MARINE CORPS GROUND SIMULATOR TRAINING NEEDS IN THE 1985-1995 TIME FRAME

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ABSTRACT

This study was initiated to develop a document to be used for the planning and programming of simulation acquisition in support of Marine Corps training.

Generic training task requirements in the ground combat (C), combat support (CS) and combat service support (CSS) fields which can be enhanced through the use of simulation were identified. Tradeoff analyses were performed to develop prioritized lists of the tasks for which simulators should be developed and of recommended generic-type simulation devices.

The extent of the need for simulation was assessed by determining which of the training task requirements would be improved by the use of simulation, taking into account the technology state-of-the-art (SOA). Measures of quality of training used included: performance, time to train, training cost, personnel support, technological risk, integratability with other training, and special assets requirements.

This paper describes the methodology applied and the results obtained. Special emphasis is put on the criteria utilized and the planned future use of the results.

The purpose of the study reported here was to develop a prioritized list of ground combat, combat support and combat service support tasks for which simulation would economically improve training. This prioritization is critical because the number of tasks whose effective training can be supported through simulation cannot be fully supported by available resources. The study resulted in a baseline of tasks and simulation technology for Marine Corps efforts to define and incorporate simulator training during the 1985-1995 timeframe.

To fulfill such a purpose, the objectives of the study were to:

- Determine those training requirements in the ground combat (C), combat support (CS), and combat service support (CSS) fields which could be enhanced through the use of simulation, and
- Develop a prioritized listing of recommended generic-type simulation devices, based on current and emerging technology, which would be capable of satisfying those requirements.

For purposes of meeting the objectives of the study, a simulator was defined as a device which provides a functional replication of hardware or operational system in an environmental context and which requires interaction between it and the trainee(s).

APPROACH

The approach started with a review of extant system front-end analyses results, followed by the determination of tasks to be trained, the development of training objectives, the determination and evaluation of training approach alternatives, the tentative selection of device needs, and a cost/benefit analysis. This study contains the basic elements of this approach at a depth of detail consistent with the broad scope of interest entailed when addressing all the tasks which are encompassed by the C, CS and CSS fields.

In deciding on the depth of detail that would be consistent with the study's purpose, consideration was given to the stated need to provide a structure within which programmers could identify where funds for simulation would provide the best returns. In this context two parameters were of most concern. The first dealt with the ability to identify validated training requirements. Performance of detailed task analyses for each military occupational specialty (MOS) in each of the three fields of interest would have resulted in a study of much longer duration and thus be inconsistent with the immediate need. The solution was to utilize existing documentation, supplemented by discussions with Marine Corps' personnel responsible for training. When combined with the methodology developed as part of the study, this would provide action officers with a valuable tool that would mature as further analyses were conducted.

The second concern dealt with the level of definition of simulation concepts. It was felt that creation of a catalog of devices would be time consuming, would produce an unmanageable document and wouldn't be what was really needed. Taking the above concerns and others into consideration, the approach to the study was defined by bounding the scope with the following guidelines:

- Definition of training requirements was based on a comprehensive review of the combat, combat support, and combat service support fields (including maintenance requirements).
- Training requirements were defined in generic terms as opposed to specific hardware. Accordingly, concepts were defined in terms of generic types of simulation, as opposed to specific training devices.
- Training requirements described tasks to be performed.
- A detailed task analysis of each MOS to determine task training requirements was beyond the scope of the study. The requirements data base was compiled from existing documentation and discussions with Marine Corps personnel responsible for training.
- Life cycle cost (LCC) evaluation was conducted based on order-of-magnitude information, since generic equipment is involved. Major factors affecting LCC were identified.
- The study took into account increasing costs of fuel and ammunition, decreasing availability of ranges and training areas, environmental impacts on training, and expected levels of learning for future user populations.

The general approach used in performing the study consisted of four parts: (1) development of the study framework, (2) assessment of the need for simulation, (3) prioritization of the simulation alternatives, and (4) development of a baseline for future efforts to define and incorporate simulator training in the Marine Corps.

STUDY FRAMEWORK

The framework within which the study was to be performed was established by the conduct of a comprehensive review of Marine Corps needs in order to define current and projected training requirements and to develop a training requirements data base. Also, the state-of-the-art (SOA) in simulation technology was determined and a technology data base was developed.

The output of the review of training requirements was a generalized task list. This list was basic to the study in that it represented the scope of training requirements for which the applications of simulation were to be evaluated. Both equipment-oriented and mission-oriented tasks were considered.

The product of the technology survey task consisted of a summary of the technology base that will be available in the 1985-1995 period which could meet the requirements of Marine Corps training. The survey encompassed simulation technology currently available, in the development stage and proposed. Emerging technology was identified.

TASK 1 - Review of General Training Requirements

The success of the data collection and review effort, it was recognized, would be dependent on acquiring, early, a clear understanding of the Marine Corps[1] training philosophy, training system, and internal responsibilities at all echelons involved in training. From this training framework, the data sources (documentary, institutional, and field unit) could be identified and the data collection effort structured. Accordingly, following an initial coordination meeting with the Contract Officer's Technical Representative (COTR) and selected Marine Corps representatives, the Falcon/XMCO team visited the Marine Corps Development and Education Command (MCDEC) and Headquarters, U.S. Marine Corps (HQMC). The primary thrust of these meetings was to explore the training situation within the Marine Corps. The visits proved to be especially valuable in view of the on-going initiatives to restructure the training system. The information gained, through briefings and documentation, covered the in-house studies which resulted in the changes which are occurring, the organizational and responsibility realignments made, the procedural changes being instituted which affect the methods used in training development, and a perspective of the direction and objectives of the training system.

