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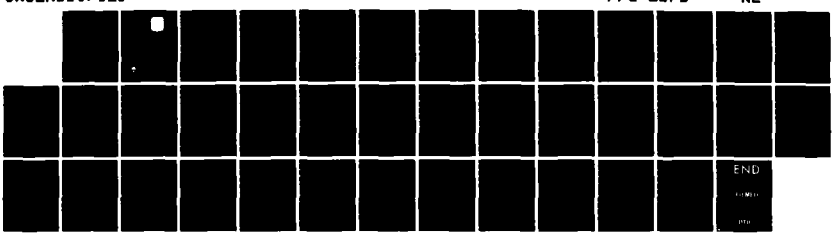

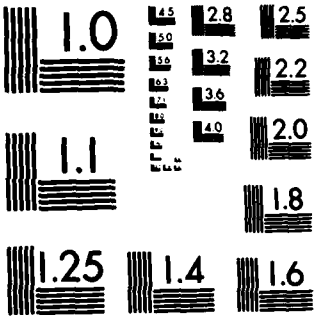

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STUDY PROJECT

EQUIPMENT PROFILES FOR MAJOR ITEMS OF ENGINEER EQUIPMENT

BY

MR. BRUCE W. SPRINGFIELD

MAY 1984

US ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013

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The cost of equipping modern military forces has risen at almost exponential rates over the past decade. The increased reliance on sophisticated equipment to improve combat effectiveness and the initiation of the largest equipment modernization program in our military history has focused our attention on the equipment acquisition and allocation process. It is imperative that the military use it's limited resources wisely by properly structuring units with the proper items of equipment to accomplish the missions expected in the priority

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scenarios. The engineer equipment requirement profiles to support the maneuver force in a European Scenario were compared with support capabilities found in typical engineer support packages. It was found that typical engineer support packages do not contain the proper mix of equipment to efficiently accomplish the high priority support tasks needed by the maneuver force within the FCZ. A higher proportion of digging equipment is required in combat engineer units to accomplish the mix of survivability, countermobility, and mobility tasks that have been defined as priority needs. Equipment profiles for major engineer equipment items as well as initiatives for unit design improvements are identified in the study.

USAWC MILITARY STUDIES PROGRAM PAPER

EQUIPMENT PROFILES FOR MAJOR ITEMS OF ENGINEER EQUIPMENT

A INDIVIDUAL STUDY PROJECT

by

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May 1984

ABSTRACT

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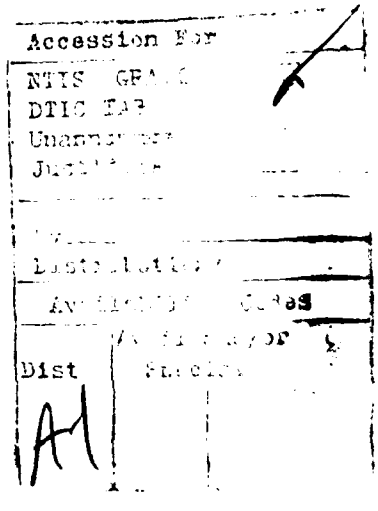
PREFACE

This individual study project was designed around a general problem statement that was submitted by the U.S. Army engineer School and Center at Fort Belvoir, Virginia. The author undertook the effort because of past experience in analytic efforts dealing with engineer equipment requirements to support various scenarios. The analysis though restricted to the evaluation of engineer requirements and capabilities is applicable in the sense of methodology to the evaluation of other branches of a military force.



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CHAPTER I

INTRODUCTION

Military organizations are becoming more and more equipment intensive. Modern technology has provided machinery and weapons that have revolutionized the tactics and doctrine used to conduct military operations on the battlefield. In a environment of constrained resources; selective development, acquisition and allocation of equipment is essential if this country is to maintain a effective fighting force. This study project addresses the issue of how one determines the equipment requirements for a military unit.

PURPOSE

The design of a military organization involves the process of combining equipment and personnel into a unit that has the

combined resource capability necessary to accomplish a stated objective(s). The purpose of this study is to analyze the equipment requirements for engineer support units involved in a European conflict. The methodology used in the analysis is appropriate for other support type organizations.

SCOPE

This study project investigates the requirements for four key items of engineer equipment needed to support army forces in the forward combat zone (FCZ). Engineer task frequencies generated by a European conventional and a integrated scenario will provide the basis for calculating individual equipment requirements. The capability of engineer organizations to efficiently satisfy the requirements will be evaluated by looking at both current and planned Tables of Organization and Equipment (TOEs). Based on the analysis recommendations to improve the equipment mix within engineer TOEs and general TOE design criteria will be made.

ORGANIZATION

This study will consist of five chapters each containing a major section of the report. Chapter I provides the introduction and sets the stage for the analysis. Chapter II evaluates the European war SCENARIOS and defines the engineer task/equipment requirements. Chapter III looks at engineer TOEs to establish what equipment capabilities are available to satisfy the requirements. Chapter IV provides a comparison of equipment requirements and capabilities and identifies problem areas. Chapter V will focus on organizational improvements and general TOE design criteria.

