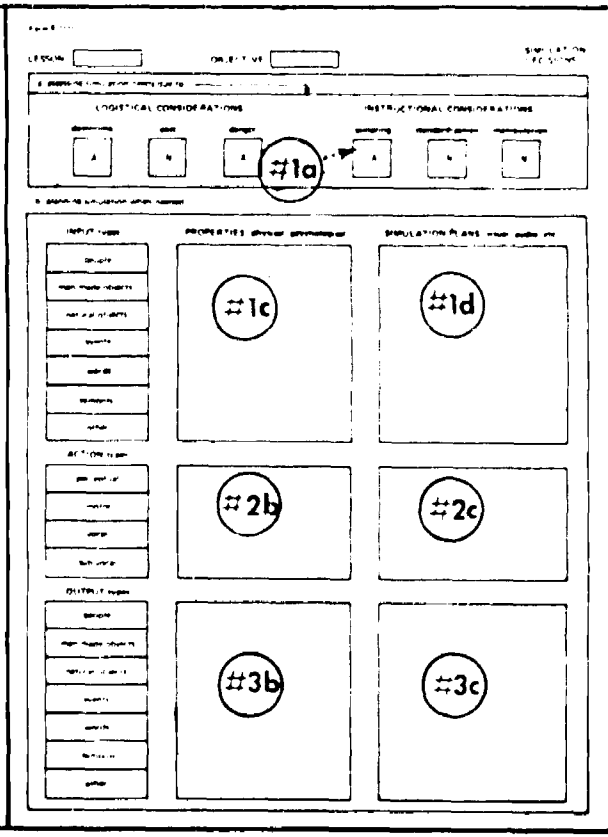
c. Plan alternative types of simulation of OUTPUTS in right-hand column of FORM E.1(1)

FORM A.5(4)





FORM E.1(1)



E.2.2

CRITERIA FOR ASSESSING THE ADEQUACY OF SIMULATION PLANS - ON FORM E.1(1)

STANDARDS MATRIX

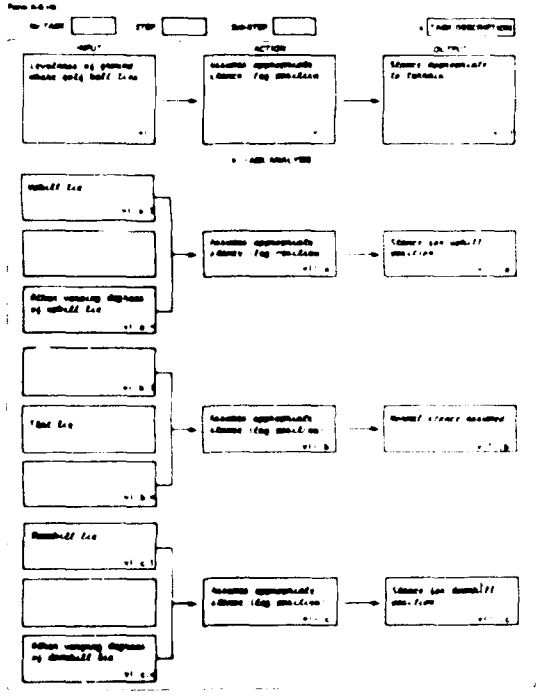
PROPERTIES	COMPLETENESS	RELEVANCE TO REASON FOR SIMULATING	CROSS-REFERENCING
CRITERIA	-*Alternative simulation plans for:* *INPUTS* *ACTIONS* *OUTPUTS*	-*To solve logistical problems of: downtime, cost, or damage/danger* -*To solve instructional problems of: sampling, standardizing, or manipulating (for unobservables)* ·*The creation of simulation as similar as possible to criterion* -*To solve instructional problems of:* *Manipulation to make learning easier in preparatory practice:* ·*The creation of simulation which is dissimilar to criterion in specified ways* (See strategy section on types of preparatory practice which makes learning easier)	-*Filed with the task analysis form(s), FORM A.5(4) or A.5(11), on which decisions are based* -*Labeling of lesson number and objective number*