With regard to this task, the information of overall interest (both current and projected) included: the composition of the C, CS, and CSS fields; their associated weapons/hardware systems; task analysis or other data reflecting general training requirements; critical tasks; training deficiencies and problem areas; and the impact of NBC defense requirements on training. The sources used to acquire this information included: HQMC, MCDEC, and field visits to agencies and units at Camp Lejeune, North Carolina; Camp Pendleton, California; Marine Corps Air Ground Combat Center, Twenty-Nine Palms; the Landing Force Training Center, Norfolk; and the Naval Training Equipment Center (NTEC), Orlando, Florida.

Task training requirements were grouped into two general categories: those associated with the operation and maintenance of equipment (i.e., tanks, trucks, radios, etc.), and those which derive from the mission requirements of a C, CS, or CSS unit (i.e., operational functions). The former are primarily individual tasks whereas the latter are primarily collective tasks.

The source data for the MOS/equipment-oriented tasks consisted of the Marine Corps' Military Occupational Specialties Manual (MCO P12000.7D with Changes 1, 2, and 4), a machine printout of tasks extracted from U.S. Army Soldier's Manuals and extracts of Computerized Occupational Data (CODAP) for selected MOSs, obtained from Headquarters, Marine Corps. The Marine Corps' Combat Readiness Evaluation System (MCCRES) volumes were the main source for mission-oriented task data. Also, personnel directly responsible and involved in training provided inputs in developing the mission-oriented task list.

The overall task list contained 198 mission-oriented tasks and 1564 MOS/equipment-oriented tasks contained in 123 MOSs for 22 occupational fields (OF). The combat, combat support, and combat service support occupational fields of interest are listed in Table 1. Table 2 presents the first ten (out of 24) tasks of the 0311 Rifleman MOS as an example of the type of MOS-oriented tasks contained in the list. These tasks will be utilized later in the paper to demonstrate the methodology that was followed in defining tasks whose training would be enhanced by simulation. Table 3 presents a sample set of mission-oriented tasks for the amphibious raid mission.

Table 1

Combat, Combat Support and Combat Service Support Occupational Fields

OF 01 - Personnel and Administration
OF 02 - Intelligence
OF 03 - Infantry
OF 04 - Logistics
OF 08 - Field Artillery
OF 11 - Utilities
OF 13 - Engineer, Construction, Equipment, and Shore Party
OF 14 - Drafting, Surveying, and Mapping
OF 18 - Tank and Amphibian Tractor
OF 21 - Ordnance
OF 23 - Ammunition and Explosives Ordnance Disposal
OF 25 - Operational Communications
OF 26 - Signals Intelligence/Ground Electronic Warfare
OF 28 - Data/Communications Maintenance
OF 30 - Supply Administration and Operations
OF 31 - Transportation
OF 33 - Food Service
OF 34 - Auditing, Finance, and Accounting
OF 35 - Motor Transport
OF 40 - Data Systems
OF 57 - Nuclear, Biological, Chemical
OF 58 - Military Police
OF 99 - Officers

Table 2

Sample MOS-Oriented Tasks

OF 03 Infantry
MOS 0311 Rifleman
1. Cleans and maintains service rifle, grenade launcher, and intracompany communications equipment.
2. Engages targets with the service rifle, grenade launcher, light antitank weapons, hand grenades, and command detonated anti-personnel mines.
3. Controls/performs fire team, squad and platoon movements.
4. Camouflages and conceals self and individual equipment.
5. Navigates using a map and compass.
6. Applies first-aid.
7. Transmits and receives messages using intracompany communications equipment.
8. Reports information on the enemy, using "salute" report.
9. Handles prisoners of war.
10. Executes embarkation and debarkation from helicopters and amphibious ships.

Table 3

Sample Mission-Oriented Tasks

15. Amphibious Raid
a. Conduct Planning
b. Performs Preparations
c. Develop a Concept of Operations
d. Task Organize
e. Develop a Scheme of Maneuver
f. Conduct Ship to Shore Movement
g. Move to Raid Objective
h. Assault the Raid Objective
i. Retire to the Extraction Point
j. Conduct Reembarkation
k. Conduct Debriefing

TASK 2 - Technology Survey

The technology data base survey encompassed simulation technology currently in existence, in the development stage and proposed. Emerging simulator technology that may be responsive to specific mission area/weapon system general training requirements was identified.

As a result of discussions with personnel cognizant of the USMC training programs/facilities at both the support and operating force levels, a USMC training device/simulation source data base of current and desired items was developed. Information on developmental items together with emerging technology within the simulation field was added through contact with NTEC personnel/USMC Liaison Officers and PM TRADE representatives.