TERMS OF REFERENCE

The terms of reference provide the axioms and assumptions on which the analysis is conducted. In general they tend to limit the scope of the study to a appropriate level. The primary terms of reference are:

Study time frame----current

Area of conflict----Europe(NORTHAG and CENTAG areas)

Area of analysis----forward combat zone of US Corps areas

Conflict parties----NATO/WP

Scenario----conventional(OMNIBUS[1] versions 1979 thru 1982)

and the TRADOC integrated scenario-(SCORES)

Warning conditions----M-day equal to D-10

Types of equipment to be analyzed-----digging(bull dozer,front end loader),hauling(NON-SQUAD--carrying dump trucks)and road maintenance(graders)

CHAPTER II

ENGINEER EQUIPMENT REQUIREMENTS

Equipment requirements are a function of the engineer tasks that must be accomplished to support the maneuver force in the FCZ and the frequency that those tasks must be preformed. Because of the resource constrained environment in which the military must operate, the relative priority of the tasks to be accomplished in terms of what impact they may have on the outcome of the battle will be considered. This stratification of equipment requirements by priority of mission permits one to design a organization that may not be able to accomplish all missions but will have the required equipment items and density to accomplish the ones that really must get done. This chapter will develop and present the time phased equipment requirements needed to support US Army forces in a European conflict. The primary source of requirements data is derived from a series of studies accomplished by the US Army Engineer Studies Center over the period 1979 through 1984(2.,3., 4.). These studies were sponsored by major army commands in Europe and have served

commands in Europe and have served to identify and initiate needed changes in engineer war fighting capabilities. The study recommendations have generally been accepted by the army engineer community. Because of this common acceptance, parameters such as tasks to be accomplished, equipment requirements per task and scenario details can be taken on face value. The task of this chapter is to define a set of time phased engineer equipment requirements.

ENGINEER TASKS IN THE FORWARD COMBAT ZONE

Engineer tasks in the forward combat zone are grouped into four functional categories: survivability, countermobility, mobility and general engineering. Survivability enhances the survivability of friendly forces by digging in weapon systems and critical command and logistic facilities. Countermobility obstructs the maneuver of the enemy in areas where fire and maneuver can be used to destroy him. Mobility preserves the freedom of movement of friendly forces by bridging, obstacle reduction, road construction/maintenance and support to counter attacking maneuver elements. The above three functional categories of work are accomplished in direct support of maneuver elements within the main battle area. General

engineering is that engineer work needed to the rear of the main battle area that is necessary to move, sustain and support the conflict. General engineering in this study effort is limited to that within the FCZ (forward of the corps rear boundary).

THE NUMBER OF ENGINEER TASKS CONSIDERED 5.

FUNCTIONAL CATEGORY	NUMBER OF TASKS
SURVIVABILITY	39
COUNTERMOBILITY	ALL OBSTACLE TASK
MOBILITY	10
GENERAL ENGINEERING	30

PRIORITY OF ENGINEER WORK

Four priority groups were developed to use as a framework for judging the relative importance of engineer support. These groups (titled "vital", "critical", "essential", and "necessary") and their criteria are summarized below.

PRIORITY GROUPS 6.

SHORT TITLE	IMPLICATIONS of NONSUPPORT
VITAL	* Jeopardizes the existence of the Corps * High loss of life * Early defeat of FCZ forces
CRITICAL	* Failure of operations in the FCZ * Increased probability of defeat
ESSENTIAL	* Short-term degradation in sustainability * Significant equipment/material losses
NECESSARY	* Long-term degradation in sustainability * Moderate equipment/material losses

Individual tasks are evaluated in terms of the impact they have on the outcome of the battle and are placed in the appropriate priority caterory. A condensed description of the types of tasks that makeup each of the priority categories follows:

VITAL: Point obstacles, minefields and tank ditches on the main avenue of approach; point obstacles on the secondary

approaches; primary and alternate survivability positions for indirect fire, Hawk weapons and radar systems and primary survivability positions for direct fire systems; minimum bridging and counterattack support to maneuver elements and rubble clearance.

CRITICAL: Tank ditches on secondary approaches; minefields and point targets which complete the obstacle plan; alternate survivability positions for direct fire weapons and supplementary positions for indirect fire, Hawk weapons and radar systems; combat trails for unit access and lateral movement; damage repair of combat trails and brigade MSRs; increased support for bridging and counterattacks; damage repair to MSRs, heliports and ALOCs; site preparation for POL and ammunition storage.

ESSENTIAL: Remaining tank ditches in the obstacle plan; supplementary positions for direct-fire weapons; full support to all counterattacks; protective construction for units in the corps and division rear areas and construction of access roads.

NECESSARY: Site preparation and expansion of ALOC and heliport facilities; site preparation and damage repair of secondary facilities; maintenance of MSRs, primary and secondary facilities.

