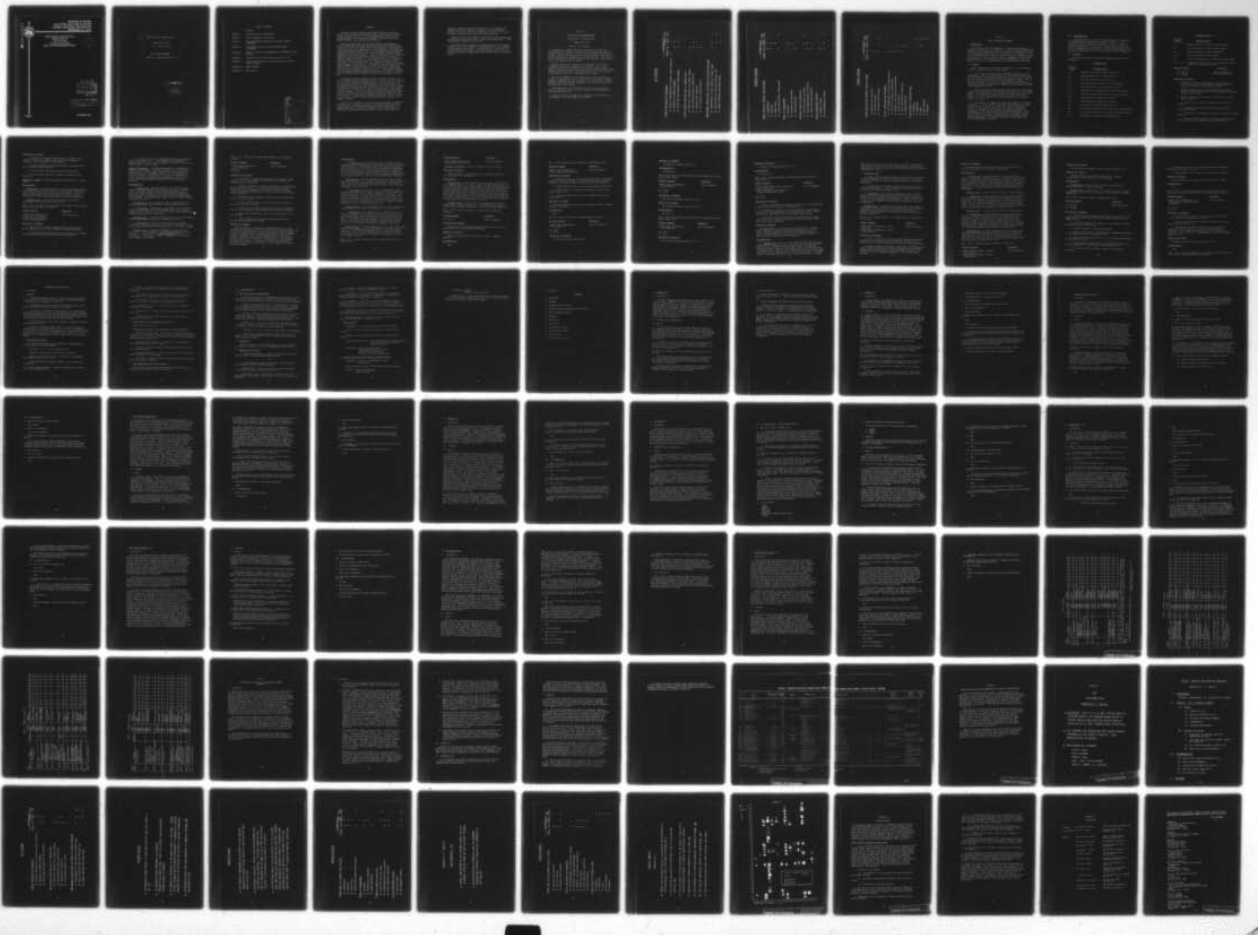
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SUMMER STUDY '76
19 - 30 JULY 1976
VOLUME 5 of 6 VOLUMES
MOBILITY SYSTEMS SUBGROUP REPORT

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FOREWORD

The Army Scientific Advisory Panel (ASAP) conducted its Summer Study '76 at the Armed Forces Staff College, Norfolk, Virginia, during the period 19-30 July 1976. The Panel addressed the theme of Future Systems through the six subgroups of Armament, Aviation, Electronic, Missile, Mobility, and Soldier Support Systems.

Thirty-six individuals from the ASAP and sixty representatives from the Department of the Army General Staff and major commands participated in the two week study. The Specific tasks of the participants were (1) to examine the compatibility of two documents - the Science and Technology Objectives Guide (STOG), which delineates desired operational capabilities in various categories, and the systems development plans prepared by the Army Laboratories - and (2) to determine if the laboratory programs contained the appropriate technology efforts to achieve the desired systems capabilities. It was requested that in the process that technical efforts non-supportive of the STOG or of marginal value be identified. Three ancillary tasks were subsequently added by which subgroup chairmen were requested to: (1) assist US Army Training and Doctrine Command (TRADOC) representatives to acquire and interpret significant material for use in input for STOG-78; (2) identify and describe ideas to be pursued by TRADOC in cooperation with U. S. Army Materiel Development and Readiness Command (DARCOM) using Concept Development and Validation (CDV) funds; and (3) suggest new initiatives appropriate for Army R&D.

The Summary Study participants arrived at a general concensus in their respective reports regarding the STOG. First of all, they felt that it is a good vehicle for providing guidance to the laboratories as well as a mechanism to conduct a dialogue between developer and user. The laboratory programs are generally responsive to the STOG and have improved in relevance to requirements over that of previous years. Most technology base efforts relate to some Science and Technology Objective (STO) to varying degrees. The level of detail of the STOG appears appropriate; however, the STOs should not constrain good laboratory efforts in high pay-off areas. The participants heartily endorsed the concept of having the STOG replace a variety of other guidance documents and serve as a guidance directory.

The STOG can be expected to be more useful and relevant in subsequent iterations, but it should not become so institutionalized that other opportunities for providing guidance and exchanges are precluded. The document should convey the user's comments on how he fights and his perception of desired systems capabilities and not closely specified

solutions. Soldier support technology, as well as techniques for better utilization of hardware in support of Corps of Engineers missions, should be covered more adequately in the STOG. The subject of smoke as a problem area arose in all areas examined.

Lastly, the STOG should include provision for countering advanced and alternate threats and reflect a strong intelligence input. A time frame should be identified in the STOG.

The reports of the subgroups are being published as six separate documents, each with a summary of recommendations near the beginning of the volume on colored paper. The documents are on file with the Defense Documentation Center. The value of Summer Study '76 will be the extent to which the appropriate Army managers find the conclusions helpful.

SECTION 1

INTRODUCTION & RECOMMENDATIONS

ARMY SCIENTIFIC ADVISORY PANEL

SUMMER STUDY 1976

Subgroup #5 -- Mobility

Subgroup #5 has adopted the Quadripartite Objective (QO) for Tactical Mobility as shown in Section H, 1026 of the Science and Technology Objectives Guide FY-77 (STOG 77), as the primary constraint for its task. Only ground support aspects of Air Mobility were covered since aircraft themselves are assigned to a separate subgroup. Some elements of Q.O. 1024 Strategic Mobility/Logistics have also been considered as they affect Logistics over the shore.

Most of the functions covered by this definition are carried out by MERADCOM, Army Corps of Engineers, and TARADCOM. All of their current programs were examined in detail and each program elements was compared with the relevant Science and Technology Objective (STO). These elements not covered by STO's were analyzed and where, in the opinion of the subgroup, a new STO is required, it is so noted.

Each of the commands (or Corps) references to above has its own section in the following report. Each section has its own introduction, findings, recommendations, and rationale. Where appropriate, recommendations for the use of Concept Development and Validation Funds (CDV) are indicated in each section.

Interpretations of the individual reports to cover the overall aspects of mobility as well as general conclusions and recommendations are contained in Section 5.

On the following three pages are the pertinent recommendations for the programs of the OCE, MERADCOM, and TARADCOM.

OCE PROGRAMS

	Recommendations			
	Cancel	OK	Program Add	New STO
COMBAT ENGINEERING PROCEDURES				
• SURFACE PREPARATION TO SUPPORT HEAVY VEHICLES	X		X	
• BARRIERS TO ENEMY MOVEMENT		X	X	
• ROUTE AND GAP-CROSSING IMPROVEMENTS		X	X	
RAPID ACQUISITION AND USE OF TERRAIN DATA				
• SPECIALTY PRODUCTS FOR COMBAT FORCES		X		
• MAP PRODUCTION AND DISSEMINATION		X	X	
• TERRAIN DATA UPDATING		X	X	
• FAR-FORWARD TERRAIN SURVEY		X		
PERFORMANCE PREDICTIONS FOR MOBILITY-RELATED MACHINES				
• IMPROVEMENTS IN ARMY MOBILITY MODEL (AMM)		X	X	X
• MODIFICATION OF AMM FOR TACTICAL USE			X	X
• COMBAT ENGINEER EQUIPMENT MODEL			X	X

MERADCOM PROGRAMS

	Recommendations			
	Cancel	OK	Add Program	New STOG
COMBAT MOBILITY SUPPORT (MULTIPLIERS)				
• COUNTERMINE		X	X	
• BARRIERS		X	X	
• DEMOLITIONS			X	
• CAMOUFLAGE/COUNTER SURVEILLANCE		X		X
MOBILITY ENHANCEMENT				
• BRIDGING		X	X	
• CONSTRUCTION EQUIPMENT			X	
• FUELS/LUBRICANTS		X		
STRATEGIC MOBILITY/LOGISTICS				
• LOGISTICS OVER THE SHORE			X	X
• CONTAINERS/MATERIALS HANDLING		X	X	
• FUELS HANDLING EQUIPMENT		X	X	
VEHICLE/EQUIPMENT SUPPORT				
• ELECTRIC POWER		X		
• ENVIRONMENTAL CONTROL		X	X	X

TARADCOM PROGRAMS

	Recommendations			
	Cancel	OK	Add Program	New STOG
COMBAT AND TACTICAL SUPPORT VEHICLE SYSTEMS				
• MODELING AND SIMULATION		X		
• TEST BED VEHICLES		X		
• ADVANCED SYSTEM CONCEPTS		X	X	X
VEHICLE SUBSYSTEMS AND COMPONENTS				
• HIGH-TEMPERATURE, HIGH EFFICIENCY ENGINES		X	X	
• INFINITELY VARIABLE TRANSMISSIONS		X		
• EXTERNAL, SELF-CONTAINED SUSPENSIONS		X	X	
• TRACKS AND WHEELS		X	X	
• ACTIVE AND PASSIVE PROTECTION		X	X	
• CW/BW PROTECTION			X	
VEHICLE MOBILITY TECHNOLOGY BASE				
• MATERIALS				X
• COMBUSTION				X
• FUELS			X	X
• HEAT TRANSFER				X
• DYNAMICS				X

SECTION 2

CORPS OF ENGINEERS PROGRAM

I. INTRODUCTION

The following report is organized into a section outlining the procedure followed by the Sub-committee, a section containing generalized findings and recommendations, and a set of separate statements relating to each STOG paragraphs judged to be relevant to the COE programs. This set of statements, which forms the real substance of the report, includes a description of relevant program elements, a judgment concerning their responsiveness to STOG requirements, and recommendations. The recommendations derive from a brief description of perceived problem areas.

II. FINDINGS

From a consideration of the material presented to the Subcommittee three very general conclusions can be drawn:

1. Much of the existing program of the COE is responsive to STOG requirements. However, because much of the COE program is devoted to the development of engineering procedure, in contrast to items of hardware, the relevance of many of the COE work items is indirect. That is, the effort is focused on how best to use equipment, or on aids to engineering design, or on methods of making the best possible selection from among candidate hardware items, rather than being directly relevant to the hardware item itself.

2. There are, however, important STOG items that are clearly within the purview of the COE which the existing COE programs do not adequately address. The inadequacies that have been noted are rarely due to oversight; in virtually every instance there is at least some minimal program. It can be concluded that the inadequacy is one of funding rather than concept.

3. The STOG does not adequately identify all important technology objectives. It is our judgment that combat effectiveness is at least as dependent upon software as on hardware. The way we fight is as critical as the things we fight with. The latter is adequately covered in the STOG-77, but the former is hardly recognized. The development of what might be called software end-items (such as mathematical models that predict the performances of equipment items in various terrain and climate situations) is as much a matter of technology development as is hardware and requires its own supportive basic and development research.

III. RECOMMENDATIONS

A generalized Summary of the COE program elements with categories of recommendations concerning them are shown in Figure 1. The categories are to be interpreted as follows: "Cancel" - terminate an existing program; "OK" - at least a portion of the program is on target; "Programs Add" - either level of effort should be increased or a new program added; and, "New STO" - add a new STO paragraph. The detailed recommendations are to be found in the following statements.

IV. RATIONALE

The following Rationale Section will address these specific STOG paragraphs.

REFERENCE TABLE

STOG Para. Number	Abridged Subject
2.2	Topographic products for land combat forces
2.3	Rapid map production for combat forces
3.4	Real-time transmission of MC&G data
4.3	Docks and piers for container ship off-loading
4.6	Surface preparation to support heavy vehicles
5.3	Highly mobile lightweight multipurpose combat vehicle
5.5	Capability within combat units to limit enemy mobility
5.10	Land navigation for individual vehicles
6.8	Earth penetration warhead for cratering
6.9	Survivability of combat support vehicles
8.2	Air defense missile vehicle to keep pace with combat forces
8.3	Air defense gun vehicle to keep pace with combat forces
9.1	Emplacement of minefields and other barriers

REFERENCE TABLE (Con't)

STOG Para. Number	ABRIDGED SUBJECT
9.3	Engineer support in crossing wet and dry gaps
9.5	Soil stabilization to improve trafficability
9.9	Improved topographic mapping capabilities
9.10	Tactical engineering in cold regions
9.11	Tactical engineering in hot humid and hot dry regions

STOG: 77-2.2 - Topographic products that are more responsive to the needs of the land combat forces.

Relevant Programs:

6.1 A/B 52 C
6.2 A/A 855
6.3 A/D 862

Proponents:

Corps of Engineers
Defense Mapping Agency

Description of Programs:

1. Field test a facility (van, equipment, and staff) for far-forward exploitation of photographic and other products obtained with RPV's or other sensor platforms.

2. Conduct evaluation tests with 9 experimental map products designed to provide specialized terrain information to specific tactical combat forces.

3. Continue exploratory development of Army Terrain Information System (ARTINS) by:

a. development of a catalog of terrain data that must be included;

b. development of internal organizational strategies for storage and retrieval;

c. development of standardized user-oriented formats for display products;

d. evaluate computer hardware and software developments for potential in systematic upgrading of system capability.

4. Develop high-speed automated image-matching strategies, for integration, including mutual rectification, of imagery obtained by different sensor systems, including imaging radar, infrared scanners, and multispectral photographs.

5. Tests of various map concepts under field conditions (MAPRO) to determine best combinations of colors, symbols, and formats for conveying special-purpose information.

Appraisal of Programs:

Existing program supports STOG and is of good quality. However, rapid update of maps, and rapid methods of combining data from two or more maps, appears to require more emphasis.

Recommendation:

Problem Area: Existing methods of compiling terrain data to configure special-purpose maps appear to be too slow to meet tactical planning needs. This is of special importance with respect to the intelligence template concept, when data on enemy dispositions, either real or conjectured, are combined with terrain data to serve as a basis for evaluating potential enemy movements.

Proposed Action: Develop very rapid methods (probably via the medium of digital data files) of updating terrain data and incorporating intelligence information for use in map products, and for combining selected data from two or more map sources (or digital data files) to produce map products configured to user needs.

STOG: 77-2.3 Rapid production of maps for tactical forces.