Since training devices/simulators are not service peculiar, a survey of U.S. Army training devices/simulators for those items of equipment, systems and functions common to both USMC and Army training requirements was made. Much of this information was supplied by the U.S. Army Training Support Center at Ft. Eustis, Virginia. Information on foreign and other existing technology was also gathered through a survey of published material and discussions with a number of industry representatives.

Although many of the technological areas are unique, most are used in support of one another to achieve a desired simulation effect. Therefore, they can be consolidated into the following disciplines of simulation technology that are at the forefront of the indicated emerging trends:

- Data Processing
  - Reduced Componentry/Environmental Requirements
  - High Speed Micro-Micro Electronics
  - Transferability/Flexibility of Software/ Courseware Modules
- Visual Simulation
  - Hi-Resolution/Hi-Density Realtime Video/ Digital Discs/Computer Generated Imagery (CGI)
- Engagement Simulation
  - Eye-Safe Lasers/Area Lasers
  - Imbedded Sensors
  - "Safe" Ammunition
  - Holographic/Liquid Crystal "Terrain" Displays
  - Robotics
  - Games
- Environment Simulation
  - Thermal Signature Generators
  - Gas Producers
- Equipment Simulation
  - Operable Mockups
  - Part-Task Trainers
- Surrogate Learning
  - Automatic User-oriented Software/ Courseware with Voice Synthesis
  - Video Games
  - Embedded Training Systems
  - Measures of Effectiveness

Development of this technology could have any of the following effects on training effectiveness:

- Real-time/better resolution
- Increased functionality (more power for the same size or same power for a smaller size)/ shipboard applicability
- Increased direct fire ranging (safe focusing) allowing force-on-force with combined arms operations
- More detailed visuals with greater fidelity
- Reduced componentry/storage requirements for visual resolution/fidelity
- 3-D visual displays
- Low cost simple displays (speed not critical)
- Allowance for "missing person" response in war games
- Realistic gunnery training target/identification using night vision devices
- Reduced range/environmental constraints
- Improved weapon environmental effects (obscuration)
- Added incentive to train with low cost
- Situation scoring response (realism)
- Allows indirect fire applications in force-on-force operations
- Increased realism to built-up area operations

Using the results of the technology survey, generic technology categories were established and are presented in Table 4. Candidates for simulation training of the tasks previously identified were chosen from this list.

Table 4

Generic Technology Categories

CODE	GENERIC TECHNOLOGY	EXAMPLE
EMM	Electromechanical/microprocessor	Panel board trainer
VDM	Video-disc/microprocessor	Video-disc COFT - firing trainer
CGI	Computer-generated imagery/computer	M1 tank gunnery trainer
TG	Tactical game (manual or computerized)	TACWAR, TWSEAS - war gaming trainers
OM	Operable mockup	Satellite communications repair trainer
SED	Signal emitter/detector	Radiac training device
IDM	Interactive display/microprocessor	Noncommunication intercept/EW trainer
IR	Infrared transmitter/detector	REDEYE trainer
L	Laser transmitter/detector	MILES - laser gun fire trainer
TB	Terrain board	Amphibious assault trainer
BS	Ballistic simulation	Pneumatic mortar trainer
MO	Mechanical-optical/microprocessor	Observed fire trainer
NAT	No applicable technology identified	

NEEDS ASSESSMENT

Once the framework for the study was established, the extent of the need for simulation was assessed by determining which of the training requirements would be improved by use of simulation, taking into account the technology SOA. For those requirements, an evaluative data base was developed.

The output of the first task in the needs assessment phase of the study (quality-of-training assessment) was a requirements/concepts matrix which was developed by: (1) matching simulation alternatives with training requirements, (2) applying the quality-of-training criteria and (3) identifying those requirements that would be improved by the use of simulators. The measures of quality-of-training employed four criteria:

- Higher performance
- Decreased time to train
- Decreased training cost
- Decreased personnel support costs

In the second task during this phase of the study (evaluation of requirements/concepts) further evaluation of the requirements/concepts matrix was performed to establish a data base for the prioritization of the concepts. Criteria that were applied included:

- Cost and risk factors
- Integratability with other training
- Special assets requirements

TASK 3 - Quality of Training Assessment

An overview of the methodology used in the performance of this task is shown in Figure 1. Essentially, the methodology represents a series of "gates" through which each task must pass successfully in order to remain a candidate for the Marine Corps program to enhance training through the use of simulation.

The first gate in the process applied five (5) criteria to the generalized task list in order to identify those tasks that need to be or could be improved and thus should be given priority and emphasis in the simulation analysis. Those tasks which met one or more of the criterion were retained for further analysis. The criteria retained tasks which: (1) presently require facilities/resources limited in availability or expendable, (2) were identified as experiencing training problems or inability to train, (3) have demonstrated weaknesses or shortfalls in unit performance, (4) are mission-critical, and/or (5) are mobilization/reserve forces oriented.

Application of criteria (1) and (2) was based on survey/interview data gathered during visits to Marine Corps facilities. Criterion (3) was based on Marine Corps Combat Readiness Evaluation Systems (MCCRESS) reports and the tactical exercise evaluations at 29 Palms. Criteria (4) and (5) were based on analysis of task requirements by the study team. Out of the original 1762 tasks, 394 were deleted through this step.