ENGINEER EQUIPMENT REQUIREMENTS

Figures 1 and 2 provide composite equipment requirements and equipment profiles for the European conventional scenario. Figures 3 and 4 provide like information for the integrated scenario. The requirements were derived from a analysis of the references at footnotes 2. 3. and 4. and were sanatized to provide a unclassified refrence for this study. Though sanitized the requirements reflect appropriate planning figures for a European scenario.

ENGINEER EQUIPMENT REQUIREMENTS FOR A EUROPEAN CONVENTIAL SENARIO

AVERAGE EQUIPMENT HOURS REQUIRED EACH DAY OF THE TIME PERIOD BY EACH DIVISION EQUIVALENT IN THE FCZ.

TIME PERIOD	DAILY EQUIPMENT REQUIREMENTS PER DIV EQUIVALENT PRIORITY OF WORK															
	VITAL				CRITICAL				ESSENTIAL				NECESSARY			
	D	L	T	G	D	L	T	G	D	L	T	G	D	L	T	G
D-10 to D-1	210	50	60	0	140	70	40	0	110	70	220	10	70	10	50	50
D to D+19	160	50	90	0	300	110	90	0	170	100	110	10	100	20	160	170
D+20 to D+39	180	40	60	0	270	110	70	0	100	70	130	10	110	20	350	350
D+40 to D+59	250	60	80	0	410	160	90	0	110	80	140	10	120	20	300	300
D+60 to D+90	90	20	30	0	190	80	50	0	90	50	60	10	80	10	400	400

(D=DOZER,L=LOADER,T=NON-SQUAD CARRING DUMP TRUCK,G=GRADERS)

FIGURE 1

PROFILE OF EQUIPMENT REQUIREMENTS BY TYPE EQUIPMENT--CONVENTIONAL SCENARIO

DISTRIBUTION OF EQUIPMENT NEEDED TO ACCOMPLISH THE ENGINEER REQUIPEMENTS (%)

FCZ PRIORITY OF WORK	DOZER	LOADER	NON-SQUAD DUMP TRUCK	GRADER
VITAL	63	15	22	0
CRITICAL	60	24	16	0
ESSENTIAL	35	23	39	3
NECESSARY	20	3	38	39

FIGURE 2

REQUIREMENTS FOR A EUROPEAN INTEGRATED SCENARIO

AVERAGE EQUIPMENT HOURS REQUIRED EACH DAY OF THE TIME PERIOD BY EACH DIVISION EQUIVALENT IN THE FCZ.

TIME PERIOD	DAILY EQUIPMENT REQIREMENTS PER DIV EQUIVALENT (EQ HR) PRIORITY OF WORK															
		VITAL				CRITICAL				ESSENTIAL				NECESSARY			
	D	L	T	G	D	L	T	G	D	L	T	G	D	L	T	G
D-10 to D-1	80	50	50	0	110	40	60	0	120	90	400	20	15	0	10	10
D to D+9	470	170	410	0	520	200	240	5	360	190	200	20	80	20	160	150
D+10 to D+19	250	90	130	0	480	190	120	5	130	80	150	30	50	20	320	300
D+20 to D+30	200	35	0	0	240	80	140	5	90	60	360	80	60	20	260	250

(D=DOZER,L=LOADER,T=NON-SQUAD CARRING DUMP TRUCKS,G=GRADERS)

FIGURE 3

PROFILE OF EQUIPMENT REQUIREMENTS BY TYPE EQUIPMENT--INTEGRATED SENARIO

DISTRIBUTION OF EQUIPMENT NEEDED TO ACCOMPLISH THE ENGINEER REQUIREMENTS (%)

FCZ PRIORITY OF WORK	Dozer	Loader	Non-squad Dump truck	Grader
VITAL	54	17	29	0
CRITICAL	55	20	25	0
ESSENTIAL	29	18	47	6
NECESSARY	20	3	39	38

FIGURE 4

CHAPTER III

EQUIPMENT CAPABILITY OF ENGINEER UNITS AND SUPPORT FORMATIONS

INTRODUCTION

The engineer equipment to satisfy the requirements identified in Chapter II is found in the combat engineer units and equipment companies employed in the FCZ. The requirements are expressed in what a average Division needs in the way of equipment support within the FCZ, a division slice of requirements if you will. The equipment capabilities of current and planned engineer units will be displayed in this chapter. It will serve as the capabilities data base for the requirements/capabilities comparison of the next chapter and improvement initiatives identified in the chapter V. Figure 5 provides the numbers of key items of equipment in appropriate engineer units and the percentage that each item represents of the units' total inventory of those key items of equipment. As a reminder it should be noted that this study tracks only

dozers or dozing equipment, front loaders, non-squad carrying dump trucks and road graders. These are considered (by the author) to be the key items of equipment needed to accomplish the preponderance of combat engineer tasks in the FCZ.