Relevant Programs:	Proponents:
6.1: A/B 52 C	Corps of Engineers
6.2: A/A 855	Defense Mapping Agency
6.3: A/D 862	

Description of Programs: Status of ongoing programs not known.

Appraisal of Programs: No appraisal possible but requirement is valid. There is an extreme urgency for a capability to update topographic products rapidly.

Recommendation:

Problem Area: Existing methods of updating terrain data and producing maps therefrom are too slow and require too much manual labor to meet the requirements of rapidly-maneuvering tactical forces. The apparent need is for a capability for very rapid (near

real-time) production of topographic maps of any selected locality at any specified scale and contour interest. This need is closely related to the Recommendations for STOG, Paragraph 77-2.2.

Proposed Action: Obtain assurances that a strong program is in being to develop a capability to update terrain data maps rapidly.

STOG: 77-3.4 Transmission of mapping, charting, and geodesy (MC&G) products in graphic form.

Relevant Programs:	Proponents:
National effort extensive, much of it in civil sector.	Electronics Command Corps of Engineers

Description of Program: Status of on-going programs unknown.

Appraisal of Program: STOG paragraph entirely justified. Very important that adequate attention be paid to methods of transferring raw imagery data from the sensor platform as rapidly as possible to the tactical combat forces.

Recommendation:

Problem Area: Among the most valuable items that could be provided, the tactical combat forces would be imagery (conventional optical, infrared, image-forming radar, etc.) of the battle area in real time. Such imagery has the prospect of showing last-minute changes in terrain conditions, locations of enemy forces, smoked areas, and so on, but it would be of maximum benefit only if it is available in near real time.

Proposed Action: Recognize need for a program to develop hardware and software required to convert imagery obtained by reconnaissance platforms (piloted aircraft, RPVs, satellites) into digital format, transmit the date via telemetry to a receiver in the combat forces, where the image is reproduced in hard copy (or as a scene displayed on an image-forming device) for immediate interpretation and use.

STOG: 77-4.3 Capability of rapid port construction and efficient discharge from container ships.

Relevant Programs:	Proponents:
Combat Support Engineering Logistics of the Shore	Corps of Engineers

Description of Program:

1. Definition of engineer effort required to support various operations systems and concepts, and design of R&D programs to eliminate current inadequacies in capabilities.

2. Develop designs for prefabricated modules for piers to support container-handling equipment.

3. Develop designs for self-elevating steel barge piers.

4. Develop design criteria for container storage areas and facilities.

Appraisal of Program: Existing program supports STOG and is of good quality.

Recommendation:

Problem Area: Existing capabilities for off-loading and handling containers in austere environments (i.e., without the facilities of a major seaport) appears to be almost wholly inadequate. The entire process of developing the necessary capabilities must be greatly accelerated if over-the-shore operations are seriously contemplated.

Proposed Action: Accelerate program to develop both self-emplacing piers and prefabricated pier modules.

STOG: 77-4.6 Methods of surface preparation to support heavy vehicles across beaches and other soft ground.

Relevant Programs:	Proponents:
(Combat Support Engineering - Logistics Over-the-Shore) (Combat Support Engineering - Lines of Communication)	Corps of Engineers

Description of Programs:

1. Development of systems for enhancing beach trafficability, through expedient surfaces (mats, membranes, confinement systems).

2. Development of expedient methods of constructing access routes using indiginous materials and existing engineer equipment.

3. Full-scale field trials using promising soil stabilization materials on problem soils. (This program will be reduced to a minimal level of effort -- i.e., maintenance of the state of the art -- upon conclusion of field trails.)

Appraisal of Programs: Existing program appears to be responsive to STOG and of good quality. Experience suggests that extensive soil stabilization by chemical means, especially for heavily-travelled areas is likely to be ineffective without very large expenditures of time and effort. The phasing-out of research to discover or develop chemical stabilizers is thus appropriate as noted in Item 3 above. Two program recommendations and one STOG change appear justified.

Recommendations:

1. Problem Area: During dry weather, dust caused by moving vehicles is a major problem in virtually all climates. It reduces rates of movement, increases rates of engine wear, and reveals positions to enemy observers. While dust-suppressing stablization does not appear to be feasible as an aid to the actual combat forces, it does appear to be possible along supply routes, in vehicle marshalling areas, and so on.

Proposed Action: Develop material and/or procedures that will suppress dust along roads and trails, in depot storage areas, etc.

2. Problem Area: Experiences to date suggest that soil stabilization with chemicals is too time-consuming, and in most instances, requires special equipment that would be difficult, if not impossible, to deploy and support in a combat area.

Proposed Action; Investigate potentiality of low-cost, low-weight, surface reinforcement systems (mats, membranes, nets, etc.).

3. Problem Area: The term "soil stabilization" is widely interpreted to mean "soil stabilization by chemical additives". This is too limited an interpretation for the context of this STOG paragraph.

Proposed Action: Change STOG Paragraph 4.6 (page C.9, lines 4 and 5) from: "...rapid methods of soil stabilization which will..." to read: "...rapid methods of surface preparation which will...." Also change: "...equipment." to read "...equipment, over the shore and contiguous inland areas".

STOG: 77-5.3 Highly mobile light-weight amphibious multi-purpose vehicle.

Relevant Programs:

(Combat Support Engineering - Ground Mobility)
6.1 AT 24
6.2 AT 42

Proponents:

Corps of Engineers

Description of Programs:

1. Development of revised environmental (i.e., climatic) design criteria, to be used for update of AR 70-38 (RDTE of Materiel for Extreme Climatic Conditions).

2. Continue refinement, extension, and validation of Army Mobility Model (AMM), specifically to: (a) improve prediction of vehicle dynamic behavior in rough ground; (b) develop soil-track interface forces under maneuvering vehicles; (c) develop improved water ingress-egress predictions.

3. Consolidate and standardize existing terrain and vehicle data bases, for use in the AMM.

4. Develop improved methods of acquiring terrain and vehicle data bases, for use in the AMM.

5. Develop improved methods of predicting vehicle performance in snow, ice, and thawing and freezing ground, for inclusion in the AMM.

6. Extend terrain data bases to all critical world areas for use with the AMM.

7. Develop deterministic stream flow forecasting system for improved characterization of wet gaps.

Appraisal of Programs:

Existing program is of good quality and responsive to the STOG, although the relationship is indirect. The STOG is directed primarily (and in the area of ground mobility, almost exclusively) at the development of specific hardware items; it does not address the need for innovative methods of improving vehicle designs, making parametric analyses of candidate vehicles to ensure mobility compatibility, or assisting the tactical combat forces in problems related to mobility. The program described above appears to be the only R&D effort directed toward providing these essential capabilities. It should therefore be maintained and extended.

Recommendations:

1. Problem Area: FM 100-5 specifies that all combat vehicles and combat support vehicles (such as air defense vehicles) must exhibit compatible mobility characteristics, and that logistics vehicles in direct support (such as munitions carriers) should have commensurate mobility characteristics. The AMM has the potential for predicting vehicle performance (speed, fuel consumption, vehicle dynamics) in all terrain and climatic conditions, thus providing the necessary parametric analyses that will reveal any lack of performance capability.

Proposed Action: New STOG Paragraph 77-5.3a to read: "Extend and validate AMM for use in parametric evaluations of candidate vehicles which is required to ensure mobility compatibility of all vehicles comprising the tactical combat fleet and to assist in the design and development of such vehicles."

2. Problem Area: At present, tactical commanders must make decisions concerning rates of march, formulation of march tables, and misssion times which involve vehicle movements on the basis of subjective integration of a large amount of terrain and climatic data. Estimations of enemy capability must be made on similar bases. An analytical procedure for predicting vehicle speed in any terrain situation would thus be invaluable as an aid both in planning friendly operations, and in anticipating enemy actions.

Proposed Action: New STOG Paragraph 77-5.3b to read: "Develop a limited version of the AMM to meet the needs of tactical forces."

3. Problem Area: The reliability of the mobility predictions made with the AMM, or any abridged or simplified modification of it, is largely dependent upon the accuracy of the terrain data that are used. While accurate data can be acquired at the present time, the effort is very costly and time-consuming. Thus, successful exploitation of the AMM for tactical purposes is dependent upon the successful prior development of terrain data acquisition procedures.

Proposed Action: New STOG Paragraph 77-5.3c to read: "Very rapid methods of acquiring the terrain data needed to drive the tactical version of the AMM (see STOG paragraph 77-5.13), and incorporating those data into the storage format required by the tactical AMM. A circular area with a radius of 30 km must be describable in a period not to exceed 24 hours."

STOG: 77-5.5 Organic capability in close combat units to limit enemy mobility.

Relevant Programs: | Proponents:

(Combat Support Engineering - Barrier/Denial Operations) | Corps of Engineers

Description of Programs: Status of programs, if any, not known.

Appraisal of Programs:

Modest investment in development of pre-configured demolition devices appears to be justifiable.

Recommendation:

Problem Areas: At the present time, close combat units have little or no organic capability to create barriers to enemy mobility other than by direct application of their weapons systems, consisting primarily of guns and missiles. Some terrain situations offer the opportunity of creating localized barriers in selected positions with a minimal effort. These include fallen trees, landslides, cratering, and so on. While such barriers would result in only short delays, they would nonetheless hold enemy vehicles under fire for longer periods than would otherwise be possible. Such a capability would be of considerable use, especially to the covering forces as described in FM 100-5.

Proposed Action: Develop family of preconfigured munitions for felling trees, cratering defiles, etc. Investigations will involve shaped charges, explosive implantation of small cratering charges, etc.

STOG: 77-5.10 Organic capability to find position quickly and accurately.

Relevant Programs: | Proponents:

6.2 A/A 855 | Corps of Engineers

Description of Programs:

Fabricate and test miniaturized gyrocompass suitable for use in ground vehicles for dead reckoning naviagation.

Appraisal of Programs:

Program of good quality and responsive to STOG. Funding is adequate.

Recommendations:

None.

STOG: 77-6.8 Earth penetrator warhead for cratering effects.

Relevant Programs: | Proponents:

(Combat Support Engineering - Barrier and Denial Operations) | Corps of Engineers

Description of Programs:

1. Analysis of data from field tests (Project ESSEX) to determine sensitivity of crater geometry to variations in depth of explosion, stemming conditions, and media (soil and/or rock) characteristics.

2. Develop plans for tests in a variety of subsurface conditions.

3. Develop methods of predicting crater geometry; given yield, depth of burial, etc.

4. Design appropriate tests for earth penetrator warhead (for Pershing II).

Appraisal of Programs:

Existing program of good quality and in support of STOG. Funding appears to be adequate.

Recommendations:

None.

STOG 6.9 General survivability of combat support vehicles

Relevant Programs: | Proponents:

(Combat Support Engineering - Ground Mobility) | Corps of Engineers

6.1 AT 24
6.2 AT 42

Description of Programs:

See under this heading, STOG 77-5.3.

Appraisal of Programs:

See under this heading, STOG 77-5.3.

Recommendations:

See STOG 77-5.3.

STOG 77-8.2 Mobile air defense weapon system to keep pace with supported combat forces.

Relevant Programs:	Proponents:
(Combat Support Engineering - Ground Mobility)	Corps of Engineers

6.1 AT 24
6.2 AT 42

Description of Programs:

See under this heading, STOG Para. 77-5.3

Appraisal of Programs:

See under this heading, STOG Para. 77-5.3

Recommendations:

See STOG 5.3

STOG: 77-8.3 Self-propelled air defense gun to keep pace with supported combat forces.

Relevant Programs:	Proponents:
(Combat Support Engineering - Ground Mobility)	Corps of Engineers

6.1 AT 24
6.2 AT 42

Description of Programs:

See under this heading, STOG Para. 77-5.3

Appraisal of Programs:

See under this heading, STOG Para. 77-5.3

Recommendations:

See STOG 77-5.3

STOG: 77-9.1 Rapid emplacement of minefields and other barriers to enemy mobility.

Relevant Programs:	Proponents:
(Combat Support Engineering - Barrier and Denial Operations) (Military Engineering Applications of Commercial Explosives - MEACE)	Corps of Engineers

6.1 AT 24
6.2 AT 42

Description of Programs:

1. Tests to determine effectiveness of conventional slurry explosives to produce craters as barriers to enemy mobility.

2. Evaluation of concepts for very rapid well-drilling machines or procedures for rapid emplacement of slurry explosives. (Note: some of this has been sponsored by Civil Works programs, not military.)

3. Development of analytical methods of predicting depth of penetration into soil of ballistic projectiles carrying explosive devices (i.e., mines) and related items.

Appraisal of Programs:

Existing program is of good quality and supports STOG. However, greater emphasis on the use of slurry explosive appears to be justified. Existing program also deficient in development of rapid methods of evaluating surface conditions for predicting mine emplacement, subsurface conditions and crater geometry.

Recommendations:

1. Problem Area: The use of atomic demolition munitions (ADM) will almost certainly trigger the use of other tactical nuclear devices and thus result in a decision to avoid the use of ADM's. In addition, national opinion in Europe has forced ADM's to be stored well back from the potential FEBA. There is little likelihood that they could be brought forward in time for effective use. In this situation, there is an urgent need for a cratering capability based on chemical explosives. The most

promising of them are the so-called slurry explosives. Difficulties result from the fact that the lower yield increases the sensitivity of the explosion to terrain effects, and this makes evaluation of subsurface conditions more critical.

Proposed Actions:

a. Develop improved analytical methods for predicting the geometry of craters formed by conventional slurry explosives as a function of specific yield, depth of burial, stemming conditions, and subsurface conditions.

b. Develop methods of repidly obtaining subsurface data required to predict performance of chemical explosives, if possible without the necessity of making test holes or pits.

2. Problem Area: The process of emplacing any mine (or other device) that must be implanted or buried within the soil is greatly affected by soil conditions, including the small-scale irregularities of the surface (microgeometry) and vegetation. Thus, successful use of mines is often dependent upon the terrain conditions in the area of deployment.

Proposed Action: Determine those terrain factors that control or significantly affect the process of implanting mines (either manually, by machine, or by ballistic projectiles) and develop analytical methods for predicting effects of variations in implantation or emplacement parameters.

STOG: 77-9.3 Engineer support to aid combat forces in crossing wet and dry gaps.

Relevant Programs:	Proponents:
(Combat Support Engineering - Ground Mobility) (Combat Support Engineering - Lines of Communications)	Corps of Engineers

Description of Programs:

1. Develop relations for predicting combat engineering equipment performance as a function of terrain conditions and type of job. (Present level of effort minimal, and restricted to program planning.)

2. Develop procedures for rapidly constructing or preparing access routes to tactical bridge sites which are separated from trafficable upland areas by zones of soft, or otherwise difficult ground. Procedures will exploit indigineous materials to the greatest extent possible.

Appraisal of Program:

Existing program is of good quality and is responsive to STOG. However, a much higher level of effort is desirable.

Recommendations:

1. Problem Area: At present there is no method, other than subjective skill gained through experience, for estimating the time and resources of manpower, material and machines required to perform such military engineering tasks as ford preparation, bridge access construction, preparation of tactical bridge launching sites, etc. Effective utilization of combat engineers in the battle area depends upon the availability of reliable procedures for estimating time and resource requirements.

Proposed Action: Increased level of effort in current programs.

2. Problem Area: In many parts of the world, suitable sites for tactical bridges are separated form trafficable uplands by zones of soft ground, thus making it very difficult or impossible to reach the bridge site with either the bridging vehicles or the tactical combat forces. In this situation, methods for constructiong access routes rapidly with a maximum use of indigenous materials and minimal expenditure of construction time and effort is urgently needed.

Proposed Action: Increased level of effort in current program.

3. Problem Area: Existing operations analysis model predicts history of tactical bridge utilization in a terrain described in probabilistic terms. An element in the model predicts the time required to emplace any specified U.S. bridge in any set of wet or dry gap conditions. Tactical commanders and planners have a need for a modified bridge emplacement and utilization model that will predict enemy construction times and utilization in actual terrain scenarios as an aid in anticipating enemy intentions and capabilities.