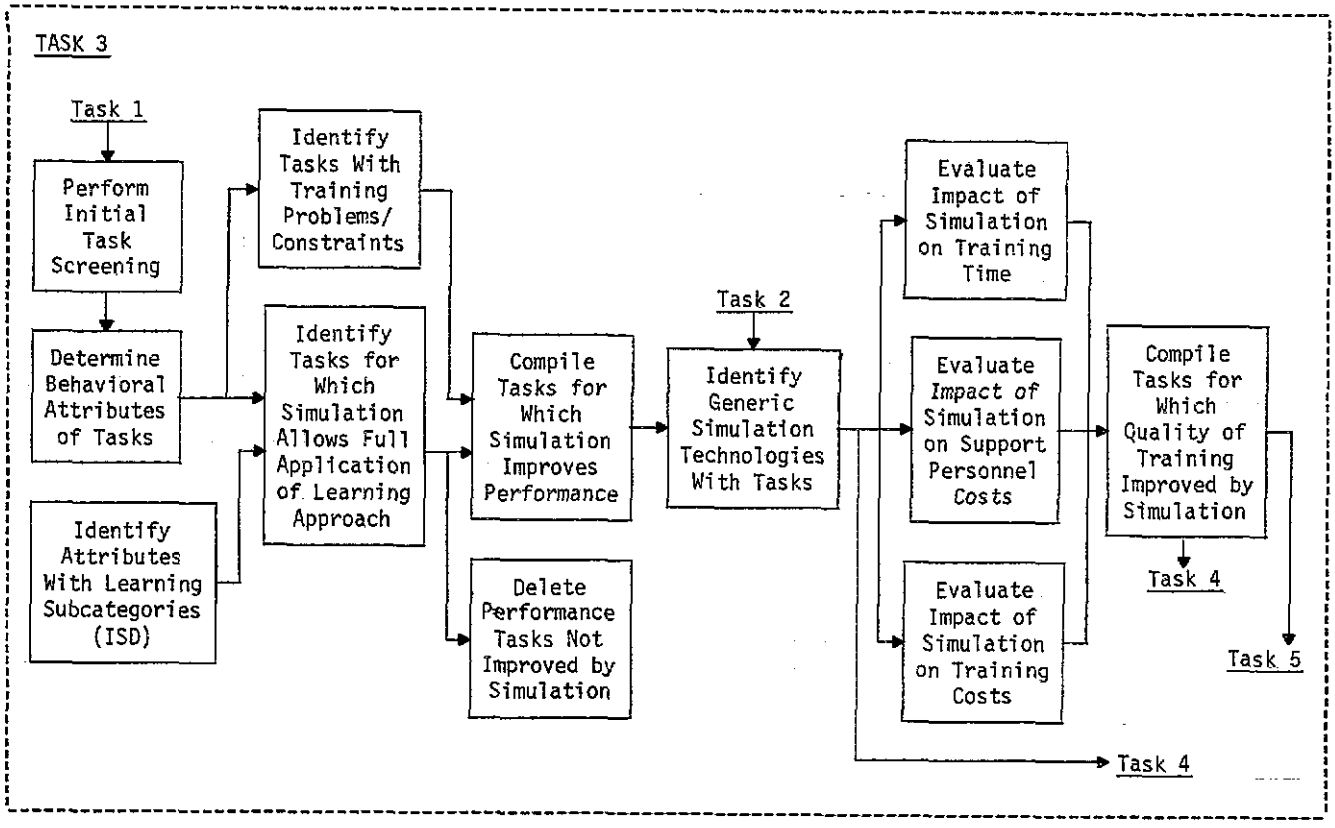

Figure 1

Task 3 Methodology Overview

The second gate applied the first of four criteria used to identify those training tasks that would be improved by the use of simulation. This "higher performance" criterion was applied using a methodology which did not require identifying the specific simulation technologies applicable to each task. The methodology employs, as a guide, the procedures defined in the Instructional Systems Development (ISD)[2] model for selecting the training delivery approach which best permits the application of learning guidelines established by the model. In this process, training tasks are addressed in terms of their behavioral attributes (mental, physical and attitudinal) essential for task performance. The ISD model associates the behavioral attributes for a task with a learning subcategory and provides learning guidelines to be used in developing effective training. For each learning subcategory, ISD also identifies the alternative delivery approaches (e.g., simulator, operational equipment, computer aided instruction, etc.) which will/will not permit complete application of the learning guidelines, considering task stimulus criteria.

In applying the above methodology, the following procedure was employed. If the task met one or more of the first three of the five criteria applied at the first gate, it was concluded that simulation would result in higher performance and the task was retained for further evaluation. If the task had been retained after having met only the fourth or fifth criterion, the methodology was applied. The results of a behavioral-attributes analysis, along with application of the guidance which relates the associated learning subcategories with alternative delivery approaches (e.g., simulator, operational equipment, etc.), were used to predict higher performance. Those tasks for which the prediction of higher performance through the use of simulation was negative were deleted from further analysis; 452 tasks were deleted, leaving 916 out of the original 1762 tasks.

For each training task identified in which the use of simulation would improve the quality of training, a determination was made as to what type of generic technology categories (as defined in Task 2 and listed in Table 4) would be applicable to produce an envisioned benefit in training quality. An applicable simulation technology could not be identified for 174 tasks. These were removed from further consideration, but a list of these tasks was included in the report for periodic review.