MIX OF KEY EQUIPMENT IN ENGINEER COMBAT UNITS

UNIT	Items of Equipment				Percent of Equipment			
	Dozer	Loader	Dp Trk	Grader	Dozer	Loader	Dp Trk	Grader
Division Bns								
MECH/AD								
TOE 5-145H	8	6	22	1	22	16	59	3
HVY DIV 86	25	4	36	0	39	6	55	0
TOE 5-145J**								
INF DIV 86	22	2	16	2	52	5	38	5
TOE 5-255T**								
CORPS CMBT BNs								
TOE 5-35 WHL	14	10	36	4	22	16	56	6
TOE 5-45 MECH**	16	12	27	0	29	22	49	0
CMBT HVY bn								
TOE 5-115	15	10	50	9	18	12	60	10
SEPARATE COMPANIES								
CMBT SPT EQUIP CO								
TOE 5-58	8	10	60	9	9	11	69	11
EGR CO SEP AR BDE								
TOE 5-127	2	2	4	1	22	22	44	12
ENGR CO ACR								
TOE 5-109	2	2	4	1	22	22	44	12
ENGR CONST SPT CO								
TOE 5-114	3	7	24	0	9	21	70	0

Notes: Equipment figures are based on TOE data sheets provided by the US Army Engineer School. These documents are continually being revised and therefore may not be totally consistant with the most current revisions. Dump truck quantities have been adjusted to reflect only non-squad--carrying vehicles. All dump trucks have have been equated to 5 ton dump truck equivalents (20 ton truck = 3ea 5 ton trucks) and all front-end loaders have been equated to 2 1/2 cubic yard loaders.

Non-squad dump trucks only.

** Draft TOE used.

FIGURE 5

Figure 6 groups engineer units into some possible support packages for a division equivalent in the FCZ. One of the Corps Combat Engineer Battalions in each support package is a mechanized version (TOE 5-45). It is intresting to note how little the distribution of the four items of equipment change as the mix of units is varried.

EQUIPMENT CAPABILITIES OF TYPICAL ENGINEER SUPPORT PACKAGES

SUPPORT PACKAGE	ITEMS OF EQUIPMENT				PERCENT OF EQUIPMENT			
	Dozer	Loader	Dt Trk	Grader	Dozer	Loader	Dt Trk	Grader
Doctrinal: (strength 5033)								
Division Bn	8	6	22	1				
3 Corps Cbt Bn	44	32	99	8				
1 Cbt Hv Bn	15	10	50	9				
TOTAL	67	48	171	18	22	16	56	6
OPTION 1: (strength 4209)								
Division Bn	8	6	22	1				
2 Corps Cbt Bn	30	22	63	4				
1 Cmbt Hv Bn	15	10	50	9				
TOTAL	53	38	135	14	22	16	56	6
OPTION 2: (strength 3385)								
Division Bn	8	6	22	1				
1 Corps Cbt Bn	16	12	27	0				
1 Cbt Hv Bn	15	10	50	9				
TOTAL	39	28	99	10	22	16	56	6
OPTION 3: (strength 3869)								
Division Bn	8	6	22	1				
1 Corps Cbt Bn	16	12	27	0				
1 Cbt Hv Bn	15	10	50	9				
2 Cbt Spt Eq Co	16	20	120	18				
TOTAL	55	48	219	28	16	14	63	7

FIGURE 6

CHAPTER IV

COMPARISON OF ENGINEER EQUIPMENT REQUIREMENTS AND CAPABILITIES

There are two tracks one could take to compare equipment capabilities with the requirements necessary to satisfy the maneuver force. One track would be a quantitative comparison which would focus on the specific equipment hours by type equipment and identify numerical shortfalls (or excesses) in capabilities to support the force for a given scenario. This type comparison has been accomplished(2.,3.,4.)and has a security classification above the desired level of this paper. The second method involves a qualitative comparison of equipment items, that is the mix or distribution of key items of equipment within the engineer TOEs that must support the force requirements. This method of analysis is not only unclassified but is more useful in the TOE and force design process. It is this latter method of comparison that will be utilized in this analysis.

ANALYSIS OF ENGINEER EQUIPMENT REQUIREMENTS

Engineer equipment requirements are to a certain extent a function of the type of scenario (conventional or integrated) and to a larger extent the priority of engineer work being performed. Figures 7 thru 10 show both the impact of the type of scenario and the priority of work on the requirements for individual items of engineer equipment. When comparing the relative distribution of the requirements for the four items of equipment being analyzed, it can be seen that the digging (dozer and loader) needs are higher for the conventional scenario and the truck and grader needs are higher in the integrated scenario.