Proposed Action: New STOG Paragraph 77-9.3a to read as follows: "Develop a mathematical simulation procedure that will predict the time required to construct any tactical bridge, including those of other nations, in any set of wet or dry gap conditions in any part of the world. The model must operate with a terrain description of any arbitrarily-selected region of the world."

STOG: 77-9.5 Expedient methods to improve trafficability.

Relevant Programs:	Proponents:
(Combat Engineer Support - Logistics Over-the-Shore)	Corps of Engineers
(Combat Engineer Support - Lines of Communication)	

Description of Programs:

See Description of Programs, items 1-3, STOG paragraph 77-4.6

Appraisal of Programs:

Programs dealing with expedient surfaces (mats, membrane-encapsulated soil layer (MESL), etc.) are on target.

Recommendation:

Problem Area: Efforts related to chemical stabilization to improve trafficability are not promising.

Proposed Action: Phase out 6.2 or 6.3 effort relating to chemical stabilization for improving trafficability, upon completion of planned field test.

STOG: 77-9.9 Improved topographic mapping capabilities

Relevant Programs:	Proponents:
6.1 A/B 52 C	Corps of Engineers
6.2 A/A 855	
6.3 A/D 862	

Description of Programs:

1. Recording Optical Spectrum Analyzer (ROSA); development of automated methods of identifying significant airphotos and other types of imagery patterns.

2. Investigate potential of holographs as a mechanism for storing very large amounts of terrain data.

3. Design of formats for special-purpose maps.

4. Develop rapid methods of updating digital topographic data files for automated compilation of topographic maps.

5. Improve radar backscatter theory, to aid in rapid interpretation of imaging radar products.

6. Special-purpose interpretation of remote-sensor products (i.e., direct interpretation of line-of-sight from air photos, etc.).

7. Evaluation of rapid and low-cost methods of forward-area surveying.

8. Fabricate and test a remotely-emplaced device for measuring water depth and current velocity.

9. STOG paragraph 77-2.2, items 1-4 of Description of Program.

Appraisal of Program:

Existing programs are of good quality and responsive to STOG

Recommendations:

None.

STOG: 77-9.10 Tactical engineering to increase mobility in snow, ice and frozen ground, and in conditions of rapid freezing and thawing.

Relevant Programs:	Proponents:
(Combat Support Engineering - Cold Region Aspects of Combat Engineer Operations)	Corps of Engineers
6.1 AT 24 6.2 AT 42	

Description of Programs:

1. Develop improved methods of predicting vehicle performance in shallow snow, for incorporation into AMM.

2. Develop improved methods of mapping the distribution of snow cover, frozen ground and ice.

3. Develop improved methods of predicting rate and depth of freezing and thawing of soils as a function of meteorological conditions, soil and vegetation characteristics, and ground water conditions. Basic thrust is to develop methods of controlling thermal regimes in soil.

Appraisal of Programs:

Programs of good quality and responsive to STOG.

Recommendations:

None.

STOG: 77-9.11 Tactical engineering to aid ground mobility in deserts, humid tropics, and humid temperate environments.

Relevant Programs:

(Combat Support Engineering - Logistics Over-the-Shore)
(Combat Support Engineering - Ground Mobility)
(Combat Support Engineering - Lines of Communication)

Proponents:

Corps of Engineers

Description of Programs:

1. See Description of Programs STOG paragraph 77-4.6, items 1-3

2. See Description of Programs, STOG paragraph 77-9.3, item 1

Appraisal of Programs:

There are at present no programs specifically aimed at the development of tactical engineering procedures to cope with the special problems found in deserts or humid tropics. Questions of beach trafficibility (see item 1, Description of Programs, STOG Paragraph 77-4.6) are equally relevant to desert sands but other special desert problems (bouldery surfaces, irregular rock surfaces, extremes of microgeometry, etc.) are not now under study. Since the humid tropics exhibit no obstacle to mobility that are not also found in humid temperate climates (albeit in different proportions), there appears no overriding justification for research focussed specifically on tropical regions.

Recommendations:

None.

SECTION 3

MOBILITY EQUIPMENT RESEARCH & DEVELOPMENT COMMAND (MERADCOM)

I. INTRODUCTION

A subgroup of the Mobility Sub-Panel of the ASAP Summer Study reviewed the programs of the MERADCOM Laboratories in the Technology Base category, viz. 6.1, 6.2, and 6.3.A. This review compared the various elements of the laboratory programs with the elements of the STOG to see where the program content supported the needs expressed in the STOG and where program content was not directed toward an identified need. In some areas, appraisal of program quality was made. From the general perspective of the Mobility Subgroup, few areas were identified where both program content and STO guidance calling for program efforts were missing and the Subgroup believed both are warranted. Since the review was conducted by MERADCOM program area the findings in this report are presented program area by program area in the sections below.

The findings and recommendations resulting from the review are summarized at the end of this section and the recommendations are further reported in Section 5.

II. FINDINGS

A. General

- The MERADCOM program content is consistent with the objectives stated in the STOG, and with a few exceptions, the MERADCOM program is comprehensive and responsive to the STOG.

- The MERADCOM program complements the TARADCOM program in the Mobility Area with very little overlap or duplication.

- The breadth of technology in the mobility area is very great. Funding constraints, which exist in most programs, for basic research, exploratory development and non systems advanced development are effectively inhibiting adequate depth of efforts in many areas critical to the improvement of mobility and mobility support items.

- The MERADCOM program takes good advantage of commercial research and development efforts.

- Although the MERADCOM program supports the STOG, a number of unfunded projects for priority STO's exist. A strict interpretation of the priority information would suggest that the lower priority efforts be terminated in favor of the unfunded elements. However, it is not apparent that the MERADCOM program would be improved by such internal trades.

B. Underemphasized Efforts

The following MERADCOM programs or portions of programs appear to have significant funding problems.

- Camouflage - No. 6.1, basic research project

- Bridging - Anchorage systems and materials research

- Logistics-Over-The-Shore (LOTS) - essentially no technology base funding in either 6.2 or 6.3a.

- Containers/Materials Handling Equipment - No. 6.2 funds out through 1982.

- Fuels Handling Equipment - inadequate funding in 6.2, particularly marine terminals area.

- Barriers - Insufficient funds in 6.2 and 6.3a program to allow any technology base effort beyond current state-of-the-art techniques.

- Countermine - Insufficient 6.2 funds to pursue state-of-the-art problems in long-range detection of mines and minefields.

- Demolitions - Currently no 6.2 funds; however, a study is underway for DCSRDA, to recommend a technology base effort.

- Environmental Control - Insufficient funds for reasonable technology base program.

- Construction - No funding projected out through 1982 in either 6.2 or 6.3a.

- Electric Power - No funding automatic test and diagnosis equipment for generators.

C. Work Underway, But Not Supported by the STOG

Bridge erection boat work.

D. GAPS, Work That Needs to be Done but Not Covered in the STOG.

- Logistics-Over-The-Shore. No effort on a Container Discharge Facility or for Rapid Port Construction modules, harware and techniques. No program exists to develop improved ways of handling prepositioned war reserve supplies and equipment.

- Materials Handling Equipment - No effort for development of bulk liquid containers for POL or water.

- Barriers - Non-mine technologies which provide active barriers are not being pursued.

- Environmental Control - No work in NBC protection in conjunction with environmental control program.

- Construction - No work on rapid entrenchment means or drilling/ tunnel construction equipment.

E. Work Identified to be of Poor Quality.

The review, which necessarily was somewhat superficial, did not identify any work judged to be of poor quality.

III. RECOMMENDATIONS

A. GAPS to be Filled to Support STOG

- Environmental Control - A program should be developed, consistent with the evolving DOD TNW policies, the STOG and the need for correction of NBC deficiencies in virtually all Army tactical equipments.

- Logistics-Over-The-Shore (LOTS) - Funding should be provided for a reasonable technology base efforts in the LOTS area. A portion of these additional funds should be allocated to developing improved ways to handle prepositioned war reserve supplies and equipment.

- Barriers - Additional funding should be provided in the technology base program to accelerate efforts beyond the nominal state-of-the-art techniques. The distinction that now separates active and passive barrier work to ARMCOM and MERADCOM should be removed.

- Demolitions - A 6.2 project in demolition should be funded to respond to STOG 9.7; however, it is not clear that the work should be separated from hard structure munitions technology.

- Camouflage - A 6.1 basic research project should be established.

- Construction - Funding should be provided in 6.2 to allow a minimal amount of technology base effort in rapid entrenchment and tunnel construction means.

B. Terminations.

None is recommended. The review did not allow a depth adequate to evaluate the quality of all of the MERADCOM technical efforts.

C. Suggestions for STOG 78.

- Logistics-Over-The-Shore - Identify in the STOG the need for Coastal, Harbor, and Inland Waterway marine craft.

and

- Containers/Materials Handling Equipment - Should identify a total integrated supply distribution system.

- Fuels Handling - Should incorporate a STO for eliminating environmental pollution by Army POL facilities.

- Countermine - Need to expand STO's in MOBA area for mine neutralization and detection (and eventually for most of the areas of mobility).

- Fuels/Lubes - Add a new subparagraph 77-14.8e. Improved engine tolerance to increase availability of fuels.

- In category 77-4, add a STO for development of materials to prevent deterioration of equipment and supplies to facilitate world wide operaton under adverse climate conditions.

- In category 14, add a STO to cover the development of multi-functional lubricants and power train fluids to reduce the number of different materials in the supply system, and to design equipment to use specification materials to eliminate need for proprietary materials.

- Construction - Add in 9.1, the need to develop improved combat zone excavation and tunneling techniques (soil and rock) to facilitate site preparation and construction of underground facilities.

- General Mobility - In category 12, add a STO for the need of nighttime mobility equal to daytime mobility.

D. New Initiatives

- Camouflage - Low cost, mobile decoys for combat vehicles.

- Electric Power - Application of cryogenics to mobile power systems.

- Bridging - Rapid anchorage system, and an expanded materials program.

- Logistics-Over-The-Shore - 60 ton high speed air cushioned vehicle.
  - 300 ton Beach Discharge Lighter
  - Materials program

- Countermine - Spray Fuel-Air-Explosive
  - Man portable sprayable explosive
  - Tactical vehicle deperming
  - Explosive dust mine neutralization

E. Concept Development and Validation Candidate Efforts.

- Camouflage - Smoke as a countermeasure to ATGM
  - Active decoys

- Logistics-Over-The-Shore - Towed air-cushioned barge system

- Barriers - Tractice Entanglement
  - Optical Coating

- Countermine - METRRA
  -Explosive Vapor detecction

- Night mobility - Using an existing vehicle, design and execute a series of experiments using night vision devices of various types to develop night mobility concepts and systems.

IV RATIONALE

CONTENTS

A. Camouflage

B. Bridging

C. Logistics Over the Shore

D. Materials Handling Equipment and Container

E. Fuels Handling Equipment

F. Barriers

G. Countermine

H. Demolitions

I. Environmental Control

J. Fuels and Lubricants

K. Construction

L. Mobile Electric Power

A. CAMOUFLAGE (1)

I. Introduction

The Army Camouflage Program has received major emphasis in the last few years. MERADCOM is the lead lab for this effort. As such they do technology base work, assessment, camouflage peculiar hardware development, technology transfer, and support to other Army organizations. Other DARCOM commands and Project Managers have camouflage responsibilities as far as their systems/items are concerned. Some forms of camouflage are best deisgned into an item rather than added on in use. As such, many STO's throughout the STOG, dealing with specific end items or systems require signature reduction or other camouflage.

II. Findings and Recommendations

A. General

For the eleven STO's that have camouflage aspects there is good support from the Camouflage Program. Broadly described STO's with long-term objectives which are directly supported by camouflage and considered most related are STO's 12.10 and 13.7. Specifically described STO's for weapons systems with shorter term objectives are also directly supported by the camouflage program, e.g., 5.2, 7.2, and 8.2.

In summary, except for an increase in priority recommended for STO 12.10 to 12.7 and seven attached comments for modifying STOG-77 objectives, the listed STO's are directly supported by the camouflage technology program.

B. Significant Comments for Use by TRADOC in Providing Input for STOG 78.

The priority implied for camouflage in STOG 12.10 appears too low. The sub-group recommends that the priority be moved up to 12.7 ahead of an objective calling for development of low cost laser diffusion techniques.

There is reason to seriously consider the establishment of a separate category in the STOG for camouflage and deception in a "target rich" environment is the pivotal issue.

C. New Initiatives

Consideration needs to be given to protecting tanks in combat by low cost, mobile decoys. A new initiative is recommended in this area.

D. Concept Development and Validation (DCV) Candidate Efforts

1. Under the STO's relating to tank protection, equipment, and self-protection, development of a MERADCOM concept is clearly indicated. The effort focuses on militarization and of field validation of a concept for smoke as a countermeasure to smart weapons.

2. In support of tank protection, technology base efforts are needed to extend current smoke/aerosol agent capability to block regions of the electromagnetic spectrum important to hostile sensor/weapons using nontoxic, noncarcinogenic obscuration/CM agents for instant dissemination.

3. It is clear that until there is a combination of active (thermal and electronic) and passive (camouflage) features, some decoys and much deception effort is clearly not supported by field validation. Technology is available for both active and passive decoy components. Their combination, proposed for an artillery unit, merits development. (FY 77 effort of 100K is recommended.)

B. BRIDGING (2)

I. Introduction

The requirements for bridging are to span wet and dry gaps and other natural barriers which might impede the mobility of assault, tactical, and line of communication type missions in CONUS and the Theater of Operations. The scope of effort includes products of MERADCOM and the Corps of Engineers' Waterways Experiment Station.

II. Findings

A. As seen in Table 1, a total of three STO's were seen to apply to the bridging task area. All of these appear to be supported adequately by program as currently planned. The recently developed Ribbon Bridge now being fielded provides significant improvement in reduction of construction time and manpower as a wet gap support bridge. The Mobile Assault Bridge (MAB) offers the same improvements for the assault phase of bridging and also for rafting operations. The new family system of bridges being developed under the Bridging for the 1980's Program provide for a longer span assault (AVLB type) bridge and a new dry gap support bridge which has the highest development priority within the bridging program at the present time. Perhaps the one area which is not adequately supported by the program is an improved anchorage system and a line of communication bridge system.

B. Work of Good Quality in Support of STOG but Inadequately Emphasized

Additional emphasis is needed for a materials program to develop and investigate high strength, lightweight materials, such as composites, to reduce weight and maintenance amd improve logistic requirements.

C. Work Identified as Good Quality and of High Relevance to Future Army Needs but not in Direct Support of the STOG.

The program for a new Bridge Erection Boat is good and essential to Army needs but is not emphasized or highlighted in the STOG.

D. Gaps - Work that Should be Done to Support STOG but not Being Accomplished

In the bridging area no work is being addressed to development of simple rapidly deployed anchorage systems and a new line of communication bridge system.

E. Work Identified to be of Poor Technical Quality

No identification is possible at this time.

III. Recommendations

A. Gaps to be Filled to Support STOG. (See D above)

B. Work to be Terminated.

None recommended.

C. Significant Comments for Use by TRADOC in Providing Input for STOG 78.

None.

D. New Initiatives.

In bridging the following new initiatives are recommended:

1. rapid anchors and anchorage systems which are compatible with the highly mobile and rapidly emplaced bridges for the future should be developed;

2. Material program to develop and investigate the use of high strength composites and high strength, ductile, weldable ferrous and non-ferrous alloys to reduce weight for logistic purposes and to improve safety factors should be provided.

E. Concept Development and Validation (CDV) Candidate Efforts.

Continue development of the family system of bridges.