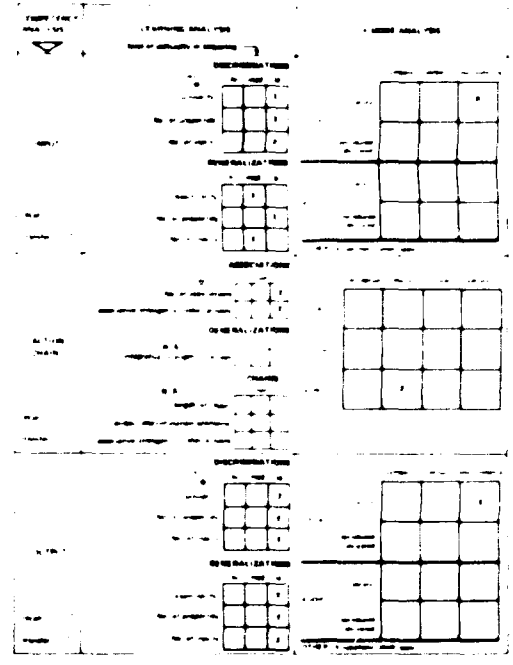
E.2.2

EXAMPLE OF SIMULATION PLANS RECORDED ON FORM E.1(1)

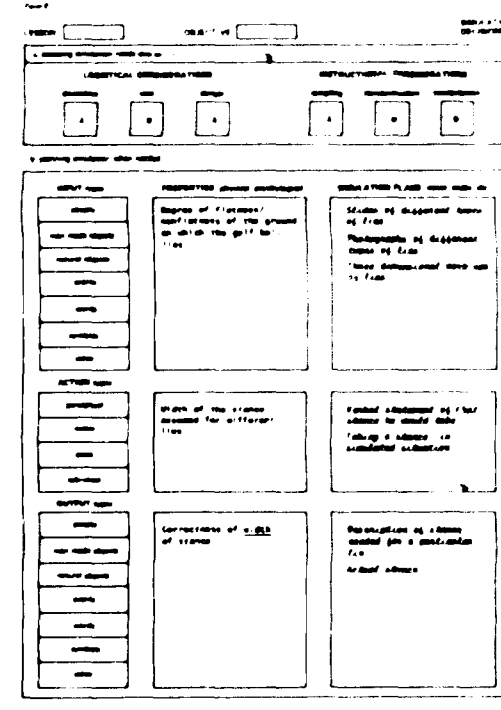
EXAMPLE

FORM A.5(4)





FORM E.1(1)



Form E 1(1)

LESSON [ ] OBJECTIVE [ ]

SIMULATION DECISIONS

a. assessing simulation needs due to →

LOGISTICAL CONSIDERATIONS			INSTRUCTIONAL CONSIDERATIONS		
downtime	cost	danger	sampling	standardization	manipulation
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. planning simulation when needed

INPUT types	PROPERTIES: physical, psychological	SIMULATION PLANS: visual, audio, etc.
people		
man made objects		
natural objects		
events		
words		
symbols		
other		
ACTION types		
perceptual		
motor		
vocal		
sub-vocal		
OUTPUT types		
people		
man made objects		
natural objects		
events		
words		
symbols		
other		

Form E 1(1)

LESSON [ ] OBJECTIVE [ ]

SIMULATION DECISIONS

a assessing simulation needs due to →

LOGISTICAL CONSIDERATIONS

downtime	cost	danger
[ ]	[ ]	[ ]

INSTRUCTIONAL CONSIDERATIONS

sampling	standardization	manipulation
[ ]	[ ]	[ ]

b planning simulation when needed

INPUT types	PROPERTIES: physical, psychological	SIMULATION PLANS: visual, audio, etc.
people		
man made objects		
natural objects		
events		
words		
symbols		
other		