The three remaining quality-of-training criteria addressed whether the use of simulation will, for the same level of proficiency, decrease: (1) training time, (2) training costs, and (3) support personnel costs. They were applied to the training task/technology matrix. Those tasks for which at least one of the three criteria would be improved by simulation were retained (84 out of 742 were dropped from further consideration at this gate).

Performance of the quality of training evaluation resulted in the assessment that 658 (505 MOS/equipment-oriented and 153 mission-oriented) tasks out of the original list of 1762 would be enhanced by the use of simulation. The data developed for this part of the effort, including the simulation alternatives identified with each task, provide an audit trail for arriving at the list of tasks.

Table 5 summarizes the results of the quality-of-training assessment for the ten tasks of the Rifleman MOS (Table 2) being used to demonstrate the methodology. From the results we see that one (No. 6) did not make it through the initial screening (five criteria). Two more (Nos. 1 and 9) did not pass through the higher performance (P) criterion. When the generic technology categories were matched with the remaining tasks, no concepts were found which could satisfy the requirements for two of them (Nos. 5 and 8). These two tasks were removed from further consideration in the study, but were compiled into a separate list for future review. Of the remaining five

Table 5

Quality-of-Training Summary Data

OF: 03 - INFANTRY	INITIAL SCREENING					QUALITY OF TRAINING SCREENING				SIMULATION TECHNOLOGY ALTERNATIVES**		
0311 RIFLEMAN	FR	PB	PF	MC	MB	P	T	TC	SC			
1. Cleans and Maintains Service Rifle, Grenade Launcher, and Intra-Company Communications Equipment	N	N	N	Y	Y	N	-	-	-	-		
2. Engages Targets With the Service Rifle, Grenade Launcher, Light Antitank Weapons, Hand Grenades, and Command Detonated Antipersonnel Mines	Y	Y	N	Y	Y	Y	Y	Y	YNN*	VDM	IR/L	L
3. Controls/Performs Fire Team, Squad and Platoon Movements	Y	N	Y	Y	Y	Y	Y	YN	YN	TB	L	
4. Camouflages and Conceals Self and Individual Equipment	Y	Y	N	Y	Y	Y	N	N	N	L		
5. Navigates Using a Map and Compass	Y	Y	N	Y	Y	Y	-	-	-	NAT		
6. Applies First-Aid	N	N	N	N	N	-	-	-	-	-		
7. Transmits and Receives Messages Using Intra-Company Communications Equipment	N	Y	Y	Y	Y	Y	N	Y	N	OM		
8. Reports Information on the Enemy, Using "Salute" Report	Y	N	N	Y	Y	Y	-	-	-	NAT		
9. Handles Prisoners of War	N	N	N	Y	N	N	-	-	-	-		
10. Executes Embarkation and Debarkation From Helicopters and Amphibious Ships	Y	Y	N	Y	Y	Y	Y	Y	Y	OM		

KEY:
- FR - Facilities or Resources Required to Conduct Training
- PB - Training Problem Identified During Field Data Collection Effort
- PF - Performance Deficiency Identified During Field Data Collection Effort
- MC - Mission Critical Task
- MB - Mobilization Training Task (IRR)
- P - Simulation Will Result in Improved Task Performance
- T - Simulation Will Decrease Training Time Required
- TC - Simulation Will Decrease Training Cost
- SC - Simulation Will Decrease Support Personnel Requirement Cost
- N - No
- Y - Yes

* Where Multiple Entries Occur, they Refer to the Technologies Alternatives in the Order Listed.
** See Table 4 for Definitions.

tasks, one more (No. 4) did not pass any of the remaining quality-of-training criteria and was dropped from further consideration. Tasks 2, 3, 7, and 10 remained from this sample group.

TASK 4 - Evaluation of Requirements/Concepts

For the surviving combinations of training task/concepts, the basis for the prioritization of alternatives was established by evaluation in terms of: (1) cost/risk involved in using the simulation, (2) integratability of the simulation with other training and (3) special requirements imposed by the use of simulation, such as host structure(s), ancillary equipment, range facilities, etc.

Essentially, the methodology consisted of the assessment of the candidate task/concepts combinations in terms of the evaluative criteria using data available on current devices and estimates for developmental and proposed systems. In this context, the list of current, developing and proposed simulators/training devices was evaluated to determine which ones could be applied to a specific MOS or mission training task requirements. The resulting matrix of task requirements and specific simulation devices was used in developing qualitative estimates for the evaluative criteria.

CONCEPTS PRIORITIZATION (TASK 5)

Using the matrix of training requirements and appropriate training concepts in conjunction with the evaluative criteria and results of the requirements/concepts evaluation, tradeoff analyses were performed to develop a prioritized list of recommended generic-type simulators. This resulted in an integration and analysis of the data developed in the previous tasks into:

- A prioritized list of generalized task training requirements, to include a prioritization of the generic technology approaches applicable to each requirement, and
- An overall prioritized list of generic simulation technology approaches.

Taken collectively, these results provide the Marine Corps with a baseline for training simulation development along either of two paths. One is on the basis of task training requirements which should be given emphasis in utilizing simulation; the other is on the basis of the applicable scope of generic simulation approaches.