C. LOGISTICS OVER THE SHORE (3)

I. Introduction

The scope of the assignment for the Marine/Logistics Over the Shore (LOTS) area of effort is to provide for movement of materiel (primarily in the form of containers) from ship to shore under conventional port marine resupply, and coastal, harbor, and inland waterway missions. This scope concentrates on transportation activities in both CONUS and the Theater of Operations and includes RDTE products of MERADCOM and Corps of Engineers (WES).

II. Findings

A. General

As seen from Table 1, six STO's were considered appropriate to the LOTS/Marine Task Area. Of these, three appear to be supported in part by development plan. The partially supported STO's are 4.7, 7.8, and 14.10. These are associated with Logistics-Over-the Shore lighterage capability, vertical lift of cargo systems, and Coastal, Harbor, and Inland Waterway (CHI) system required to move International Organization for Standards (ISO) and American National Standard Institute (ANSI) containers over water in a theater of operations. Those not supported are STO's 4.4, 9.6, and 9.11 which represent efforts associated with providing container offloading from non-self-sustaining container ships, rapid port construction, and stabilization of beach and lowland areas to support LOTS operations.

B. Work of Good Quality in Support of STOG but Inadequately Emphasized:

Additional emphasis is needed in programs to provide large payload towed air cushion barge systems in support of LOTS and other missions. Additional emphasis is also needed in support of development of a Beach Discharge Lighter capable of handling 20-30 containers to support LOTS operations through-puts currently projected. Further emphasis on investigating lighter-than-air container discharge concepts is also needed.

C. Work Identified as Good Quality of High Relevance to Future Army Needs but not in Direct Support of the STOG:

None.

D. GAPS - Work that should be done to support STOG but not being accomplished. Currently, at MERADCOM, no work is being addressed to (1) STO 4.4, Container Discharge Facility, (2) STO 9.6, Rapid Port Construction, (3) Deployment of stabilization of rapid surface reinforcements of beach and lowlands in support of LOTS.

E. Work Identified to be of Poor Technical Quality.

None.

III. Recommendations.

A. Gaps to be filled to support STOG (see II D above).

B. Work to be terminated: None.

C. Significant Comments for Use by TRADOC in Providing Input for STOG 78. Consideration be given to providing STOG reference which will identify, specifically, the need for Coastal, Harbor, and Inland Waterway (CHI) marine craft in support of providing logistics over water in T/O. Also, a specific reference to identify the need to provide necessary support and maintenance craft that support the Army LOTS and CHI fleet (i.e., Floating Cranes, Floating Maintenance Shops, etc.).

D. New Initiatives. In LOTS/Marine area, the following new initiatives are recommended: (1) development of 60T high-speed amphibian (ACV) to support LOTS operatons; (2) development of 300T Beach Discharge Lighter to provide increased container throughput in LOTS operations; (3) development of rapidly deployable modularized container port facility to support both LOTS and reduced conventional port capability.

E. Concept Development and Validation (CDV) Candidate Efforts:

(1) Towed Air Cushion Barge System.

(2) Rapidly Deployable Modularized Port for Containers.

(3) 60T High-speed Air Cushion Vehicle.

D. MATERIALS HANDLING EQUIPMENT AND CONTAINERS (4)

I. Introduction

The adoption of the cargo container as the principal vehicle in moving material world wide has thrust the military into an environment that requires orientation of the Army logistics system around the International Standard Cargo Container and the cellular containerships that move these containers. Contained in the Container/MHE area is a program directed to the development of an Integrated Supply Distribution System composed of four basic elements; Unitization, that effort that goes with unitizing the load; Material Handling; Transportation, equipment such as the intra-terminal transporters; and Control and Identification, the area where we are striving to develop a system for identifying and keeping track of the commodities as they move through the logistic pipe line.

II. Findings

A. General

A total of nine STO's were identified that impact on the Container/MHE Area. The identified STO's cover the Integrated Supply Distribution System quite well except in the area of Control and Identification. One STO can be associated with this important element of the system, but additional STO's would assist in element clarification, In particular good STO coverage is provided in the Unitization Element, 5 of the 9 STO's being associated with this area. Material Handling and the Transportation elements of the system are covered by three rather generalized STO's that provide a rather nondefinitive identification of field of endeavor element requirements. Additional STO statements are needed in these two areas.

Total life cycle R&D Integrated Supply Distribution funding is lacking. Very little exploratory development is underway; the majority of the funds are for advanced development; and outputs from the 6.3 STO efforts are being translated into requirement documents to support engineering development.

B. Work of Good Quality in Support of STOG but Inadequately Emphasize.

In the Integrated Supply Distribution System, work of good quality which is not sufficiently emphasized includes the Logistics-Over-the-Shore phase of all of the system elements (see Section C).

Operational test using basically commercial equipment have shown that a LOTS operation can be accomplished. In addition, the Transhydro Study has identified specific areas where hardware development is needed in support of the LOTS operation. Of particular interest is a shore side container handler, a device that would remove containers from the lighterage and place them on a transporter for movement to a temporary holding area. This item would replace the commercial 250 ton crane currently being used and which presents a tremendous deployment problem because of its physical size.

The use of modular containers/inserts/and packages must be exploited to insure satisfactory through shipment of goods in commercial cargo containers from source to user. In general, commercial cargo is too large for through movement to the user level, but the modular package will provide the packaging flexibility. Work has been accomplished that illustrates the desirable interface between the modular container and the commerical cargo container, but sufficient funds are not available to develop an operational concept.

C. Work Identified as Good Quality and of High Relevance to Future Army Needs, but not in direct support of the STOG.

In the area of logistic control, work is being accomplished on interrogation device and programable label that will feed container passing reports into existing logistics software control programs. This system has been recognized by the user, TRADOC, as a required system.

D. Gaps - Work that Should be Done to Support STOG but not Being Accomplished.

No effort is being expended on bulk liquid containers suitable for POL-Water transport. There are other semi-solid commodities such as cement and road surfacing preparations that can be satisfactorily transported in containers and would be supported by STO 14.7.

Although TARADCOM is designing rather conventional fifth wheel trailers for container/break bulk movement, means should be devised to facilitarte container movement over short distances by auxiliary MHE other than trailers and container compatible MHE.

E. Work Identified to be of Poor Technical Quality.

None.

III. Recommendations

A. Gaps to be Filled to Support STOG.

See D above.

B. Work to be Terminated.

None to be recommended.

C. Significant Comments for use by TRADOC in providing input for STOG 78.

That a total Integrated Supply Distribution System must be identified and provided for and that significant impact can be made on LOTS efficiency through use of a shore side tansfer device and providing machine mobility that is independent of beach preparation.

D. New Initiative

See III, D above.

E. *Concept Development and Validation (CDV) Candidate Efforts.*

None.

E. FUEL HANDLING EQUIPMENT (5)

I. Introduction - The importance of Fuel Handling Equipment in modern warfare cannot be overemphasized as most modern weapon systems are useless without an adequate fuel supply. The necessity for rapid installation by troops in all parts of the world makes it difficult if not impossible to use commercial fuel handling systems in the theater of operations. It is therefore essential that a strong R&D effort in this field be continued.

The Army fuel handling responsibilities begin at the Marine Terminal where means must be provided to moor the tanker, usually a considerable distance offshore, and move the fuel ashore through some type of pipeline or hoseline. Onshore storage facilities must be provided both at the marine terminal and further inland. Lack of time, personnel, and mechanical skills such as welders in large numbers, demand that these storage facilities consist of an assemblage of coated fabric, collapsible tanks or reservoirs. Pipelines and hoselines that can be quickly constructed by relatively unskilled personnel must be provided. These include pumping stations and in some cases pressure regulating stations. Fueling stations of various types must be provided to service combat vehicles, equipment and aircraft in the forward area. Means must of course be provided for the removal of gross contaminant at marine terminals and for the removal of contaminant before the fuel is dispensed to the using equipment. STOG 77-4.3, 77-7.9, and 77-14.7 recognize the need for a strong research effort in this area. The R&D effort is directed toward meeting the needs cited in these STOG paragraphs.

II. Findings

A. General

As indicated above, three STOGs are considered appropriate to fuels handling equipment. STOG 77-4.3 directs the development of capabilities for rapid port construction/rehabilitation to include capabilities for efficient discharge from non-self-sustaining container ships and POL tankers. STOG 77-7.9 directs development of the capability for fueling and rearming at least two helicopters simultaneously in a forward area and STOG 77-14.7 directs development of simple flexible bulk liquid (POL and water) transportation, storage, handling, and dispensing techniques, etc.

We have just completed type classification of the Multileg Mooring and Offloading System and plan limited in-house and contract effort directed toward development of high capacity quick installation offshore pipeline and development of a marine terminal filter/separator in support of STOG 77-4.3. In support of STOG 77-7.9 we

are engaged in development of Forward Area fueling system suitable for use in the Arctic. Work is planned or in progress on improved collapsible tank materials, large pillow tanks, cross country hoseline, and pipeline friction reduction in support of STOG 77-14.7.

B. Work of Good Quality in support of STOG but inadequately emphasized - Funding in the Marine Terminals Area (STOG 77-4.3) is grossly inadequate. The user recognizes need for a floating/submersible storage system for applications in situations where enemy capability makes it impossible to moor the tank ship and pump into an onshore tank farm in the normal manner. The 6.2 effort on this equipment would require approximately 250K over a two-year period with a total development cost of approximately 4000K. Other unfunded items in the marine area for which a need is recognized are work boats designed to service the Multileg Mooring System, Offshore Hoselines, Shallow Draft Barges, and a Mono Buoy Mooring System.

C. Work identified as Good Quality and High Reliance to Future Army Needs but not in Direct Support of the STOG.

In this regard the STOGs support or at least imply support to development of all elements of a POL system.

D. Gaps - Work that should be done to support STOG But Not Being Accomplished. As indicated in B above, with exception of improved offshore pipeline and the Marine Terminal Filter/Separator, all effort in the Marine Terminals area is unfunded. A vigorous well-supported 6.2 program is needed if future operational requirements are to be met.

Increased costs are slowing development of the large (10,000 bbl) pillow tanks needed for Marine Terminals and other tank farm applications.

E. Work identified as Being of Poor Technical Quality.

None.

III. Recommendations

A. Gaps to be filled to support STOG.

See IIB &D.

B. Work to be terminated.

None.

C. Significant comments for use by TRADOC in providing input for STOG 78.

Initiate STO to eliminate environmental pollution by Army POL facilities (Closed Circuit Refueling, Vapor recovery systems for Tanks, etc.)

D. New Initiatives

Development of unfunded Marine Terminal facilities as indicated above is recommended.

E. Concept Development and Validation Candidate Efforts.

None.

F. BARRIERS (6)

I. Introduction

This portion of the report is limited exclusively to non-mine barriers, as called for in STOG 77-9.1. The existing non-mine barrier program at MERADCOM was evaluated in detail to ascertain direction and accomplishments. Funding levels were compared to plans to assess realism. The overall plan was compared to the STOG to evaluate adequacy of response. The existing plan for development addresses barrier concepts within the existing state-of-the-art. No effort or plans for development are applied to developments which require advances in the state-of-the-art because existing resources are not sufficient to support such as task.

II. Findings

A. General

Effort being conducted is in direct support of the STOG for non-mine barriers. Currently, four major tank vulnerabilities are being examined: Engine interference, optical interference, visual degradation and tractive interference. Several concepts are proposed for each vulnerability, all within the existing state-of-the-art, for a total of 13 concepts. Investigations have been or are being conducted on six of these concepts. Work on the remaining seven is deferred until resources become available. Four concepts under engine interference have been narrowed down to one, combustion interference, in which gas agents are injested in the engine to degrade power output. The other two concepts under active investigation are optical coatings and tractive entanglement. For optical coatings, a spray device is triggered by sensors to disburse obscuring films over tank optical surfaces. Tractive entanglement employs mechanisms to entangle in tanks and draw track disabling devices to the tracks. The current plans support the STOG well for development of barriers within the existing state-of-the-art. However, far term approaches, requiring advancement of the state-of-the-art are not currently planned such as microwaves for anti-personnel barriers, lasers to degrade vehicle optics and hyper-velocity particles against armor.

B. Work of good quality in support of STOG but inadequately emphasized. The whole area of non-mine barrier is of good quality but has not received the proper emphasis. The funding level has been sustained at the level of hundreds of thousands of dollars per year. Two concepts have been ready for entry into advanced development for two years. However, no 6.3 funds are programmed until FY 78.

Allocation of unfunded requirements, which roughly doubles the program, would provide for timely development and type classification of items beginning in FY 81.

C. Work identified as good quality and of high relevance to future Army needs but not in direct support of the STOG:

None.

D. Gaps - Work that should be done to support STOG but not being accomplished:

Effort should begin on barrier approaches beyond the current state-of-the-art. This work should include applications of microwaves, lasers, and hypervelocity.

E. Work identified to be of poor technical quality:

None.

III. Recommendations

A. Gaps to be filled to support STOG: Resources should be allocated to conduct effort on non-mine barrier approaches beyond the existing state-of-the-art.

B. Work to be terminated:

None.

C. Significant comments for use by TRADOC in providing input to STOG 78. STOG 77 for barriers is adequate.

D. New Initiatives:

Advanced systems concepts for implementation of barriers should not be inhibited by restrictions on active vis a vis passive concepts because couplings of concepts can be very beneficial and ideas for effective new approaches are best pursued by those that conceive them.

E. Concept Development and Validation (CDV) candidate efforts. CDV candidate efforts should be tractive entanglement and optical coatings.

G. COUNTERMINE (7)

I. INTRODUCTION

A great deal of work is being done in the Countermine field to satisfy the STOG requirements. However, there are severe shortfalls due to funding limitations, especially in the field of mine detection. The main emphasis in the neutralization program is to develop a series of mutually supporting systems ((Fuel Air Explosives, Roller, Vehicular Mounted Magnetic Signature Duplicator (VEMASID), etc.). Similarly, no one "universal" detector can be developed. In fact, state-of-the-art technolgoy barriers are causing work to progress slowly in certain detection programs (trace vapor, enzymatic).

II. FINDINGS (Mine Neutralization)

A. General

Comparisons of STOG with Laboratory Plans. Mine Neutralization is addressed by STO paragraphs 9.4 (Tactical Engineering) and by 5.2j (Close Combat). STO 9.4 breaks countermine into detection and neutralization, and STO 5.2j treats the topic of integral land mine protection systems.

B. Work of good quality in support of the STOG but inadequately emphasized.

Neutralization requirements for area breaching as approached by the Dust Explosive (SUSTEX), Man-portable plastic explosive (MANPLEX), and pyrophoric neutralization systems are receiving inadequate attention. Route clearance requirements addressed by the VEMASID concept, and MOBA requirements addressed by MANPLEX are inadequately emphasized. Integral protection approaches in need of emphasis are deperming, vehicle hardening and the VEMASID and DUSTEX concepts.

C. Other work of good quality and high relevance to future Army needs but not in direct support of STOG consists of the Hand Emplaceable Minefield Marking Set (HEMMS). In addition, the 6.1 effort is only indirectly applicable. This consists of determining the characteristics and equatation of state parameters for composites used for road wheel and track hardening. Road wheel hardening capability is good and the successful completion of these fundamental investigations is not expected to improve it.

III. Recommendations: (Mine Neutralization)

A. Gaps to be filled to support STOG.

1. Planning for meeting neutralization and protection requirements has intensified and has resulted in defining a number of significant new approaches. The Single Project Element Funded (SPEF) effort in support of neutralization should be funded at a higher level for 2 or 3 years to determine the feasibility of the new approaches, and support for selected Concept Development and Validation candidate efforts should be provided.

2. Augmented technical effort is required to demonstrate the feasibility of DUSTEX, MANPLEX, and pyrophoric fragement neutralizing concepts.

B. Significant comments for use by TRADOC in providing input for STOG 78.

1. Generally, one-line descriptions are too vague to be of assistance in deciding where to allocate resources for R&D. It is hoped that as TRADOC becomes more familiar with the new approaches to meet STOs, they will emphasize preferred lines of approach.