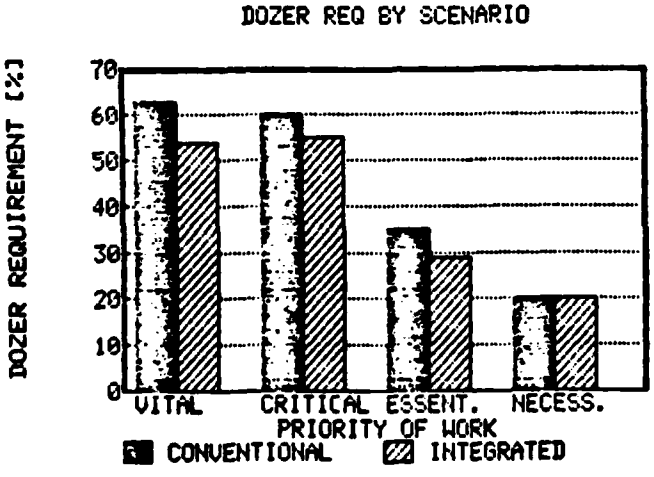
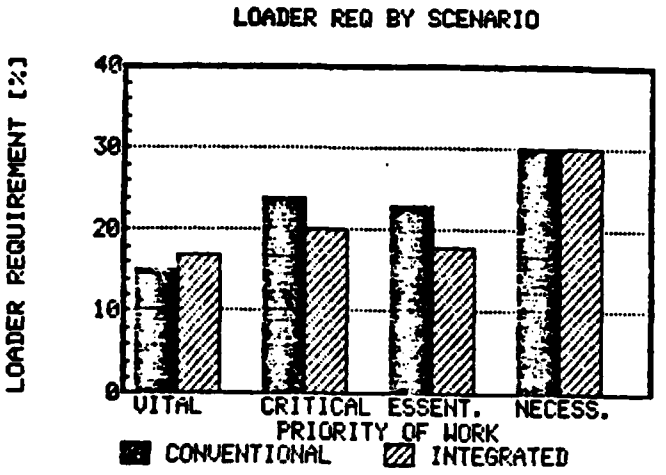


FIGURE 7



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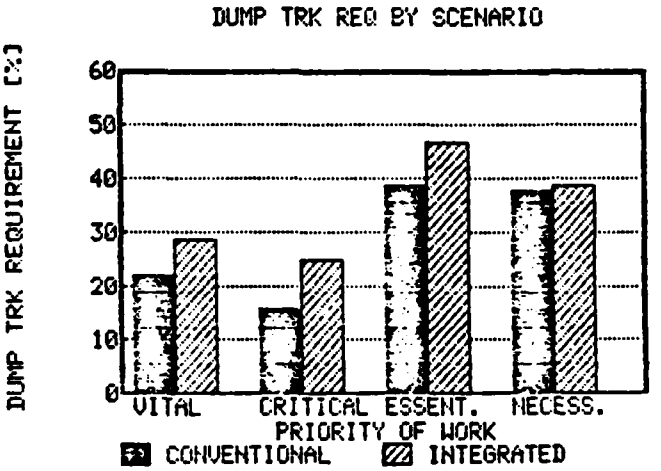


FIGURE 9

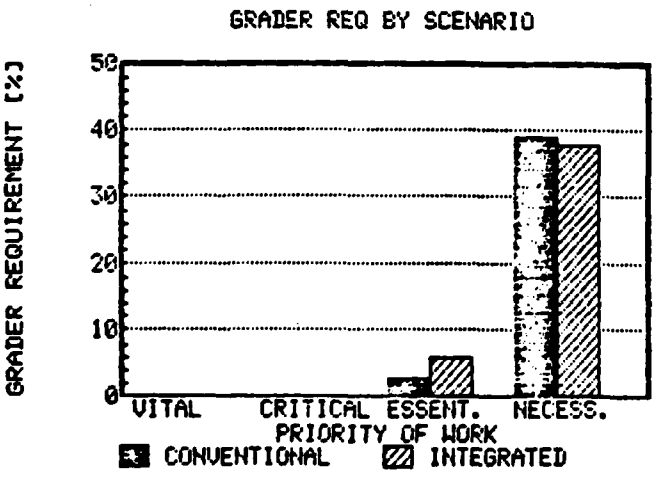
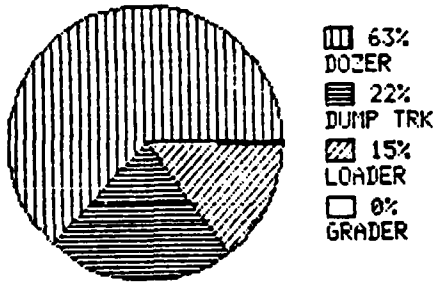


FIGURE 10

The distribution of equipment to accomplish the various priorities of work required by the force in the FCZ varies more significantly and provides a opportunity for more meaningful observations and recommendations. Looking at the conventional requirements; figures 11 thru 14 show more clearly the distribution of requirements needed for each priority of work. This breakout becomes important if certain units such as divisional battalions were to be equipped to accomplish or focus on a certain group of priority tasks such as VITAL and CRITICAL tasks. If this were the case divisional battalions would have a equipment distribution of about 60% dozers, 17 to 20% loaders, and about 20% non-squad carrying dump trucks. (IT IS IMPORTANT TO REMEMBER THAT THE comparisons AND PERCENTAGES ARE BASED ON THE ANALYSIS OF THE REQUIREMENTS AND CAPABILITIES OF ONLY FOUR ITEMS OF ENGINEER EQUIPMENT).