The generalized task requirements and associated simulation technologies considered in the prioritization process were those for which it had been determined, in Task 3, that the use of simulation would improve the quality of training. A flow diagram of the steps taken in completing this task is shown in Figure 2.

The first step in the process was to consolidate tasks, where appropriate, on the basis of training commonality. Through this effort, those task requirements which are common across an occupational field(s) (e.g., communicate using radio equipment or conduct planning) and those which, in fact, are elements of a larger task (e.g., establish and operate an intelligence

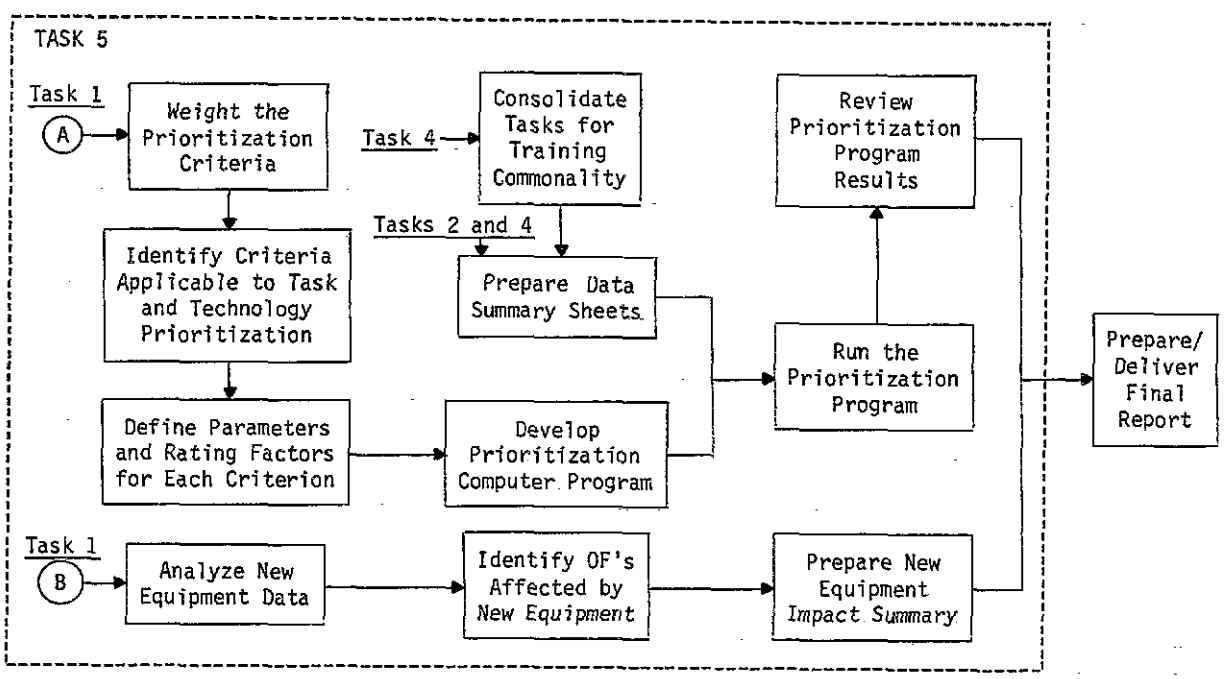

Figure 2

Task 5 Methodology Overview

section or a fire support coordination center) were combined.

The prioritization process required that 10 criteria be applied. A rank-ordered listing of the criteria and the basis used for rating them are summarized in Table 6. From a review of the criteria, it can be seen that they fall into two groups: those which affect the prioritization of generalized task training requirements (items 1, 2, and 3) and those which affect the prioritization of applicable generic technology concepts (items 2,

Table 6

Prioritization Criteria Rating

CRITERION	DESCRIPTION
1. Mission criticality of task trained (emphasis placed on combat-type tasks in anticipated combat environment).	For combat MOSs/units, those tasks essential to accomplishment of the combat mission; for noncombat MOSs/units, those tasks essential to support combat operations on a sustained basis.
2. The existence of training problems or deficiencies (due to cost of ammunition and fuel, range availability or other resource constraints).	Information collected during data collection/research effort. Type of resources required to conduct training further divided into three categories (live fire ranges, resources such as helicopters, field environment).
3. Commonality of type skills trained (type of tasks using a generic type simulator).	Combining of tasks based on training commonality; potential training population density for the task; frequency of generic technology usage identified with individual tasks.
4. Site adaptability (ship- and/or shore-based training).	Simulator concept, based on generic technology alternatives, with regard to size, resources required (e.g., environmental controls), and compatibility with amphibious shipping used by the Marine Corps.
5. Projected or estimated training effectiveness.	Experience with application of the generic technology in training the same or similar tasks; the portion of the task which can be trained (full or part); an assessment of the technology's ability to simulate the essential elements of a task.
6. Suitability for mobilization and reserve training.	For mobilization, the ability to reduce training time (i.e., train large numbers of people quickly) and task importance in mobilization training; for reserve use, the probable availability of facilities/area requirements associated with use of the generic technology.
7. Schedule (i.e., projected technology availability).	Status of current, developmental, or proposed use of the technology to train the same or similar type tasks.
8. Ability to modify the simulator to reflect changes in training requirements or the hardware/system being simulated.	For training changes, the ability of the user to modify/tailor the trainer to training needs; for hardware/system changes, whether modifications would likely involve simple hardware changes or complex hardware and/or software changes.
9. Relative cost of the simulator/facility.	Unit cost of similar existing devices, when possible; an assessment of the task elements and the complexity of simulation requirements; for laser engagement simulation, the cost of a "battalion set"; for games, the size of the group to be trained using manual or computerized versions.
10. Development risk (i.e., maturity of the technology).	Current, developmental, or proposed use of the technology application to the same or similar tasks.

and 4 through 10) with regard to each requirement. The criteria were applied accordingly.