2. MOBA mine neutralization - The Army knows very little about the use of mines in the MOBA environment. A study on MOBA is on-going at CACDA, another under the auspices of QWG/Infantry, and others under ARPA sponsorship. The STOG is too general to be of use in guiding developments.

3. Integral Protection - MERADCOM has approached the project managers of the major combat vehicle systems, and has gotten the impression that the mine threat is secondary to the kinetic energy threat in killing tanks. The veracity of those priorities is not denied. The impact on the mine neutralization program to develop integral protective materiel may be severe, however, and one is led to support that installation of protective materiel against mines may be deferred or avoided because requirements for this type of protection are only general and development plans do not consider such inclusions. TRADOC should review the STOG 78 with these considerations in mind and provide some guidance as to how urgently they need or will accept (once developed) passive protection components.

C. New Initiatives.

DUSTEX
MANPLEX
SPRAY FAE
Deperming
Pyrophoric fragment neutralization
VEMASID

D. Concept Development and Validation Efforts:

The following have draft or approved Letters of Agreement:

a. ROLLER
b. CHENS
c. VEMASID

E. Addendum.

Discussions dealing with Explosive Ordnance Disposal (EOD) problems and their relationship to Mine Neutralization are presented in the chapter on Demolitions.

II. Findings (Mine Detection)

A. General

Mine Detection techniques are covered by STO 77-9.4 in general. However, the potential exists within the Laboratory to also support STOs 77-9.12 and 12.1. The state-of-the-art is such that the development of electronic detection equipment is progressing slowly.

B. Work of Good Quality in Support of STOG but Inadequately Emphasized.

1. A concept called METRRA (Metal Reradiation Radar) is being developed for airborne, vehicular and man-portable modes. It is based on scattering of electromagnetic energy from artifacts that are characterized by a non-linear transfer function. The system only responds at the third harmonic of the transmitted frequency which eliminates the normal clutter problems associated with conventional radar. This system detects stationary non-linear targets in an environment of heavy foliage. The system is designed to detect surface mines and booby traps, but could also be used for STANO applications. Funds are inadquate to support this concept.

2. Some successful advancement has been made in the area of using dogs and other small animals to act as mine detectors. The animals almost always keyed on the explosive vapor eminating from the mine rather than any human scent. However, this program has been terminated by TRADOC. Because of state-of-the-art problems, no equipment has been developed yet which can duplicate the olfactory capability of the animals. There are no funds available for the animal program and inadequate funds available for equipment development.

3. In general, the total mine detection program does not have sufficient funds to support a viable development process.

C. Work Identified as Good Quality and of High Relevance to Future Army Needs but not in Direct Support of the STOG.

None.

D. GAPS.

None.

E. Work Identified to be of Poor Technical Quality.

None.

III. Recommendations (Mine Detection)

A. Gaps to be filled to support STOG.

None.

B. Work to be terminated.

None.

C. Significant comments for use by TRADOC in providing input for STOG 78.

No mention is made of developing means to detect mines and booby traps in the MOBA environment. This should be emphasized.

D. New Initiatives.

None.

E. Concept Development and Validation (CDV) candidate efforts.

As described previously, the METRRA and Explosive Vapor Detection Programs would be CDV candidates.

None.

H. DEMOLITIONS (8)

I. Introduction

The total scope of demolitions falls under STO 77-9.7. However, work in this field is split among many Army agencies. This chapter attempts to organize several thoughts concerning demolitions development and employment into a cohesive presentation. Even so, several questions are raised which should be answered.

II. Findings

A. General - Demolitions are addressed by STO 77-9 par 9.7 that call for 4 areas of demolition requirements as follows:

1. destruction of massive concrete/steel targets with pounds rather than tons of explosives.

2. accomplish other barrier missions using demolitions. (See also Section 3.2.6)

3. detonate munitions by remote control.

4. (provide procedures, material for) controlled demolitions in built up areas (i.e., military operations in built up areas (MOBA)).

The development of tactical demolitions materiel and techniques is conducted at several laboratories in the Army. Essentially explosive formulations and the development of firing devices, adoptation and testing of the military worth of commercially developed items and explosive is conducted at Picatinny Arsenal. The development of demolition procedures and techniques, to include the drilling of hole and determining optional locations of explosive for a particular demolition job, and is responsible for the 6.2 effort. In addition, demolitions techniques are developed at the Waterways Experimental Station.

B. Work of good quality in support of STOG but inadequately emphasized.

None.

C. Work identified as good quality and of high relevance to future Army needs but not in direct support of the STOG.

MANFLEX and DUSTEX demolitions systems

D. Gaps.

None - study is being initiated.

E. Work identified to be of poor technical quality.

Not applicable.

III. Recommendations

A. Gaps to be filled to support STOG.

None.

B. Work to be terminated.

None.

C. Significant comments for use by TRADOC in providing input for STOG 78.

None at this time.

D. New Initiatives.

None.

E. Concept Development/Validation Efforts.

None.

IV. Detailed Study Results and Rationale for Findings.

A. The MERADCOM rationale in the classification of demolitions (see Table I) and in the first-cut lab approaches has been influenced as a result of discussion among DA staff personnel. The British in particular have conducted two major studies on bridge demolitions with the results that:

1. Scaling laws are non-linear and what works to demolish a small bridge won't work on a larger one.

2. They are dissatisfied with a study to define requirements for bridge demolition equipments because of the multiplicity of different types of devices recommended. In addition to the above, the MERADCOM rationale has been influenced by the ABCA Operational Concept 1986-1995, and by discussions on EOD aspects of demolitions to provide solutions to the random delay munition threat, in particular with the Naval EOD Facility at Indianhead, Maryland, and with DARCOM HQ when an EOD staff supervision office was located there.

It should be noted also, that MERADCOM, as far back as 1971, proposed a new demolitions program aimed at reducing still further the amounts of explosive and manpower required to accomplish the mission. The major deficiency of the proposal was that it placed too much emphasis on bridge component destruction and avoided the question of total bridge destruction under the constraints of time, manpower and materials.

V. ADDENDUM. The results of the British in dealing with the bridge demolition problem because of scaling difficulties may very well have to be addressed by construction of full-size bridge sections of sufficient width and length to provide a "standard" bridge for testing. In addition, the requirements for demolitions in MOBA operations require testing of devices and procedures in a realistic environment. Queries have brought out that there are no test facilities in the U.S. for material developed for use in MOBA. Consequently, as part of its long range plan, MERADCOM has requested resources to build a test of a size requisite for testing of this type, and for construction of large Autobahn bridge sections.

I. ENVIRONMENTAL CONTROL (9)

I. Introduction.

Environmental Control includes the functions of heating, air-conditioning, ventilation, filtering, humidifation and de-humidifation. Work is divided into two main areas: Development of general purpose items and support for specific major systems.

II. Findings

A. General.

The 5 STO's which cover environmental control efforts are adequately supported by the MERADCOM program, although the programs are inadequately funded.

B. Work of Good Quality in Support of STOG but Inadequately Emphasized.

All work pertaining to R&D on heating and air conditioning equipment appear to be inadequately funded. A major portion of the R&D work is accomplished with customer funds in providing environmental support for major systems (e.g., PATRIOT, ROLAND, SAFEGUARD). Little effort is being accomplished to support the technology base and final general purpose items.

C. Work Identified as Good Quality and of High Relevance to Future Army Needs, but Not in Direct Support of the STOG.

Not applicable.

D. Gaps - Work That Should Be Done to Support STOG but Not Being Accomplished.

Funding is needed to support development of heating and cooling equipment which utilizes waste heat. The power consumption of environmental control equipment used in the mobile field army, averages approximately 50 percent of the total demand. Utilization of waste heat from fuel burning power generating equipment will reduce the power demand to less than 5 percent of the energy required for existing environmental control equipment.

Work should be initiated to improve efficiency in the area of heat exchange. Heat pipe technology should be expanded to permit application in military systems operating under world wide temperature extremes.

To reduce electromagnetic interference and improve reliability, additional emphasis should be placed on solid state controls for use in environmental control equipment.

Also lacking is work in air filtration which could remove the majority of CB contaminants without requiring large externally installed collective protection systems.

III. Recommendations.

A. Gaps to be filled to support STOG:

See D above.

B. Work to be terminated.

None.

C. Significant comments for use by TRADOC in providing input for STOG 78.

1. STO 77-10.6.8: Collective protection equipment employing gas and particulate filtration necessitates relatively large fan horsepower which finally converts to heat, raising the air temperature as much as 15°F. Obviously, this requires air cooling in inhabited spaces.

D. New Initiative.

None.

E. Concept Development and Validation (CDV) Candidate Efforts.

None.

J. FUELS AND LUBRICANTS (10)

I. Introduction

The Fuels and Lubricants field of endeavor is designed to meet short and long-range Army objectives and requirements for fuels, lubricants, hydraulic/power transmission fluids, corrosion preventatives and specialty compounds, including weapons lubricants. This program provides support for every system that requires fuel, lubricants, power transmission and hydraulic fluids, or corrosion protection either in storage or usage. Many of the products developed under this program are used by DOD and other governmental activities. In the international field, close coordination of military requirements, product standardization, and new product trends are maintained through NATO, ASCC, and Quadripartite working groups.

The primary objectives for this area are to (1) provide combat/tactical equipment with fuels and fluids possessing greater fire-retardant characteristics and (2) provide products to the field that will assure satisfactory mission performance, result in low engine/vehicle maintenance, and be available in adequate quantities at a minimum cost in terms of quantities and logistics.

At present, six areas of technical effort are being addressed: Fire-Safe Fuels, Less Flammable Hydraulic Fluids, Liquid Hydrocarbon Fuels and Combustion, Lubricants Friction and Wear, Power Transmission Fluids, and Corrosion Preventatives and Specialty Compounds. Priority has been given to the development of fire-safe fluids in view of recent combat damage data wherein fuels and fluids contributed to vehicle vulnerability. In fuels and combustion, various methods are being investigated to increase fuel availability which involve evaluation of prototype candidate fuels from syncrude processes (shale oil and coal liquefaction), potential use of selected well-head crudes as field emergency diesel engine fuels, and defining fuel tolerance capabilities for Army engines. In terms of lubricants, the development of multi-purpose year-round synthetic engine oils for the Army tactical fleet and efforts to eliminate oil drains are being pursued. Similarly, multi-grade gear lubricants are being explored as they will preclude seasonal changes and would result in a savings of material and labor. Power transmission fluid research has involved development of silicone automotive brake fluids which will provide an all-seasonal capability as well as that of a preservative fluid. In corrosion preventatives, research is being directed to extend the service life of military anti-freeze by either reclaiming and/or use of reinhibiting additives.

II. Findings

A. General

In reviewing the STOG, approximately 18 STO's are identifiable within the current objectives of the Fuels and Lubricants Field of Endeavor (FOE). The STO's are included with in the categories of Strategic Mobility, Close Combat, Air Mobility, Tactical Engineering, Logistics, and Construction/Facility Engineering, and Environmental Quality.

B. Work of good quality in support of STOG but inadequately emphasized.

Under Combat Capability Category 5 - Close Combat, para. 77-5.7b states "RAM-D engineering to yield 500 MMBF." Should not this be 5000 MMBF as 500 is not very realistic in relation to RAM-D engineering.

Under Combat Support Capability Category 14 - Logistics, it is suggested that the following be added to para 77-14.8 as "e":

"Improved engine tolerance to fuel composition to increase availability of fuels."

C. Work identified as good quality and of high relevance to future Army needs but not in direct support of the STOG.

Under Strategic Capability Category 4 - Strategic Mobility, it is recommended that the following STO be incorporated:

"Develop materials and techniques to prevent deterioration of equipment and supplies and to facilitate world-wide operation under adverse climatic conditions."

Under Combat Support Capability Category 14 - Logistics, it is recommended that the following STO be incorporated:

"Develop multi-functional lubricants and power train fluids to reduce the number of different materials required in the supply system and design equipment to use specification materials eliminating the need for proprietary materials."

D. Gaps - Work that should be done to support STOG but not being accomplished.

None can be recommended.

E. Work identified to be of poor technical quality.

No identification is possible from information provided.

III. Recommendations

A. Gaps to be filled to support STOG

See above recommendations under IIB and IIC.

B. Work to be Terminated.

None can be recommended.

C. Significant comments for use by TRADOC in providing input for STOG 78.

No input.

D. New Initiative.

None can be recommended.

E. Concept Development and Validation Candidate Efforts.

Not applicable.

K. CONSTRUCTION (11)

I. Introduction

The Construction Equipment field broadly encompasses a number of widely differing construction engineering and excavation tasks. A rapid excavation capability is required, for instance, for the construction of underground facilities, protective emplacements, barriers, trenches, roads, airfields, etc. In addition to these varying functional requirements, the environmental and ground conditions will also differ and will include soft soil, wet earth, hard rock, etc. Further, the developments of excavating equipment materiel and techniques have to satisfy two major mission categories: rear area general purpose capabilities; and, forward area combat engineer tactical support capabilities. These requirements are not entirely compatible and tend to lead to differing approaches to solve the problems associated with each of the mission categories. The current policy is to use commercial equipment, modified or adapted, to the maximum extent possible, particularly for those engineer units and tasks away from the combat zone. Use of off-the-shelf, commercial equipment and techniques in the combat support mission category is frequently found inappropriate because critical performance requirements exceed commercially available technology.

Within the Construction Equipment area, MERADCOM has a research and exploratory development plan geared to investigate, exploit, and develop new or improved bomat theater construction, earthmoving, clearing and highway maintenance equipment. The thrust of development is toward lightweight equipment capable of: rapid excavation in a variety of worldwide geologic media (soil and rock); high mobility including travel over off-road, swamp, and other marginal terrain conditions; and, rapid transport to remote and/or hostile sites by parachute and helicopter.

II. Findings

A. General

The twelve STO's identified herein point out construction engineering tasks in the broad requirement areas of strategic mobility, close combat, tactical engineering, NBC defense, and extreme environments technology. New excavation methods to defeat hard rock and rapid construction techniques have recently been the main interests. In general, construction equipment should require less human skills, be flexible, have multiple applications or uses, and be useable in all environments including extreme cold, desert, and tropics. This area should provide means for soil stabilization,

dust control, ground troop protection, and mobility equal to supported forces (particularly for tactical engineering missions). It should provide the technology, techniques, and design to accomplish all construction engineering tasks. A review of the STO's and current planned work indicates that some are fairly well covered, but that others are practically forgotten. For example, STO's 4.2, 9.2, and 9.5 should be largely satisfied by the UET and the FAMECE. STO's 4.3, 4.6, 5.5, and 9.1 are being partially satisfied in our 6.2 program but require additional funding. STO's 9.6, 9.10, and 9.11 are not being covered at present due primarily to funding limitations.

B. Work of Good Quality in Support of STOG But Inadequately Emphasized.

In this area is included the tasks: explosive drilling system, two stage combustion explosive ripper, and vibratory dozer blade. A low level of funding over the past four years has caused development efforts to be stretched over an undesirable long period. Current funding guidance can support only an in-house effort to explore scientific information sources.

C. Work Identified as Good Quality and of High Relevance to Future Army Needs but Not in Direct Support of the STOG.

None.

D. Gaps - Work That Should be Done to Support STOG but Not Being Accomplished.

Land clearing techniques and subsequent development of mobile equipment could improve troop mobility and speed construction sub-phases. Entrenching capability must be up-graded to provide high quantities of sub-surface protection for ground troops and field artillery equipment and personnel. Unconventional drilling methods and tunnel construction should be developed to provide rapid means of creating underground storage and military strongpoints.

E. Work Identified to be of Poor Technical Quality.

None.

III. Recommendations.

A. Gaps to be Filled to Support STOG.

See D above.

B. Work to be Terminated.

None to be recommended.