ACTION types		
perceptual		
motor		
vocal		
sub-vocal		

OUTPUT types		
people		
man made objects		
natural objects		
events		
words		
symbols		
other		

PREVIEW OF THE NEXT SubSTEP

YOUR PRODUCT	*Selection from among alternative simulation plans the most cost effective one.*
WHAT YOU WILL WORK FROM	(1) Alternative simulation plans recorded on FORM E.1(1).
WHAT YOU WILL DO	(1) Assess logistical costs of implementing each of the simulation plans listed. (2) Select the most cost effective.
FORMS YOU WILL USE	None

DESCRIPTION OF Sub-STEP	E.2.3

INPUT	ACTION	OUTPUT
Alternative simulation plans on FORM E.1(1) vii	Assess logistical burden of implementing simulation, and select most cost effective plan consistent with instructional needs viii	Cost effective plan for simulation ix

Job Aid Contents

CRITERIA FOR IDENTIFYING INPUTS	ACTION TO BE TAKEN	STANDARD FOR OUTPUTS	FORMS TO USE
-MATRIX: Assessing logistical burden of alternative simulation plans 68	-MATRIX: Selecting the final simulation plan 71	-MATRIX: Adequacy of selection of simulation plan 73	SUMMARY OF PROCEDURES . . . 72

Required Materials

COMPLETED MATERIALS	STEP	COMPLETED FORMS	STEP	BLANK FORMS
		FORM E.1(1) SIMULATION DECISIONS	E.2.2	

Sub-STEP E.2.3

JOB DIAGRAM

INPUT	ACTION	OUTPUT
Alternative simulation plans on FORM E.1(1) vii	Assess logistical burden of implementing simulation, and select most cost effective plan consistent with instructional needs viii	Cost effective plan for simulation ix

Logistical burden of using instructionally optimum simulation plan is low to medium vii.a	Select the instructionally optimum simulation plan viii.a	Cost effective and/or logistically acceptable simulation plan ix.a
Logistical burden of using instructionally optimum simulation plan is medium to high vii.b	Select the simulation plan which maximizes achievement of instructional goals and is within acceptable logistical limits viii.b	Cost effective and/or logistically acceptable simulation plan ix.b

JOB PROCEDURES

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Factors making simulation plans logistically acceptable	68
Determining how to select from among alternative simulation plans	71
SUMMARY OF JOB PROCEDURES	72
Assessing adequacy of selection of simulation plan	73

E.2.3

IDENTIFICATION MATRIX

CRITERIA FOR IDENTIFYING FACTORS THAT MAKE SIMULATION PLANS LOGISTICALLY ACCEPTABLE

FACTORS	When simulation is to be used in criterion practice, in testing, or in preparatory practice: COST	When simulation is to be used in criterion practice, in testing, or in preparatory practice: ADMINISTRATION
CRITERIA	*COST OF:* *-Preparing simulation* *-Using simulation* *•Equipment* *•Space* *-Using personnel to administer* *-Preparing new versions of simulation as required*	*ADMINISTRATIVE PROBLEMS DUE TO:* *-Need of personnel to prepare simulation* *-Need of personnel to administer simulation* *-Complexity of administration and potential need to train personnel to administer* *-Complexity of scheduling based on potential simulation (e.g., equipment/trainee ratios)*
EXAMPLES	e.g., cost of preparing film or animation to be used for simulation of criterion situations are likely to be expensive e.g., if frequent changes in the nature of the criterion situation occur, simulation, which is expensive to begin with and which may have to be altered frequently, becomes prohibitive	e.g., non-automated simulation of complex equipment may require the use of people to run the equipment e.g., simulated equipment may increase training time if of necessity trainee/simulation ratio must be high