EQUIP REQ FOR VITAL WORK



FIGUR' 11

EQUIP REQ FOR CRITICAL WK

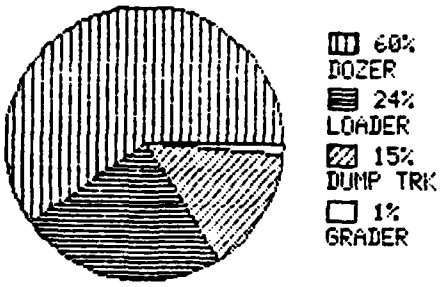


FIGURE 12

EQUIP REQ FOR ESSENT. WORK

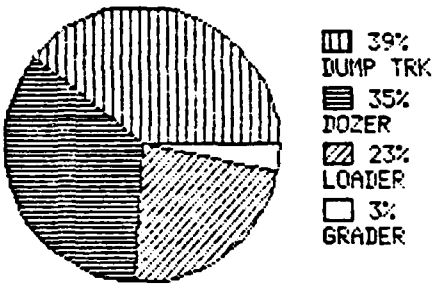


FIGURE 13

EQUIP REQ FOR NECESS. WORK

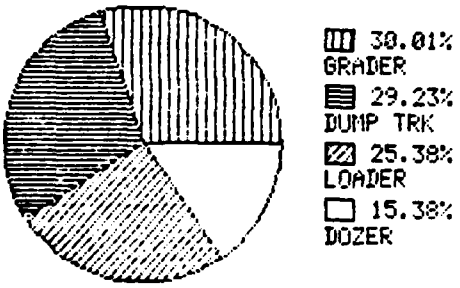


FIGURE 14

ANALYSIS OF ENGINEER EQUIPMENT CAPABILITIES

The doctrinal and the three optional engineer support packages that might support a division positioned in the FCZ (ie. a division slice of engineer support) all provide approximately the same distribution of the four key items of engineer equipment. Figure 15 illustrates the similarity of th various options.

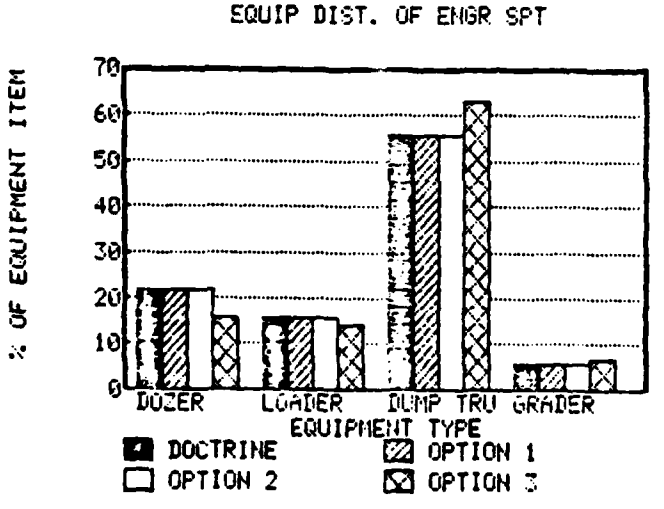


FIGURE 15

The distribution of the four items of equipment in engineer units at various organizational levels oddly enough does not vary significantly. Figure 16 shows the distribution of equipment at division, corps, echelons above corps (but a unit doctrinaly found in the FCZ), and a equipment company that is normally used to augment FCZ engineer equipment capabilities. Most notable is the lack of a unit that can markedly increase dozer capabilities of a engineer force without also increasing dump trucks and graders which are already excess to requirements. It would seem that engineer units are all equipped to accomplish about the same wide range of tasks.

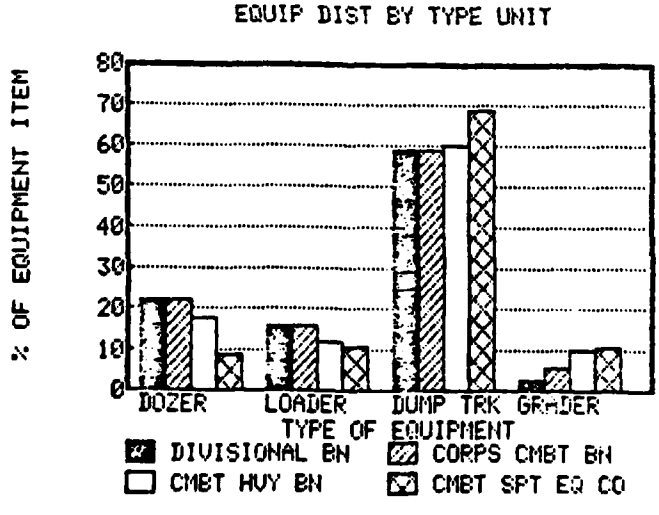


FIGURE 16

Rather recent developments in engineer TOE's reflect a recognition of the increased need for earth moving equipment. Figure 17 illustrates the equipment distribution within several divisional TOE's and the increased emphasis on the need for more dozer capability in the divisional area for the high priority survivability and countermobility tasks. Additional digging capability will be realized in the FCZ as the Armored Combat Earthmover(ACE/M-9) is fielded. This item of equipment will be considerably more effective because of it's mobility and survivability in the combat environment.