C. Significant Comments for Use by TRADOC in Providing Input for STOG 78.

Place emphasis on the excavation technology where there is a substantial volume of material to be moved for the construction job and where hard rock or other difficult considerations are involved. When concerned with the elements of excavation technology, site investigations, ground control, excavation method and safety are some of the factors that must be addressed.

D. New Initiatives.

Add: 78-9.1. Develop improved combat zone excavation and tunneling techniques in soil and hard rock to facilitate surface and subsurface site preparation and construction of emplacements and underground facilities. The ultimate goal is to provide a worldwide capability in high speed excavation and rapid means of underground construction for utilities and as an avenue for material transport and mobility of people.

L. MOBILE ELECTRIC POWER (12)

I. Introduction

The Electric Power Area has widespread application, including post camp general housekeeping, shop sets, flood and search lights, topo and mapping vans, refrigerator units, missiles, battery charging, field hospitals, military construction sites, aircraft and vehicle APU's, radar, communications, and water purification. Most of these needs are presently serviced by the DOD standard family of gasoline engine driven tactical generator sets (0.5, 1.5, 3.0, 5.0 and 10 KW), the DOD standard family of diesel engine driven general purpose generator sets (5, 10, 15, 30, 60, 100 and 200 KW), and old state-of-the-art special purpose turbine generator sets (30 and 60 KW). There are a number of areas in which improvement over the capabilities of these power sources are required to meet the STOG requirements; i.e., life, reliability, weight, volume, multifuel capability. MERADCOM is working in a number of areas because the commercial developments do not provide ready-made solutions to militarization of power sources, use of logistic fuels, and military RAM conditions.

MERADCOM is developing fuel cell power plants to achieve sources of electric power having increased reliability, compactness, mobility and silence. Gas turbine engine driven generator sets are being developed to provide longer life, higher reliability, and higher efficiency. Of equal importance to the fuel cell and turbine program mentioned is the development of power conditioners to be used with these generators and also to couple to any source of power to provide precisely what any load may require.

II. Findings

A. General

A total of 14 STO's were considered as being served by this area of effort. Of the technologies supporting these STO's fuel cells appear to have adequate support. Improvements in the gas turbine generator sets are partially aided by the engineering development effort; however, increased support in FY 77 and 78 is highly desirable. Devices which offer great gains in size, weight, and power capability over present technology are not well supported. In the solar power area, all present funding is from ERDA to provide a demonstration of military application of photovoltaic systems. Development of these systems would benefit from added support in the Technology Base. Electrical transmission and distribution has suffered

from a lack of funding but appears to be phasing in well. Increased funding would aid in some critical areas of this effort; i.e., modularity and uniformity of vital components.

B. Work of Good Quality in Support of STOG bu inadequately emphasized.

In the area of power conditioning, work of good quality which is not sufficiently emphasized include the Integrated Power Switch and Transcalent Devices. The switch provides improved cost and RAM characteristics via modularization by incorporating the power stage as well as integral control and protective logic and is most suitable for power conditioner approaches in the 5 to 30 KW range. The transcalent devices are based on heat pipe technology and provide excellent cooling of the semiconductor chips yielding improved reliability and decreased weight and size as compared to conventional semiconductors with their necessary heat sinks.

In the gas turbine area, development of ceramic components will proceed, but is adequately funded only after FY 79, which is too late to provide a significant impact on STOG requirements in the time frame being considered. Increased emphasis in FY 77 and 78 is indicated.

C. Work Identified as Good Quality and of High Relevance to Future Army Needs but Not in Direct Support of the STOG.

None.

D. Gaps - Work that Should be Done to Support STOG but Not Being Accomplished.

This lies in all Test, Measurement and Diagnostic Equipment (TMDE) areas where nothing is being done. Present equipment could be retrofitted and ongoing development items could have the capability as an integral part. The control systems cited in B above are particularly adaptable to the incorporation of TMDE capabilities.

E. Work Identified to be of Poor Technical Quality.

None.

III. Recommendations.

A. Gaps to be Filled to Support STOG.

See D above.

B. Work to be Terminated.

None to be recommended.

C. Significant Comments for Use by TRADOC in Providing Input for STOG 78.

Emphasize that almost all systems or capabilities required by STOG need adequate power sources.

D. New Initiatives.

None.

E. Concept Development and Validation (CDV) Candidate Efforts.

None.

TABLE 1 - SUMMARY

	STOG NO.	SUBJECT	PRIORITY	PROJECT NO.	PROGRAM DESCRIPTION	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
	3.1c	Power Sources	OK	AH67 DG, 10,11	Electric Power	X									
(1)	4.2	Air Transportability	OK	AH67 DG14	Construction Equipment	X									
(2)	4.3	Rapid Port Constr/ Rehabilitation	OK	AH67 DG14	Construction Equipment		X								
		Capabilities for Discharge of NSS snips		AH67 D526	Logistics-over-the-shore		C*		C		C		C	C	C
		Capability for discharge of PCL		AH67 DK41	Fuels Handling		5								
	4.4	Ammo Supply Restraint devices	OK	AH67 DG14	Containers/ Materials Handling	X									
	4.6	Logistics over-the-shore Beach Stabilization	OK	AH67 DG14	Construction Equipment		X								
(2)				AH67 DG14	Containers/ Materials Handling		D								
				AH67 D526	Logistics-over-the-shore		C		C		C		C	C	C
				AH67 DK41	Fuels Handling		E								
(1)	4.7	Adjustable Container Chasis/Multiple Size Containers	OK	AH67 DG14	Containers/ Materials Handling	X									
	4.8	Flat Rock Container	OK	AH67 DG14	Containers/ Materials Handling	X									

(a.) General, oil. (b.) Good program in support of STOG. Inadequate emphasis. (c.) Good quality work, no STO. (d.) Gaps - work should be done but not currently funded. (e.) Poor quality. (f.) Gaps exist, need to be filled to support STOG. (g.) Terminate program. (h.) Suggestions to TRADOC. (i.) CDV candidates.

NOTES: (1) See TARADCOM
(2) See OCE

*LETTERS REFER TO SUBPARAGRAPHS OF THE RATIONALE SECTION. X indicates program category w/o specific comment in Rationale Section.

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TABLE 1 - SUMMARY (Continued)

	STOG NO.	SUBJECT	PRIORITY	PROJECT NO.	PROGRAM DESCRIPTION	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
(1)	5.2a	Main Battle Tank ATGM Defense Smoke	OK	AH67 D471	Camouflage	X									
	5.2f	Fire Safe Fuels/Fluids	OK	AH69	Fuels/Lubes	X							J		
(1)	5.2j	Integral vehicle protection against mines	OK	AH66 D606	Countermine		G								
	5.5	Organic barrier capability	OK	AH66 D606	Barriers		F								
			OK	AH67 DG14	Construction Equipment	X									
	5.7e	High Energy fuel	OK	AH69	Fuels/Lubes	X									
(1) (2)	6.9	Packaging, Logistical Handling Equipment	OK	AH67 DG14	Containers/ Materials Handling		D						D		
	7.2a	Survivability (Helo) signature reduction	OK	AH67 D471	Camouflage	X									
	7.2i	Survivability (Air Craft) fires/fire fighting	OK	AH69	Fuels/Lubes	X									
	7.8	Logistics over-the-shore Vertical lift	OK	AH67 D526	Logistics over-the-shore	X									
	7.9	Fueling, Rearming of Helicopters	OK	AH67 DK41	Fuels Handling	X									
(1) (2)	8.2a	Mobility	OK	AH67 DG10 DG11	Electric Power	X								L	
	8.2d	Camouflage - AD weapons	OK	AH67 D471	Camouflage	X									
	8.2e	One minute set up/take down	OK	AH67 DG10 DG11	Electric Power	X									
	8.9	Camouflage, concealment, decoys, etc.	OK	AH67 D471	Camouflage	X									

NOTES: (1) See TARADCOM also
(2) See OCE also

TABLE 1 - SUMMARY (Continued)

	STOG NO.	SUBJECT	PRIORITY	PROJECT NO.	PROGRAM DESCRIPTION	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
	9.1	Barriers, minefields, Non-mine barrier technology	OK	AH66 D606	Barriers		F		F		F				F
(2)		Minimum signatures Integral Camouflage		AH67 D471	Camouflage	X									
		Rapid Emplacement		AH67 DG14	Construction Equipment		K		K		K		K		
	9.2	Rapid Construction Techniques	OK	AH67 DG14	Construction Equipment		K				K				
		Camouflage, CPS facilities, Comm circuits		AH67 D471	Camouflage	X									
(2)	9.3	Wet/Dry Gap Crossing, Rafting	OK	AH67 DG01	Bridging	X									
	9.4	Countermine, detection, neutralization	OK	AH66 D606	Countermine		G						G	G	G
	9.6	Rapid Construction Bases, Ports, Facilities	OK	AH67 DG14	Construction Equipment		K		K		K				
		Reduce time Indegenous materials		AH67 DG10 DG11	Electric Power	X									
		Reduce Engr skills		AH67 D526	Logistics-over-the-shore		X								
				AH67 DK41	Fuels Handling		X								
	9.7	Demolitions, Explosives	OK	AH66	Demolitions				H		H				

NOTES: (1) See TARADCOM also
(2) See OCE also

TABLE 1 - SUMMARY (Continued

	STOG NO.	SUBJECT	PRIORITY	PROJECT NO.	PROGRAM DESCRIPTION	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
(1) (2)	9.9	Topographic info minefields obstacles	OK	AH66 D606	Countermine		X								G
	9.10	Tactical Engr. North temp. Artic	OK	AH67 DG14	Construction Equipment	X									
(2)		Excavation of frozen materials		AH67 DG01	Bridging		B							B	
		Engr. Activities		AH67 DK39	Environmental control		I								
	9.11	Tactical Engr, Arid, desert	OK	AH67 DG14	Construction Equipment	X									
(2)		Soil stabilization Dust control Water purification		AH67 D609	Bridging ----	X									
		Gaps crossing Beach stabilization		AH67 D526	Logistics-over-the-shore		C								
	9.12	Mine field marking, mapping	OK	AH66 D606	Countermine		X								
	10.6	Armored vehicles in CB environment	OK	AH67 DG14	Construction Equipment		K				K				
(1)		Equipment operation in CB environment		AH67 DK39	Environmental Control		I		I		I				
(1)	10.8	NBC Defense, vehicles & vans shelters	OK	AH67 DK39	Environmental Control		I								
	11.2	Power Sources	OK	AH67 DG10 DG11	Electric Power	X									

NOTES: (1) See TARADCOM also
(2) See OCE also

TABLE 1 - SUMMARY (Continued)

STOG NO.	SUBJECT	PRIORITY	PROJECT NO.	PROGRAM DESCRIPTION	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
11.3	Power Sources low signatures	OK	AH67 DG10,11	Electric power	X									
			AH67 D471	Camouflage	X									
11.46	TMDE	OK	AH67 DG10,11	Electric power		L								
11.4c	Standardized electric modules Maintenance logistics	OK	AH67 DG10,11	Electric power	X									
11.10	Environmental control, tactical communica-tions	OK	AH67 DK39	Environmental control		X								
12.1	Surveillance, target acquisition, smoke, weather, foliage camouflage	OK	AH66 D606	Countermine		X								
12.10	Techniques to defeat surveillance Reduce detection	Raise to 12.7	AH67 D471	Camouflage		A				A			A	A
12.11	Solar power	OK	AH67 DG10,11	Electric power		X								
13.6	Decoys, deception ECM ARM countermeasures	OK	AH67 D471	Camouflage	X									
13.7	Decoy technology Deception technology	OK	AH67 D471	Camouflage		A				A			A	A
14.1	Standard containers Handable loads Environmental Protection	OK	AH67 DG14	Containers/ Materials handling	X							K		
14.3 (1)	TMDE	OK	AH67 DG10,11	Electric Power		L								
			AH69	Fuels/lubes		E								

NOTE: (1) See TARADCOM also

TABLE 1 - SUMMARY (Continued)

	STOG NO.	SUBJECT	PRIORITY	PROJECT NO.	PROGRAM DESCRIPTION	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
	14.7	Bulk liquid/POL distribution		AH67 DK41	Fuels handling	X							E		
				AH67 DK39	Water supply		X								
				AH67 DG14	Camouflage		D		D						
	14.8	High Energy Fuel Reduce Consumption Commonality of fuels Alternative Energy sources		AH69	Fuels/lubes	X							J		
				AH67 DG10,11	Electric power	X									
	14.9	Batteries, solar devices, fuel cells Reduce signature		AH67 DG10,11	Electric power	X									
				AH67 D471	Camouflage	X									
(1)	14.10	Move containers ISO, ANCI in T/O		AH67 DG14	Containers/ Materials handling	X									
				AH67 D526	Logistics-over-the-shore				C				C		
(1)	14.12	Fire Safe Fuels		AH69	Fuels/lubes	X									
	14.13	Containers, physical security transportation		AH67 DG14	Containers/ Materials handling	X									
	14.14	Environmental controls, heating, A/C, etc.		AH67 DK39	Environmental control		I								
	18.6	Energy conversation New energy sources		AH67 DG10,11	Electric power	X									
				AH69	Fuels/lubes	X							J		
	18.9	Elimatic/Environment Engineering functions		AH67 DG14	Construction equipment	X									

NOTE: (1) See TARADCOM also

SECTION 4

TANK AUTOMOTIVE RESEARCH & DEVELOPMENT COMMAND (TARADCOM)

I. Introduction

Combat and tactical vehicles are basically elements of Army systems that rely heavily on mobility technology for their effective utilization. Combat vehicle systems include armored vehicles such as tanks, personnel carriers, scouts, self-propelled artillery and special purpose gun and missile carriers. Tactical vehicles include wheeled trucks and trailers and tracked cargo carriers fulfilling a large variety of logistic and support functions to all combat elements of the Army. In most cases, the vehicle is the integrating hardware element for a combat system and much of the work carried out at TARADCOM has a systems orientation. However, in this study of the relevance of TARADCOM's programs to STOG-77, emphasis was placed on mobility science and technology with the assumption that the Armament, Missile, and Electronics Panels would deal with the weaponization aspects of combat vehicles.

The STOG does not treat mobility as a separate topic, but gives mobility a high priority in several of the individual STOG categories such as close combat. A foldout sheet at the end of this section lists all STOG-77 items having vehicle-type mobility objectives and shows the relation between these STO's and the TARADCOM programs. Included within the table on the foldout sheet are comments on the findings as well as comments and recommendations relevant to each program and the STOG items.

The subsequent parts of Section 4 present the findings of the subpanel on mobility, the key recommendations, and some discussion of the analysis and rationale supporting the findings and recommendations of the subpanel.

II. Findings

A. The STOG will be a valuable document during the next few years in helping the R&D community focus their effort on solving the Army's problems.

B. The STOG is "mission oriented" and, therefore, does not provide specific guidance to basic and applied research on a fundamental level. Development of advanced technology and its useful application is an iterative process between the developer and user. It is not likely that a user will provide sufficient input to the basic and applied research process. Therefore, the Army should assign discretionary funds, on a level of effort basis, in the 6.1 vehicle area. Work in this area such as high temperature materials, fuel chemistry, combustion, acoustics, and many others, have pioneered the way for advances in vehicle development. As an example of a current need, STO 77-14.3 calls for predicting component failures. The vehicle diagnostic program is proceeding well, but vehicle component prognosis requires expanded basic research in failure mechanisms, including vehicle tests. It is judged that the Army effort in the combat/tactical vehicle area should be about $3 M/yr directed toward 6.1 vehicle areas. It should be relatively constant and receive only very general guidance from the STOG. FY 77 effort devoted to basic vehicle mobility research within the TARADCOM labs is $500 K direct-funded and $390 K ILIR, inadequate to support a vehicle basic tech base.