To facilitate the process of integrating and applying the criteria and to ensure consistency, a computer program was developed to perform the prioritization function (Program for the Evaluation of Training Simulation, PETS). The program applies weights to each criterion and to the ratings given within each criterion to each task training requirement and the technology alternatives. It should be noted that the application of the technology is, for the most part, task dependent. Therefore, the values assigned for a particular technology may vary depending on the task requirement. Figure 3 presents the flow diagram for the prioritization methodology.

A modified Delphi technique was used to determine the weight to be given to each criterion and the possible values to be given within each criterion. Seven retired officers (one brigadier general, two colonels, three lieutenant-colonels, and one captain) comprised the Delphi panel. In arriving at the criteria weightings, two constraints were placed on the group: that the first criterion (mission criticality) would be rated 100, and that the weightings assigned to each criterion could not result in a reordering of the criteria.

Using the data previously collected and the established rating values, a data sheet was prepared for each combined task, the data was entered into the computer, and the program was run.

Note the shaded area in the flow diagram. Although not part of the study requirement, the training devices currently in being, under development, or proposed have been identified with the task requirements for which they have potential application. This information will ensure that those responsible for implementing the results of the study are aware of their availability. This will allow them to tailor their simulation decisions accordingly.

BASELINE FOR DEFINITION AND INCORPORATION OF SIMULATORS IN TRAINING

As stated earlier, the objectives of the study were to determine those training requirements in the combat, combat support and combat service support fields which could be enhanced through the use of simulation, and determine a prioritized listing of recommended generic-type simulation devices which would be capable of satisfying those requirements. To this end, a number of data lists, to be found in Reference 1, were developed which provide a basis for future

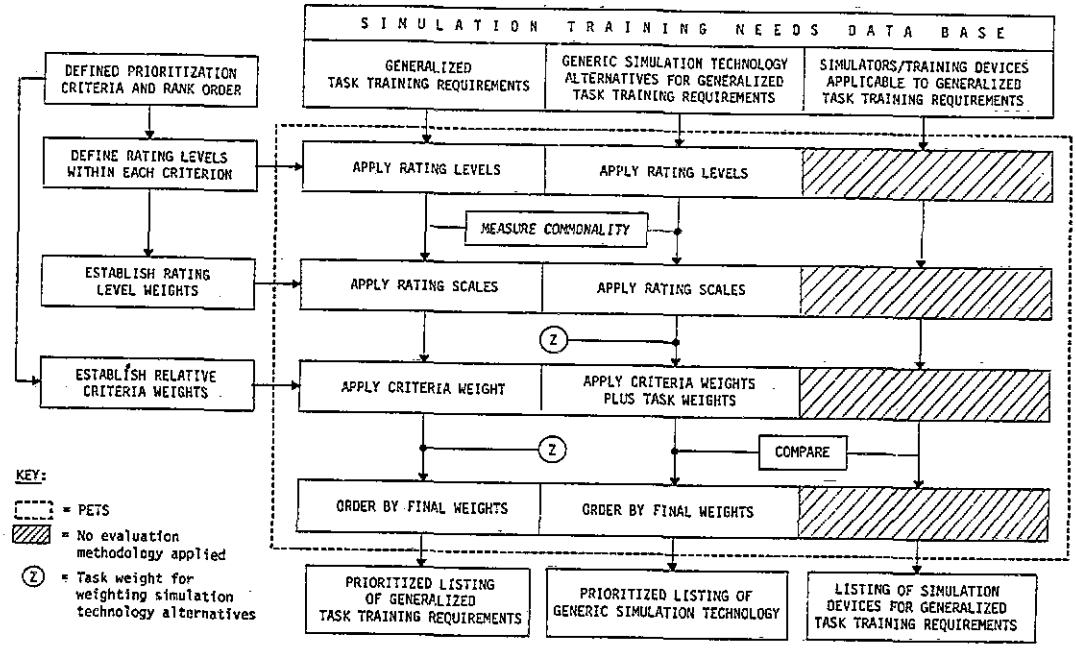

Figure 3

Overall Prioritization Methodology

Marine Corps efforts to define and incorporate simulation concepts in training. Of specific interest are:

- Inventory of simulator/training devices currently available, in development or planned.
- Overall task list and list of tasks assessed to be improvable by simulation.
- Results of needs assessment task and weighting factors applied to criteria used in prioritizing the requirements/concepts matrix.
- Prioritized list of task training requirements by field and corresponding prioritized list of generic simulation concepts for each task.
- Prioritized list of generic simulation concepts and corresponding prioritized list of task training requirements for each concept.