E.2.3

EXAMPLES OF SIMULATION VARYING IN DEGREES OF LOGISTICAL BURDEN DUE EITHER TO COST OR TO ADMINISTRATIVE CONSIDERATIONS

BURDEN DUE TO	CRITERION TO BE SIMULATED	COMPARATIVE DEGREE OF BURDEN: HIGHER	MIDDLE	LOWER
COST	Driving a car	e.g., simulated three-dimensional car: with film for displaying both driving conditions and results of actions taken; provision for actually taking action	e.g., film of driving conditions; verbal responding by trainee to indicate action to be taken; verbal feedback about correctness	e.g., verbal description of driving conditions; verbal description by trainee to indicate action to be taken; verbal feedback about correctness
ADMINISTRATIVE CONSIDERATIONS	Comprehending and speaking a foreign language	e.g., each student has a personal tutor who speaks to and listens to student This introduces problem (not only of cost) of scheduling.	e.g., use of tape recorders with pre-recorded inputs; -student records responses -gets feedback from trainer who reviews recording	e.g., use of tape recorders with pre-recorded inputs; -student records responses -correct response is on tape; learner compares his own response with correct response

E.2.3

DETERMINING HOW TO SELECT FROM AMONG SIMULATION PLANS DIFFERING IN LOGISTICAL BURDEN

DECISION MATRIX

CONDITIONS	LOGISTICAL BURDEN of instructionally optimum simulation plan is low to medium	LOGISTICAL BURDEN of instructionally optimum simulation plan is medium to high
ACTION TO TAKE	-*Select the instructionally optimum simulation plan*	-*Select the simulation plan* •*Which can be produced within acceptable or allowable logistical limits* *AND* •*Which, at the same time, maximizes the instructional purpose of simulation* •*Maximizes similarity between criterion and simulation* *OR* •*Is capable of creating dissimilarity*

EXAMPLES		
	CRITERION *Salesman (teacher, supervisor) reacts to customer's (student's, subordinate's) tone of voice* SIMULATION PLANS (1) *Trainee responds to live actors* (2) *Trainee records responses to filmed presentation* (3) *Trainee writes responses after seeing photographs*	
	The budget available for the training program is large. Use of live actors, although expensive, when used with many trainees is the most preferable. This type of simulation allows for key properties of inputs (customer's facial expression), actions (salesman's response), and outputs (customer's reaction) to be represented.	On a severely limited budget, simulation involving photographs and written responses. If photographs display enough key properties, they may be adequate to the task. A criterion verbal response (simulating an oral response) can be effectively used.