C. The STOG stresses mobility and places the #1 Strategic Mobility (77-4.1) priority as reducing volume, weight, etc. of Army supplies. It would be useful to have a list of scenarios, with numbers, to provide more specific guidance. For instance, the SCORES model for Middle East and Europe would predict a daily combat consumption requirement of about 8000 tons/day to support 4 Army divisions. By adding the basic equipment for 4 Army divisions, tradeoff factors for parameters of weight, volume, cost, etc., against mission capability could be generated to provide guidance to the developer of logistic support equipment (e.g., vehicles).

D. The STOG does not list Land Mobility as a separate category but distributes this requirement among several areas such as close combat, fire support, strategic mobility, surveillance, and others. As a result, some areas appear neglected such as logistic support of active combat forces. It would appear that a higher priority for this function (particularly FEBA support) is needed than implied by 77-6.9.

E. The STOG makes several references (77-5.2E, 77-10.6, 77-10.8) to developing a capability of fighting in a NBC/CW/BW environment; yet this factor is not considered in vehiclular designs other than a capability to "plug in" gas masks in some combat vehicles. The application of this priority item needs better definition in terms of the STOG and in Development effort. Army should be specific in defining the need for vehicles.

F. A requirement is mentioned several times in the STOG (77-9.9, 12.3, 12.5) for a Remotely Piloted Vehicle (RPV), but no mention is made of a Remotely Controlled Ground Vehicle (RCV). Many of the requirements of close combat in built-up areas, surveillance, and mapping, etc., could be accomplished with such a device; so work should be devoted to both air and ground remotely controlled vehicles. Perhaps the STOG should add RCV to each paragraph that specifies RPV's.

G. While the tank and automotive tech base programs are good, they would benefit from a discipline in wide use in industry. Each component area: propulsion, transmissions, suspension, tracks, etc., should have a specific set of numerical goals for improving technology versus time. The achievement of a specific advanced goal should be demonstrated in a full-scale test vehicle to establish its practicability before it is considered for engineering development. Component technology is thus stimulated and applied on a low risk basis.

H. The emphasis on the combat vehicle (tank) as the principal Army weapon system per FM 100-5 implies a corresponding need for continued aggressive R&D activity both for product improvement (PIP) and new vehicle concepts. Perhaps this should be reflected in the STOG by increasing the priority of 77-5.2 (new MBT or PIP) to 77-5.1.

III. Discussion

Comments on individual STOG paragraphs regarding mobility areas (Combat and Tactical Vehicles) are included in the fold-out table at the end of Section 4, which summarizes the applicable STOG Paragraphs, relevant Program Numbers, Findings for each program, and Recommendations.

IV. Recommendations

It is recommended that serious considereation be given by the Army to the initiation of programs in those ares defined as Gaps (under Findings in the fold-out table).

Of the total of 39 STOG paragraphs (or subparagraphs) applicable to Combat and Tactical Vehicles, 20 have no technical programs. This appears to be a surprising lack of technical effort, but it is recognized that the Army allocation of funding to TARADCOM in this area is low, approximately $15 M of the Army's $600 M program in 6.1, 6.2, and 6.3a---or only 2 1/2 percent of the Army's total technology base effort.

V. Rationale

Besides the specifics shown on the foldout sheets, the subpanel on mobility discussed a number of overall issues that impact strongly on what the Army should be doing in mobility as related to combat and tactical vehicle systems. The essence of these issues and the thoughts of the subpanel are as follows:

A. The systems requirements and needs for an adequate, advanced technology base for armored combat vehicle systems are scattered throughout STOG-77 with the consequence that the needed user guidance to the developer lacks cohesion. In particular, the bases for making tradeoffs in the course of developing advanced systems concepts that are fully responsive to user needs are frequently lacking and thus contribute to the difficulty of establishing the proper military worth of new concepts.

B. The STOG-77 emphasizes the importance of the tank and the ability of future tanks to operate effectively on the battlefield against numerically superior forces. The logical way to achieve such an objective is the extensive use of advanced technology including mobility related capabilities. This means that training of tank crews must be directed to the upgrading individual crewman in training. Oversimplification and training at reduced skill levels are not consistent with the goals of the Army or with the technology level of the equipment.

C. In the context of the current state-of-the-art in reliability and commercial automotive technology in the United States, the extremely low levels of mean miles between failure (MMBF) of main battle tanks during peacetime seems pathetic. The Army needs to examine carefully its peacetime MMBF goals versus combat requirements and to fund adequately the technology base for subsystems and components, plus instituting improved quality assurance and more testing of complete vehicles to achieve substantially improved RAM-D performance for tanks.

D. The new version of FM-100-5 places great stress on the ability of the Army to fight with equal effectiveness at night as well as in daytime. This operational need is not reflected in STOG-77 with respect to either tank-automotive equipment or mobility in general.

E. Reduced crew size in armored combat vehicles is desirable, but will require extensively expanded human engineering research and expanded reliance on technological devices, neither of which are properly recognized with respect to vehicles in STOG-77.

SECTION 4 - TARADCOM STOG'S RELATED TO MOBILITY AREAS (COMBAT & T

STOG #	STOG SUBJECT	COMMENT ON RELATIVE STOG PRIORITY	RELEVANT PROGRAM NUMBER (S)	PROPONENT	PROGRAM DESCRIPTION	A	B
77-4.1	Minimize equipment weight, volume	#1 (satisfactory)	AH91	TARADCOM	Tank & automotive technology		X
			D424	"	Advanced vehicle components & subsystem	X	
			D103	"	Vehicle diagnostics	X	
77-4.2	Air transportability	#2 (satisfactory)	AH91	"	*Tank-automotive vehicle concepts*		X
			D118	"	Advanced land mobility systems	X	
77-4.7	Adjustable container (trailer) chassis	#7 (satisfactory)	None	"			
77-4.9	Vehicle tie-down devices	#9 (satisfactory)	None	"			
77-5.2	Next MBT (new or PIP)	Should be -5.1	AH91	"	Advanced combat vehicles		X
-5.2a	Acceleration, signature reduction		AH91	Also see report sec. 3 MARADCOM			X
-5.2e	CW/BW protection		AH91	TARADCOM			
-5.2f	Armor protection		AH91	"		X	
-5.2h	EW countermeasures		AH91	"			X
-5.2i	Reduced crew requirements		AH91	"			X
-5.2j	Integral land mine protection		AH91	"			X
77-5.3	Advanced, lightweight combat vehicle	#3 (satisfactory)	AH91	TARADCOM	Advanced concept vehicles		X
			D118	"	High survivability, high mobility test bed	X	
77-5.7	Low priority items for next MBT	#7 (satisfactory)	AH91	"			X
-5.7b	RAM-D (power train)	#7 (satisfactory)	AH91	"	Advanced power train/suspension tech		
			D307	"	Engines		X
			D395	"	Transmissions	X	
			D424	"	Suspensions		X
			D424	"	Track		
-5.7c	Human engineering	#7 (satisfactory)	AH91	"	Human engineering		
-5.7d	Closed loop, automated target acq.	#7 (satisfactory)	AH91	"	Target Acquisition		
-5.7e	High energy fuels	#7 (satisfactory)	AH91	MERADCOM/TARADCOM	Development of concentrated energy and/or reduced fuel consumption		
-5.7f	Auto-launch of anti-ATGM	#7 (satisfactory)	AH91	TARADCOM	Active armor concepts		
77-5.9	AT/AD enclosed firing techniques	#9 (satisfactory)	DF23	"	TOW under armor (ITV)	X	
77-6.5	Fire support for artillery	#5 (satisfactory)	AH91	"	RAM-D for SP guns		
77-6.9	Logistic support of field artillery	Should be 6.1	AH91	MERADCOM/TARADCOM	Advanced replacement for M548		
77-8.2a	Mobile air defense (general)	#2 (satisfactory)	AH91	TARADCOM	Tracked air defense vehicle		X
77-8.3	Mobile air defense gun system	#3 (satisfactory)	AH91	"	Armored, mobile gun carrier vehicle		X
77-9.9	Information Acquisition	#9 (satisfactory)	AH91	TARADCOM	RCV development		
77-10.6	Vehicle protection against CB	#6 (satisfactory)	AH91	TARADCOM	Improved combat vehicle protection		
77-10.8	Vehicle protection against NBC	#8 (satisfactory)	AH91	"	Improved combat vehicle protection		
77-11.7	Land navigation	#7 (satisfactory)	AH91	"	Application to combat vehicles		
77-12.3	Signature free remote control vehicle	#3 (satisfactory)	AH91	"	Use of RCV's for the application		
77-12.5	Remote controlled payloads	#5 (satisfactory)	AH91	"	Use of RCV's for the application		
77-12.7	Laser diffusion techniques	#7 (satisfactory)		"			
77-14.2	General RAM-D for equipment	#2 (satisfactory)	AH91	"	General RAM-D technology development		
77-14.3	Field repair, simplified diagnosis parts commonality, failure prognosis	#3 (satisfactory)		"	Work now directed toward diagnosis & parts commonality in vehicle families		X
77-14.4	Maintenance training methods	#4 (satisfactory)	D203		Work now directed toward diagnosis & parts commonality in vehicle families		X
77-14.6	Improved body armor	#6 (satisfactory)			Application to combat vehicle crews		
77-14.8	Reduce fuel handling & storage	#8 (satisfactory)	DG07	TARADCOM	Commonality of fuels for vehicles		X
77-14.10	Efficient container movement	#10 (satisfactory)	AH91	"	Tactical and support cargo carriers		
77-14.12	Fire-safe fluids	Should be 14.7	AH91	MERADCOM/TARADCOM	Modify vehicle design to accommodate		X
77-15.2	Improved human engineering data	#2 (satisfactory)	AH91	TARADCOM	Crew human factors research		
77-19.3b	Noise and emission abatement	#3b (satisfactory)	DG07			X (Emissions)	

LEGEND: A - General (OK as is)
B - Good Quality Supports STOG, Inadequate emphasis on funding
C - Good Quality, No Stated STOG
D - Gap, Needs Funding Support
E - Poor Quality
F - Gaps to be filled to Support STOG
G - Work to be terminated

TABLE 2

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LATED TO MOBILITY AREAS (COMBAT & TACTICAL VEHICLES) TARADCOM

PROGRAM DESCRIPTION	A	B	C	D	E	F	G	SUGGESTIONS TO TRADOC FOR STOG 78	COMMENTS ON NEW INITIATIVES	CDV CANDIDATE EFFORTS
k & automotive technology		X						(4.1) Put quantitative number on objective		
anced vehicle components & subsystem	X									
icle diagnostics	X									
k-automotive vehicle concepts		X								
anced land mobility systems	X									
				X		X		(4.7) Needs more input from TRADOC		(4.7) X
				X		X		scenarios		
anced combat vehicles		X						(5.2) As a principal Army weapons system		
		X						per FM 100-5 priority should be increased		
				X		X		(5.2e) Army must make up mind	No present R&D tech base effort on CW/BW position (total vehicle)	
	X									
		X								(5.2i)X
		X								
		X								
nced concept vehicles		X						(5.3) Maintain continued emphasis		
survivability, high mobility	X									
bed		X								
anced power train/suspension tech					X	X		(5.7b) 500 MMBF FAR too low		
ngines		X						an objective		
ransmissions	X									
spensions		X								
rack					X	X			(5.7b) New track technology as well as RAM-D effort is needed	
an engineering				X	X	X				
et Acquisition				X		X				
elopment of concentrated energy and/or duced fuel consumption				X		X		(5.7e) STO, as written, is too specific; there are other ways of achieving the STO objectives		
ve armor concepts				X		X				
under armor (ITV)	X									
-D for SP guns				X		X			TOG is nearly silent on	
anced replacement for M548				X		X		(6.9) Put proper emphasis on FEBA support	attlefield front line	
cked air defense vehicle		X							ogistics support to	
ored, mobile gun carrier vehicle		X							eet FM-100-5	
development				X		X		(9.9) Also consider RCV's	e RCV for this purpose	(9.9)X
oved combat vehicle protection				X		X			(10.6) No R&D effort for vehicle	
oved combat vehicle protection				X		X			10.8) No R&D effort for vehicle	
ication to combat vehicles				X		X				
of RCV's for the application				X				(12.3) Consider RCV's	Consider RCV's	
of RCV's for the application				X				(12.5) Consider RCV's	Consider RCV's	
				X		X			(12.7) No effort in this area--Requires program	
ral RAM-D technology development					X				(14.2) Many MTBF objectives seem too low	
now directed toward diagnosis & parts		X		X		X			(14.3) Present effort is on diagnosis. Need R&D6.1 programs on methods of prognosis	
monality in vehicle families										
now directed toward diagnosis & parts										
monality in vehicle families		X		X		X			Need program with NARADCOM for Combat Vehicle Crew Armor	(14.4) X
ication to combat vehicle crews				X		X				
monality of fuels for vehicles		X						(14.8) PER DOD Directive H140.43		
ical and support cargo carriers				X		X			(14.10) No program for vehicles (truck) to handle containers in theater of operation	
y vehicle design to accommodate		X								
human factors research					X	X				
	X (Emissions)			X (Noise)		X			(19.3b) No program on noise abatement for combat & tactical vehicles	

to Support STOG

nated

TABLE 2

2

SECTION 5

GENERAL CONCLUSION AND RECOMMENDATION ON FUNDING OF LAND MOBILITY

Review of Field Manual 100-5 reveals a strong emphasis on land mobility in all of the combat roles of the Army in the field and in the many support functions associated with both the deployment and in-theater movements of Army Divisions. The great majority of the Army's active divisions are structured as surface mobile, as opposed to airmobile organizations. In both their deployment and combat activities they (the majority) are dependent on land mobility for successful execution of their roles.

These premises of FM 100-5 constitute an important departure from the heavy dependence of the Army's fighting divisions on the helicopter -- the situation that so dominated land force operations in the Southeast Asia theater of operations. Concomitant with this change of emphasis there should be a reemphasis on the development of technology in support of land mobility. This reemphasis can be highly significant in terms of productivity in improving land mobility, especially in reliability and product lifetimes and at only modest fractions of the technology base investments that have been made to develop our capabilities in air mobility.

Therefore, the panel recommends that a broad review of Army dollar investments in mobility technology be made with an eye toward major transition of emphasis toward solving the technological problems of land mobility -- consistent with the Army's plans for relying more heavily on land mobile forces in future conflict.

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APPENDIX I

ASAP

1976 SUMMER STUDY

SUBGROUP NO. 5 - MOBILITY

- DEFINITION: STOG FY 77, Q.O. 1024, TACTICAL MOBILITY, EXCLUDING AIRCRAFT, BUT INCLUDING GROUND SUPPORT OF AIRCRAFT MOBILITY PLUS LOGISTICS OVER THE SHORE AS CALLED OUT BY Q.O. 1024, STRATEGIC MOBILITY/LOGISTICS.

- OCE, MERADCOM, AND TARADCOM ARE THOSE GROUPS PRIMARILY CONCERNED WITH THE SUBJECT OF MOBILITY. THEIR REPRESENTATIVES ARE PRESENT.