Table 7 presents a summary of the results in terms of the top ranked simulation concepts by mission area. The results are shown for both common- (applicable across all grade levels) and leader- (applicable to NCO/officer grade levels) oriented task training requirements. The fourth column of summary results shows the percentage of the generalized training requirements (the actual number is shown in parentheses) that would be satisfied by the simulation categories shown.

The fifth column shows the percentage of task requirements within the top 40 percentile of prioritized tasks which are satisfied by the simulation categories shown. The last column

Table 7

Prioritized Listing of Generic Simulation Technology

MISSION AREA	GENERIC SIMULATION TECHNOLOGY (SEE TABLE 4)	TECH. RANK	% GENERALIZED TRAINING REQUIREMENTS SATISFIED	% WEIGHTED GENERALIZED TRAINING REQUIREMENTS SATISFIED BY TOP 40 PERCENTILE	OCCUPATIONAL FIELD MOSs TRAINED (SEE TABLE 1)
(1) For Common Generalized Task Training Requirements by Mission Area					
Combat	L VDM OM IR	1 2 3 4	65 (87/131)	48 (29/60)	03, 08, 18
Combat Support	OM TGM/TGC	1 2	76 (64/85)	49 (19/39)	02, 13, 26
Combat Service Support	OM EMM VDM	1 2 3	72 (185, 256)	41 (52/125)	04, 11, 13, 21, 23, 25, 28, 34, 35, 40, 57, 58
(2) For Leader Oriented Generalized Task Training Requirements by Mission Area					
Combat	TGM/TGC TB	1 2	97 (90/103)	45 (19/42)	03, 08, 18, 99
Combat Support	TGM/TGC TB	1 2	100 (33/33)	44 (6/14)	13, 26, 99
Combat Service Support	TGM/TGC TB	1 2	88 (65/75)	52 (16/31)	04, 13, 25, 57, 99

shows the occupational fields within each mission area that can be trained with the simulation categories shown.

From the results shown and the data base developed, the following conclusions can be reached:

Technology

- Majority of simulation needs can be met by existing technology and/or improvements to existing technology.
- Trends are developing toward:
  - --"Families" of devices using common simulation technology (e.g., panel-type trainers).
  - --Games, both manual and computerized, for common- and staff-type task training functions.
  - --Shift in emphasis from few devices located in formal schools to multiple devices for sustainment training.
- NBC simulation technology is currently limited, but development/planned programs are progressing. NBC simulation is difficult to achieve by the nature of the task.

Quality-of-Training

- The quality-of-training of 37% of all tasks in the combat, combat support, and combat service support fields can be improved by the use of simulation.
- No technology concepts could be identified for a number of tasks which, otherwise, would have been improved by simulation. These tasks should be reviewed at regular intervals.

Evaluation of Requirements/Concepts

- No constraints were found for the generic simulation concepts of interest that would preclude or hinder integratability with training.

Prioritization of Requirements/Concepts

- Results obtained are based on the established criteria and the weight/rating level assigned. As these are refined, reevaluation of the prioritization may be required.
- The prioritization of generalized task training requirements ordered by decreasing importance relative to training needs shows that:
  - --the occupational fields of Infantry (03), Field Artillery (08) and Land and Amphibian Tractor (18) predominate in both the common- and leader-oriented combat mission area tasks.
  - --the occupational field of Engineer, Construction, Equipment and Shore Party (13) is predominant in both the common- and leader-oriented combat support and combat service support mission area tasks.
  - --mission-oriented tasks have the most shortfall of all leader-oriented task training.

FUTURE USE

In order to provide an explanation of how this study will be used by the Marine Corps it is necessary to introduce two on-going efforts of considerable impact.

The first of these efforts is in the realm of front end analysis. The Marine Corps has recently begun an effort to develop documented training standards for individuals. That effort is now underway and as portions of it are completed they will be subject to this study's findings.

The second effort is a program titled the Training Resource Initiative Program (TRIP). TRIP was developed to solicit input from trainers, training managers and commanders at all levels. That input is requested in the form of deficiencies or areas in which training is not conducted. Respondents have been directed not to consider resources, environmental or political restraints as they develop their input. They have been further directed to prioritize their submissions in terms of the stated deficiencies' impact on mission accomplishment.

Therefore, the first of these efforts will produce training standards which will be used to refine the evaluation of simulation support needs in training. In addition, the task analyses that are conducted in order to develop training standards will be used to refine what is now a generic effort and give it specificity necessary for the most effective identification of appropriate training medium. There is a third value to the identification of training standards and that is a form of feedback not now available. With a standard for performance we can document the now generically approved technology to a degree not presently possible. With that documentation, reordering of the recommended technologies or further substantiation of their present order will be possible.

The interface with the second effort, TRIP, is expected to provide a more immediate return. With documented evidence of the value and cost benefit various technologies can afford identified training requirement, the results of the study can be applied directly by resource managers in developing plans to respond to identified deficiencies.

In summary, the Marine Corps will use this effort as a dynamic tool of particular value to the resource manager as he seeks to provide the most effective, efficient media for training, and to the trainer as he seeks to identify the most definitive means to measure training program effectiveness.

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