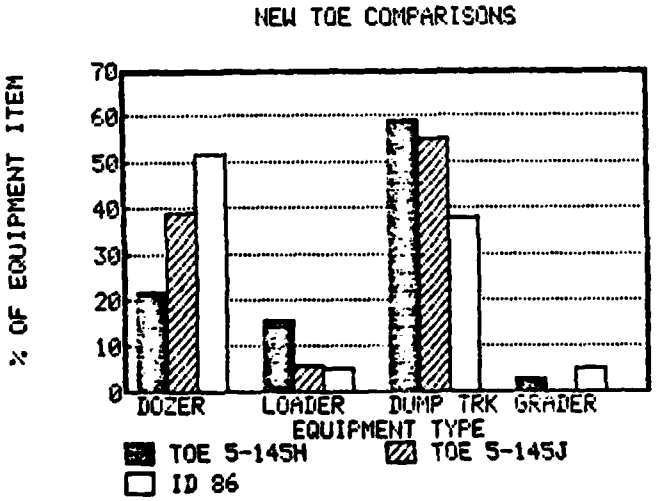


FIGURE 17

SUMMARY OF REQUIREMENTS AND CAPABILITIES COMPARISON

Engineer equipment requirements in the FCZ require a relatively high percentage of earth moving equipment. This is particularly true for the high priority VITAL and CRITICAL tasks. Current engineer support packages for a divisional slice, whether they be doctrinal or likely options, do not provide a distribution of equipment that seems to be in synchronization with requirements. It is also evident that there is a lack of flexibility within the engineer force structure,ie. the TOE base that can address the apparent mismatch.

CHAPTER V

RECOMMENDATIONS FOR ORGANIZATIONAL IMPROVEMENTS

The foregoing analysis of engineer equipment requirements and capabilities to support a division slice within the FCZ has highlighted several rather significant shortfalls. For the most part these shortfalls have been previously identified in major study efforts sponsored by Unites States Army Europe and TRADOC (2., 3., 4., 8.). It has been the intent of this paper to revisit those and other appropriate efforts; to normalize if you will the various terms of reference,priority tasks, time frames and analyses and from this more common base make recommendations. This amalgamation is necessary to persuade the engineer community that the shortfalls do in fact exist, that in spite of previous warnings nothing or precious little has been done to correct the situation and that correction can be accomplished in-house without engineer force structure increases. If the analytic community says it loud enough, long enough possibly something will be done!

ENGINEER UNIT IMPROVEMENT INITIATIVES FOR FCZ SUPPORT

1. There is a urgent need to develop a TOE for a engineer equipment company that contains primarily digging equipment. It's mission would be to augment divisional and corps engineer battalions with the high densities of dozers/M- 9s required to accomplish the high priority VITAL and CRITICAL tasks. The unit should have at least 90% M-9s (in the near term medium full tracked dozers will have to be used) and must be organized with the necessary command and control structure to manage the preparation of survivability positions throughout the division area.

2. Continue and intensify where possible the trend in divisional engineer TOE modifications. Recognition of the equipment requirements needed to support the highest priority tasks in the main battle area have to some extent driven recent TOE changes. Particular emphysis should be placed on the following:

-increase dozer/M-9 distribution to at least 70%

-reduce non-squad carrying dump trucks to minimum needed

-reduce/eliminate graders

-focus unit design and training to optimize vital and critical task accomplishment.

3. Change the TOE structure of the Corps Combat Engineer

battalion. Like the divisional battalion emphysis must be placed on the capability to accomplish VITAL and CRITICAL tasks. Engineer equipment is versatile enough to permit "combat engineer" standards of construction and maintenance with combat oriented equipment. Scrapers, graders, large dump trucks and the like should left to combat heavy and augmentation units to provide if needed, to the combat zone. Corps combat battalions are deployed within and augment the capability of the division--they should be equipped to accomplish the equipment tasks most critical to the tactical level of war.

4. Redesign of engineer units must be accomplished within a environment that is strongly influenced by the realities of personnel strength and lift limitations. The days of 20,000 man divisions and 1,000 man engineer battalions are gone forever. Engineers will continue to be constrained to less than the historic 10% of the total force strength (now about 6%) and must structure themselves to provide that support that is most effective on the battlefield. A lean but highly capable divisional battalion augmented as the theater matures with corps and theater plugs (corps combat battalions, combat heavy battalions and appropriate equipment units) will provide the flexibility and strategic mobility needed for proper support. It is far better to give limited support to the maneuver force when it is needed than full support after the battle is over.