- ASAP SUBGROUP NO. 5 MEMBERS:

  RALPH E. FADUM

  DAVID R HEEBNER

  ROBERT L. HESS

  JACK I. HOPE (VICE CHAIRMAN)

  GEORGE J. HUEBNER, JR. (CHAIRMAN)

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OUTLINE: ANALYSIS AND REPORTING PROCEDURE

SUBGROUP NO. 5 -- MOBILITY

I. INTRODUCTION

(CAVEATS, ASSUMPTIONS, Q.O. DEFINITIONS, ACTIONS)

II. FINDINGS: STO'S IN MOBILITY AREAS

(A) GENERAL

(1) SUBJECT OF STO

(2) RELATIVE PRIORITY OF STO

(3) RELEVANT LAB PROGRAM NUMBERS

(4) PROPONENT(S)

(5) PROGRAM DESCRIPTIONS

(B) FINDINGS ON PROGRAM

(1) GOOD QUALITY, SUPPORTS STO, BUT INADEQUATE EMPHASIS

(2) GOOD QUALITY, BUT NOT IN DIRECT SUPPORT OF STATED STO

(3) GAP, NEEDS NEW WORK TO SUPPORT STO

(4) POOR QUALITY IN PROGRAM WORK

III. RECOMMENDATIONS

(A) GAPS TO BE FILLED TO SUPPORT STO'S

(B) WORK TO BE TERMINATED

(C) SUGGESTION TO TRADOC FOR STOG-78

(D) NEW INITIATIVES (NEW STO'S)

(E) CDV CANDIDATE EFFORTS

IV. RATIONALE

CORPS OF ENGINEER R&D PROGRAMS

GENERAL MESSAGES ABOUT GROUND MOBILITY

- MOST EXISTING PROGRAMS RESPONSIVE TO STOG ITEMS, BUT
- SOME IMPORTANT STOG ITEMS NOT ADEQUATELY ADDRESSED IN PROGRAMS, AND
- STOG DOES NOT ADEQUATELY IDENTIFY ALL URGENT NEEDS

CORPS OF ENGINEER R&D PROGRAMS

TWO BASIC CATEGORIES OF PROGRAM INADEQUACIES

- COMBAT ENGINEERING PROCEDURES IN SUPPORT OF COMBAT FORCES
- METHODS OF QUICKLY ACQUIRING AND USING TERRAIN DATA RELEVANT TO VEHICLE MOBILITY

ONE BASIC CATEGORY IN WHICH STOG IS INADEQUATE

- SYSTEMS FOR MAKING QUANTITATIVE PREDICTIONS OF MOBILITY PERFORMANCE

OCE PROGRAMS

	Recommendations			
	Cancel	OK	Program Add	New STO
COMBAT ENGINEERING PROCEDURES				
• SURFACE PREPARATION TO SUPPORT HEAVY VEHICLES	X		X	
• BARRIERS TO ENEMY MOVEMENT		X	X	
• ROUTE AND GAP-CROSSING IMPROVEMENTS		X	X	
RAPID ACQUISITION AND USE OF TERRAIN DATA				
• SPECIALTY PRODUCTS FOR COMBAT FORCES		X		
• MAP PRODUCTION AND DISSEMINATION		X	X	
• TERRAIN DATA UPDATING		X	X	
• FAR-FORWARD TERRAIN SURVEY		X		
PERFORMANCE PREDICTIONS FOR MOBILITY-RELATED MACHINES				
• IMPROVEMENTS IN ARMY MOBILITY MODEL (AMM)		X	X	X
• MODIFICATION OF AMM FOR TACTICAL USE			X	X
• COMBAT ENGINEER EQUIPMENT MODEL			X	X

MERADCOM PROGRAM

- THE MERADCOM PROGRAM CONTENT IS CONSISTENT WITH THE OBJECTIVES STATED IN THE STOG

- THE MERADCOM PROGRAM COMPLEMENTS THE TARADCOM PROGRAM IN THE MOBILITY AREA. VERY LITTLE OVERLAP OR DUPLICATION OF PROGRAM CONTENT IS APPARENT

- THE BREADTH OF TECHNOLOGY IN THE MOBILITY AREA IS VERY GREAT. SUPPORT OF BASIC RESEARCH AND EXPLORATORY DEVELOPMENT IS INADEQUATE TO PROVIDE ADEQUATE DEPTH OF EFFORT ACROSS THE SPECTRUM OF RELEVANT TECHNOLOGIES

- THE MERADCOM PROGRAM TAKES GOOD ADVANTAGE OF COMMERCIAL RESEARCH AND DEVELOPMENT EFFORTS.

MERADCOM PROGRAM

- THE PROGRAM IS UNDERFUNDED IN THE AREAS OF FUELS AND FUEL HANDLING WITH RESPECT TO THE PRIORITIES IDENTIFIED FOR THESE AREAS IN THE STOG.

- NO NUCLEAR, BIOLOGICAL, CHEMICAL PROTECTION PROGRAMS EXIST FOR VEHICLES (OR SHELTERS). A SERIOUS PROGRAM IN THIS AREA IS CONSIDERED BY THE PANEL TO BE OF VERY HIGH PRIORITY. (THE STOG IS LESS EMPHATIC WITH RESPECT TO PRIORITY.)

- LIMITING ENEMY MOBILITY HAS HIGH PRIORITY IN THE STOG AND WHILE SOME IMPRESSIVE CONTRIBUTIONS HAVE BEEN MADE, PROGRESS WOULD BE ENHANCED BY INCREASED SUPPORT OF TECHNOLOGY WORK AND REMOVING THE DISTINCTION THAT SEPARATES ACTIVE AND PASSIVE BARRIER WORK TO ARMCOM AND MERADCOM, RESPECTIVELY.

MERADCOM PROGRAMS

	Recommendations			
	Cancel	OK	Add Program	New STOG
COMBAT MOBILITY SUPPORT (MULTIPLIERS)				
• COUNTERMINE		X	X	
• BARRIERS		X	X	
• DEMOLITIONS			X	
• CAMOUFLAGE/COUNTER SURVEILLANCE		X		X
MOBILITY ENHANCEMENT				
• BRIDGING		X	X	
• CONSTRUCTION EQUIPMENT			X	
• FUELS/LUBRICANTS		X		
STRATEGIC MOBILITY/LOGISTICS				
• LOGISTICS OVER THE SHORE			X	X
• CONTAINERS/MATERIALS HANDLING		X	X	
• FUELS HANDLING EQUIPMENT		X	X	
VEHICLE/EQUIPMENT SUPPORT				
• ELECTRIC POWER		X		
• ENVIRONMENTAL CONTROL		X	X	X

SUBGROUP NO. 5 - MOBILITY

TANK-AUTOMOTIVE - R&D

- OVERALL TANK-AUTOMOTIVE TECH PROGRAMS SUPPORT THE STOG IN GENERAL TERMS BUT THERE ARE GAPS IN CONCEPT COVERAGE

- BETTER DEFINITION OF NUMERICAL GOALS FOR COMPONENT PROGRAMS AND A METHOD OF PROVING THESE COMPONENTS IN TEST VEHICLES

TARADCOM PROGRAMS

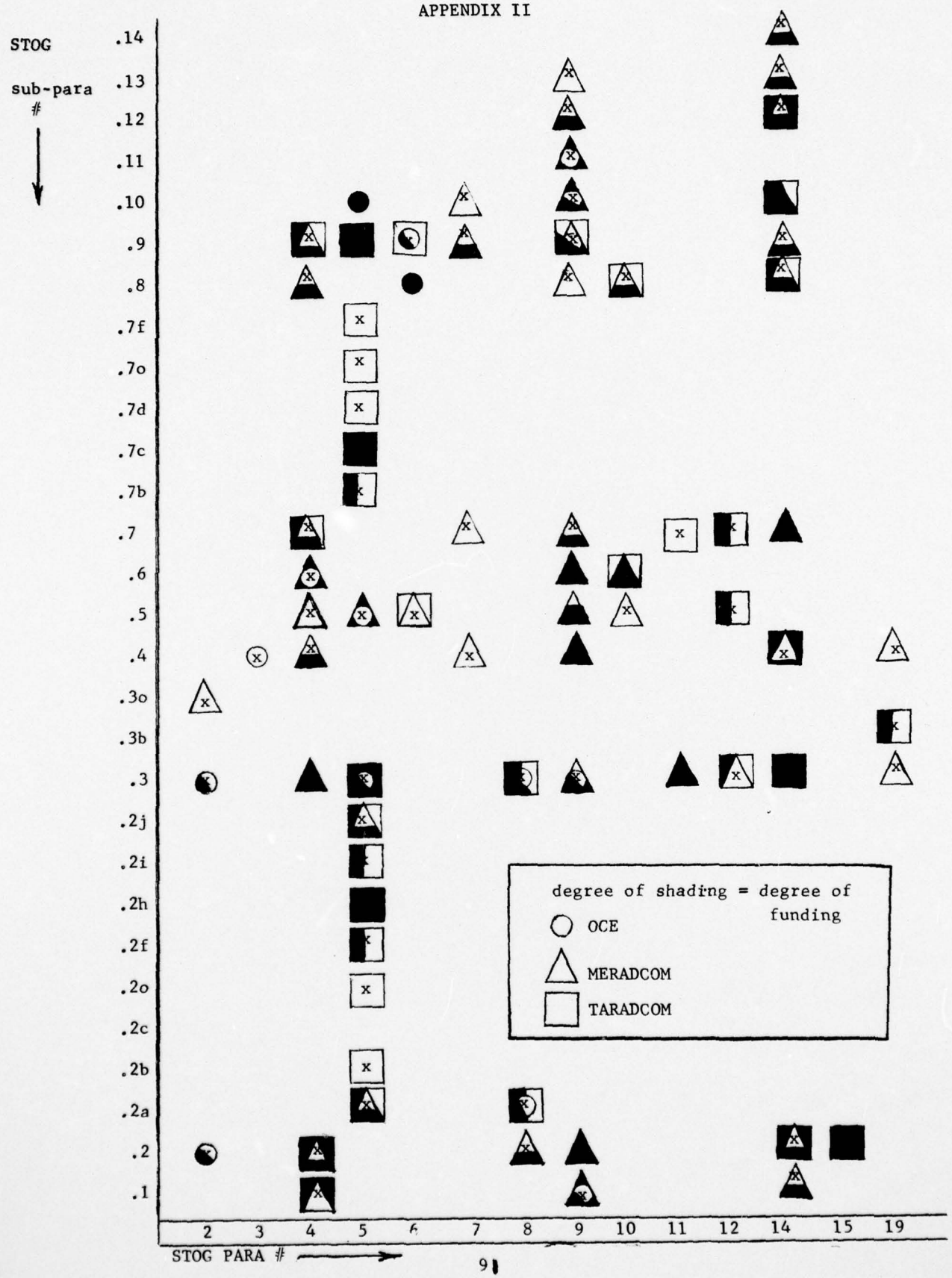
	Recommendations			
	Cancel	OK	Add Program	New STOG
COMBAT AND TACTICAL SUPPORT VEHICLE SYSTEMS				
• MODELING AND SIMULATION		X		
• TEST BED VEHICLES		X		
• ADVANCED SYSTEM CONCEPTS		X	X	X
VEHICLE SUBSYSTEMS AND COMPONENTS				
• HIGH-TEMPERATURE, HIGH EFFICIENCY ENGINES		X	X	
• INFINITELY VARIABLE TRANSMISSIONS		X		
• EXTERNAL, SELF-CONTAINED SUSPENSIONS		X	X	
• TRACKS AND WHEELS		X	X	
• ACTIVE AND PASSIVE PROTECTION		X	X	
• CW/BW PROTECTION			X	
VEHICLE MOBILITY TECHNOLOGY BASE				
• MATERIALS				X
• COMBUSTION				X
• FUELS			X	X
• HEAT TRANSFER				X
• DYNAMICS				X

GENERAL COMMENTS

SUBGROUP NO. 5

- SUMMER STUDY HAS BEEN EFFECTIVE IN INITIATING THE INTEGRATION OF STOG REQUIREMENTS INTO A NEW MOBILITY-PROGRAM UNITY.
- STOG FOCUSES R&D EFFORTS BY PROVIDING A BASIS FOR REVIEW AND ANALYSIS, BUT
- STOG IS PRIMARILY SYSTEMS ORIENTED, IN THE FUTURE IT SHOULD ALSO PROVIDE GENERAL GUIDANCE TO URGENTLY REQUIRED BASIC RESEARCH
- MOST EXISTING PROGRAMS RESPONSIVE TO STOG ITEMS, BUT
- SOME IMPORTANT STOG ITEMS NOT ADEQUATELY ADDRESSED OR FUNDED, AND
- STOG DOES NOT ADEQUATELY IDENTIFY ALL URGENT NEEDS, AND
- STOG PRIORITIES DO NOT ALWAYS SEEM TO REFLECT REAL NEEDS.

APPENDIX II



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APPENDIX III

TRADOC COMMENTS

1. The ancillary task of the ASAP is to identify and describe ideas to be pursued by TRADOC in cooperation with DARCOM Concept and Validation (CDV) Funds was discussed. It was considered inappropriate to try and identify or prescribe specific ideas to be pursued by the combat developer and the materiel developer. The ongoing programs of each of these major commands adequately provide for initiating concept evaluation projects by either DARCOM or TRADOC or in conjunction therewith. The broad procedures governing the TRADOC Concept Evaluation Program and the interface with DARCOM are discussed below:

TRADOC Concepts Evaluation Program (CEP).

a. CEP is a TRADOC Program which involves the use of specific RDTE and OMA (TRADOC controlled) funds for the conduct of a broad spectrum of tests and evaluations of a new or modified concepts involving doctrine, tactics, training, and hardware. CEP provides TRADOC commands a quick-reaction and simplified process for resolving or solidifying combat and training development thinking pertinent to Operational Capability Objectives (OCO), Letters of Agreement (LOA), Required Operational Capabilities (ROC), Letter Requirements (LR), and Training Device Requirements (TDR). CEP supports procurement of existing items (e.g., commercial modification of existing items, or fabrication of prototypes for use by a TRADOC school/center/activity in conducting test and evaluation.

b. Products of CEP include:

(1) Determination of the operational and training potential of concepts or items.

(2) Development of operational doctrine, tactics and techniques.

(3) Development of training techniques.

c. CEP will not be used to compete with, replace or augment the normal R&D efforts of AMC. CEP will not be used in lieu of developing an LOA or other requirements documents to circumvent the normal materiel acquisition process.

d. Responsibilities for management of and participation in CEP are listed below:

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(1) Headquarters TRADOC--CEP will be managed by the Experimentation and Test Directorate (ETD), Office of the Deputy Chief of Staff for Combat Development (ODCSCD). Other elements of the TRADOC staff including the Office of the Deputy Chief of Staff for Training will participate in the overall coordination of CEP.

(2) TRADOC Centers/Schools/Activities--As proponent for their applicable part of the CEP, develop, plan, supervise conduct of, and report on the results of CEP tests and evaluation.

(3) TRADOC Test Facilities--Support CEP as required on a customer service basis.

e. Suggestions for the conduct of test and evaluation of a new or modified concepts may be made by any one within TRADOC. Normally, these suggestions will be surfaced by the proponent (TRADOC Center/ School activity).

f. Upon approval of a CEP request, copies are provided DARCOM for information.

g. Those requests which are not considered within the purview of the TRADOC CEP program as outlined above, but which are viewed worthy of consideration by the materiel developer are forwarded to DARCOM for their consideration. Most of these more properly fall in the category of Technical Feasibility, governed by AR 70-10.

2. To win, our soldiers will need the best weapons that industry and technology can provide. But weapons, no matter how powerful, are ineffective in the hands of inept, ill-trained, unsure operators. An even proficient crewman can be rendered impotent if improperly employed by the battleleader. Overall battlefield effectiveness depends on weapons capability, the proficiency of teams or crews, and the tactics or techniques of the commander. Thus, the US Army must obtain powerful weapons, develop fully the proficiency of the men who man them, and train leaders capable of employing weapons and crews to best effect.

APPENDIX IV

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Technology Base Efforts
Plans and Requirements Compatibility
Mobility

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The Army Scientific Advisory Panel (ASAP) conducted Summer Study '76 at the Armed Forces Staff College, Norfolk, VA, during the period 19-30 July 1976. The Panel examined the compatibility of the Science and Technology Objectives Guide (STOG), which delineates desired operational capabilities, and the system development plans of the various Army Laboratires to determine if the laboratory programs include the appropriate technology efforts to achieve the desired systems capabilities. The Panel made the examination through the efforts of the six Subgroups of Armament, Aviation, Electronics, Missiles, Mobility, and →

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