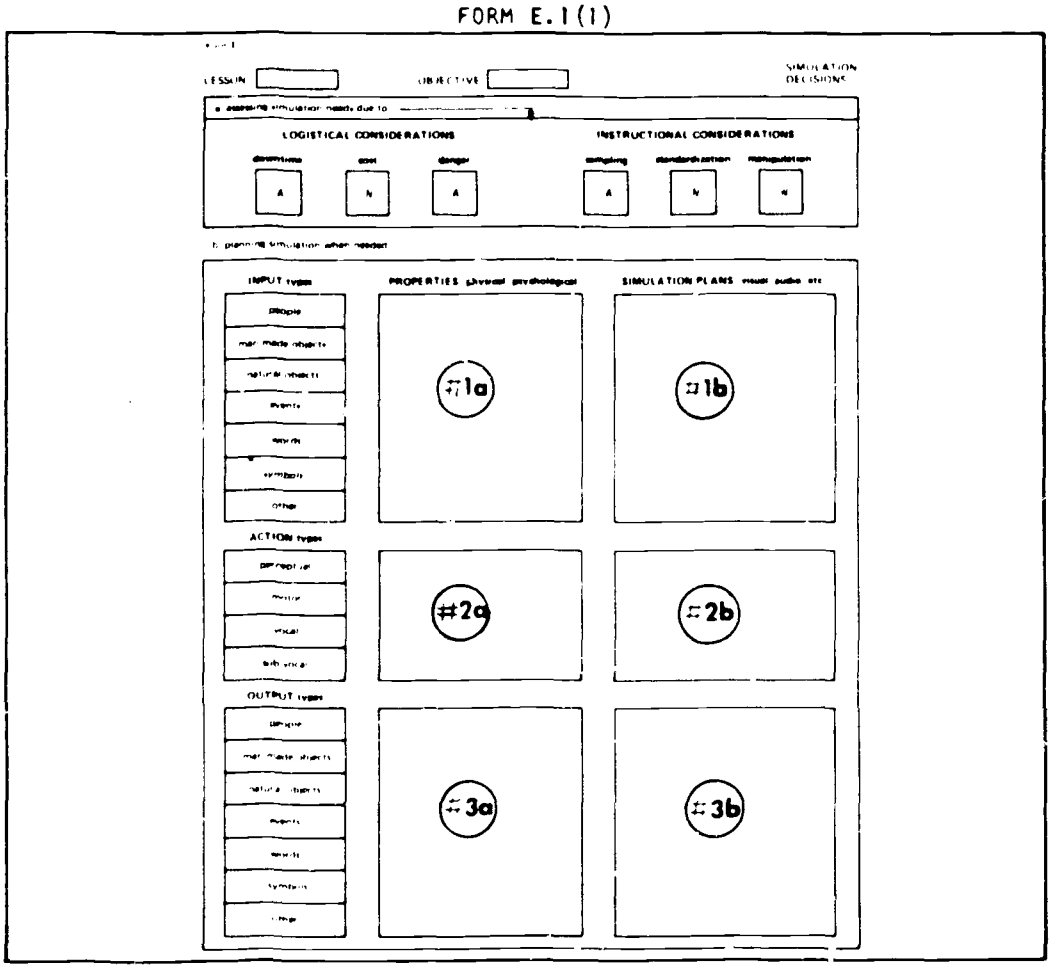
E.2.3

ILLUSTRATION SUMMARIZING PROCEDURES INVOLVED IN MAKING FINAL SELECTION OF ONE SIMULATION PLAN

#1	#2	#3
a. Review properties of INPUTS to be simulated	a. Review properties of ACTIONS to be simulated	a. Review properties of OUTPUTS to be simulated
b. Review alternative simulation plans for INPUTS	b. Review alternative simulation plans for ACTIONS	b. Review alternative simulation plans for OUTPUTS
c. Assess logistical burden of each plan	c. Assess logistical burden of each plan	c. Assess logistical burden of each plan
d. Select plan which can maximize simulation requirements and still be within acceptable logistical limits	d. Select plan which can maximize simulation requirements and still be within acceptable logistical limits	d. Select plan which can maximize simulation requirements and still be within acceptable logistical limits

Steps 1, 2, and 3 will probably be performed simultaneously.

FORM E.1(1)



E.2.3

THREE CRITERIA FOR ASSESSING THE ADEQUACY OF THE SELECTED SIMULATION PLAN

STANDARDS MATRIX

FACTORS	1 COMPLETENESS	+ 2 INSTRUCTIONAL ADEQUACY	+ 3 LOGISTICAL ADEQUACY
CRITERIA	*Simulation plan provides for:* -*Display of relevant inputs* -*An opportunity for trainee to exhibit an action* -*The resulting production of an output*	*Simulation plan provides for:* -*Maximized similarity of properties between criterion and simulated situation* -*Adequate opportunity to create dissimilarity when necessary*	*Simulation plan:* -*Is within acceptable cost limitations* -*Is within acceptable administrative limitations*

STEP E.2

COMPLETION CHECKLIST

	IDENTIFIED	PERFORMED	PRODUCED	FORMS COMPLETED
E.2.1	-Properties requiring simulation			FORM E.1(1)
E.2.2			-Alternative plans for simulation	FORM E.1(1)
E.2.3		-Selected optimum simulation plan		