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STUDY REPORT
CAA-SR-89-21

DESIGN FOR DISCARD (DFD) STUDY

JULY 1989

PREPARED BY
OFFICE OF THE SPECIAL ASSISTANT
FOR MODEL VALIDATION

US ARMY CONCEPTS ANALYSIS AGENCY
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CAA
CONCEPTS ANALYSIS AGENCY

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The reason for performing the study was to determine the impact of the Design for Discard (DFD) concept on the Army's current maintenance support force structure. DFD is an Army initiative to reduce materiel maintenance requirements by focusing on discard of system components in lieu of fault isolation and repair, i.e., an effort to identify parts which cost more to repair than to replace. The study addressed those items currently coded for repair which could be candidates for discard, using criteria and an economic methodology developed by the US Army Materiel Systems Analysis Activity (AMSAA). Revised annual maintenance manhours for those items meeting the criteria were applied against the current Manpower Requirements Criteria (MARC). The Force Analysis Simulation of Theater Administrative and Logistic Support (FASTALS) Model was the tool used to assess the impact on force structure of the reductions in manhours due to DFD.

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US Army Concepts Analysis Agency
8120 Woodmont Avenue
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DEPARTMENT OF THE ARMY
US ARMY CONCEPTS ANALYSIS AGENCY
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REPLY TO
ATTENTION OF
CSCA-MVD (5-5d)

06 NOV 1989

MEMORANDUM FOR U.S. Army Materiel Command, 5001 Eisenhower Avenue,
ATTN: AMCRE-C, Alexandria, VA 22333-0001

SUBJECT: Design for Discard (DFD) Study

1. Reference:

a. Verbal Request for Analytical Support (CAA Form 233), 31 May 89, subject: Design for Discard (DFD).

b. Memorandum, USACAA, CSCA-MVD, 27 Sep 89, subject: Design for Discard Study for Sponsor Review.

c. Memorandum, AMC, AMCRE-C, 11 Oct 89, subject: Design for Discard Study for Sponsor Review.

2. Reference 1a requested that the U.S. Army Concepts Analysis Agency (CAA) provide an assessment of the impacts of DFD on the Army's force structure at the detail, i.e., Military Occupational Specialty and Table of Organization and Equipment, level.

3. This final report documents the results of our evaluation.

4. This Agency expresses appreciation to all commands and agencies which have contributed to this study. Questions and/or inquiries should be directed to the Office of the Special Assistant for Model Validation, U.S. Army Concepts Analysis Agency, 8120 Woodmont Avenue, Bethesda, MD 20814-2797, AUTOVON 295-5225.

E. B. VANDIVER III
Director

CAA	**DESIGN FOR DISCARD (DFD) STUDY**	**STUDY SUMMARY CAA-SR-89-21**

THE REASON FOR PERFORMING THE STUDY was to determine the impact of the Design for Discard (DFD) concept on the Army's force structure. DFD is an Army initiative to reduce materiel maintenance requirements by focusing on discard of system components in lieu of fault isolation and repair. It is an effort to identify parts which cost more to repair than to replace. The goal is to design or select system components which are easily diagnosed and isolated upon failure and, if possible, inexpensive enough to throw away at failure. The resultant avoidance of maintenance allows personnel spaces to be realigned or converted to other military occupational specialties (MOSs) and applied against force structure shortfalls.

THE STUDY SPONSOR was the US Army Materiel Command (AMC), AMCRE-C.

THE STUDY OBJECTIVE was to determine the force structure impact of the DFD concept on current Army maintenance support requirements.

THE SCOPE OF THE STUDY was as follows:

(1) The DFD Study was based on the Defense Guidance (DG) Illustrative Planning Scenario (IPS) and the 1996 Total Army Analysis (TAA)/Table of Organization and Equipment (TOE) Army.

(2) The study focused on the reparable components of 60 major end items which constitute about 60 percent of the total maintenance workload estimated using Manpower Requirements Criteria (MARC) factors. Currently, MARC factors account for only combat mission essential repairs of equipment, not including any associated with combat damage.