5. The impact of a integrated scenario on the distribution of equipment requirements appears to be fairly insignificant. It must be reemphasized that I am addressing only the relative balance or distribution of the four key items of equipment and not the quantitative differences caused by introduction of chemical and nuclear weapons. The quantitative differences are quite significant and are analyzed in detail in references at footnotes 3. and 4.

GENERAL PARAMETERS FOR UNIT DESIGN

Chapter IV provides the basic data necessary to structure the basic equipment requirements for engineer units. The data has been structured to permit evaluation of priorities of work, scenario impact and the influence of time on the requirements (chapter II data).

The unit design process should start first with the identification of tasks to be done and then proceed to the prioritization of each task. Each unit will doctrinally have a area within which it normally operates and therefore that unit should be equipped to accomplish the most important tasks in that area. This work prioritization and area orientation define the general design parameters for each unit or support package.

EXAMPLE OF SUPPORT PACKAGE DESIGN

If the task were to design a engineer support package to provide a proper mix of equipment to accomplish priority tasks of a division slice in the FCZ and we had freedom to act on the initiatives outlined previously a logical process would be as follows.

-Structure the capability to accomplish the VITAL and CRITICAL tasks. In doing this the highest priority work will be covered with the proper equipment and the tasks that have a lesser impact on the outcome of the battle can be accomplished possibly less efficiently as the the primary equipment becomes available. This focus of mission and equipment distribution should apply to the divisional engineer battalion who has the primary support mission for the division but also for the corps combat battalion and the combat equipment company that augments with digging equipment. The doctrinal location and mission for these units is to provide engineer support to the maneuver force in the FCZ, therefore it is appropriate for these units to structure for that mission.

-Develop a combat engineer equipment company to provide digging equipment to the maneuver force. It is beyond the scope of this paper to design a detailed TOE, however, if the current combat support equipment company were used as a base and the densities of major items of equipment (dozers, loaders,

graders, dump trucks and scrapers) were adjusted without increasing their total, significant improvements could be made. Figure 18 reflects the results of a simplistic first try.

-Streamline the corps combat battalion to provide more digging equipment. Again it is not the intent to provide a detailed design but rather to adjust the densities of key items of equipment in light of the distribution needed to accomplish the tasks that must be done in support of the force. A first try would be to simply trade some of the dump trucks and graders for dozers and transporters(results shown in figure 18).

-Develop a engineer support package for the force being deployed. Consideration must be given to personnel and lift constraints and the total mission to be performed. For the purpose of this example let us assume that equipment is the critical component as opposed to squad/manpower oriented tasks and that the number of engineers must be kept to a low level. With these primary considerations the following support package might be a appropriate starting point for force development:

EXAMPLE FORCE PACKAGE

UNITS	ITEMS OF EQUIPMENT				PERCENT OF EQUIPMENT			
	Dozer	Loader	Dt Trk	Grader	Dozer	Loader	Dt Trk	Grader
Divisional bn								
5-145J (951)	25	4	36	0	39	6	55	0
Corps Bn (modified)								
5-35? (824)	33	10	21	0	52	16	32	0
2ea Combat Equipment Co								
5-58? (242 X 2=484)	50	18	18	0	58	21	21	0
TOTAL	108	32	75	0	58	21	21	0

FIGURE 18

It can be seen by this simple example, that compared to the doctrinal support package (Figure 6) the number of dozers can be increased by over 60%, the distribution of equipment much more closely match priority requirements and it can be done with less than 50% of the personnel force. Too simplistic ? I think not.

STUDY PROJECT FOOTNOTES

1. Department of the Army, Office of the Chief of Staff, Army, United States Army Concepts Analysis Agency, Force Design Directorate, OMNIBUS Capability Study FY 79 (OMNIBUS-79)(U), Volumes I-III, Bethesda, Maryland, 31 August 1979(SECRET);

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2. Department of the Army, United States Army Corps of Engineers, United States Army Engineer Studies Center, US Army Engineer Assessment, Europe(U). Four Volumes. Washington, D.C., June 1981(SECRET-NOFORN).

3. _____,Analysis of VII Corps Combat Engineer Wartime Requirement(U). Washington,D.C. April 1983(SECRET-NOFORN).

4. _____,Analysis of V Corps Combat Engineer Wartime Requirement(U). Washington, D.C. December 1983(SECRET-NOFORN)

5. US Army Engineer Assessment, Europe,Volume II

6. Ibid.,Volume IV.

7. Department of the Army, US Army Engineer School, Directorate of Combat Development, TOE Data Sheets(U).,Fort Belvoir, Va, Posted April 1981.

8.Department of the Army, US Army Engineer School, Combat Support, Engineering and Mine Warfare Mission Area Analysis(U), Fort Belvoir Va, May 1983.

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