(3) Only those components with maintenance tasks of repair, test, or overhaul at the direct support (DS) and general support (GS) levels were considered.

THE MAIN ASSUMPTIONS of this work are:

(1) The sample of major end items used in the study provides a reasonable basis for an estimate of potential force structure savings which accrue from discarding and replacing components due to reliability, availability, and maintainability (RAM) failure in lieu of repair/overhaul of components.

(2) The leader MOS concept used in the Force Analysis Simulation of Theater Administrative and Logistic Support (FASTALS) Model for determining maintenance unit requirements still applies.

(3) Failure rates of components in wartime will not vary significantly from peacetime experience.

(4) Estimates used in place of missing data elements were reasonable.

THE BASIC APPROACHES used in this study were to:

(1) Include those systems encompassing 60 percent of the DS and GS maintenance workload.

(2) Focus on the component parts of these end items which are currently coded for repair but could become candidates for discard.

(3) Compare these items against criteria developed by the US Army Materiel Systems Analysis Activity (AMSAA).

(4) Apply reductions in workload factors for items meeting the criteria, using the FASTALS Model to determine potential force structure savings. Identify the savings, if any, in terms of military spaces by MOS and standard requirement code (SRC).

THE PRINCIPAL FINDINGS of the work reported herein are as follows:

(1) Many components of major end items could be reclassified as discardable items based on the economic methodology used in the study.

(2) Force structure savings based on the labor savings achieved through the use of the DFD concept and applied through the study methodology were negligible.

(3) Further study should be undertaken by the US Army Training and Doctrine Command (TRADOC), possibly to include replacement (versus repair) of components due to combat damage. No significant savings in force structure will be realized through the use of the DFD concept unless the Army's maintenance structure is realigned. Changes in unit design and allocation rules are necessary for the DFD concept to prove effective in reducing required force structure.

THE STUDY EFFORT was directed by Ms. Julianne Allison, CSCA-MVD, 295-5225.

COMMENTS AND QUESTIONS may be sent to the Director, US Army Concepts Analysis Agency, ATTN: CSCA-MV, 8120 Woodmont Avenue, Bethesda, Maryland 20814-2797.

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DESIGN FOR DISCARD (DFD) STUDY

CHAPTER 1

INTRODUCTION

1-1. BACKGROUND

a. Design for Discard (DFD) Concept. Design for Discard (DFD) is an Army initiative to reduce materiel maintenance requirements by focusing on discard of system components in lieu of fault isolation and repair, i.e., an effort to identify parts which cost more to repair than to replace over the life cycle of the system. The goal is to design or select system components which are easily diagnosed and isolated upon failure and, if possible, inexpensive enough to throw away at failure. The resultant avoidance of maintenance would allow personnel spaces to be realigned or converted to other military occupational specialties (MOSs) and applied against force structure shortfalls.

b. Previous DFD Studies. During 1987 and 1988, two macrolevel studies were conducted to examine the DFD concept and its possible implications. In 1987, the Inventory Research Office (IRO) of the US Army Materiel Systems Analysis Activity (AMSAA) completed a study entitled "Approximate Procedures to Reevaluate Reparable Items' Costs for the Option Throwaway (The APRICOT Analysis)." The study looked at the Army's catalog of current reparable components for fielded end items to assess the impact of a DFD environment on the current maintenance of items. The repair versus throwaway costs were compared for items in the reparable catalogs. Estimated failure rates and average manhours and cost data were used. The findings showed potentially significant savings in the form of dollars and manpower could be achieved by implementation of the concept. However, further study was recommended to identify these savings at a more detailed level. Army Materiel Command (AMC) commanding officers, after being briefed, requested analysis of specific systems. A follow-on study was conducted in 1988 which focused on two major end items, the M109 howitzer and the M939 truck series. Again, the potential manpower and dollar savings estimated in this study that would result from reclassifying existing reparable components as throwaway for the two end items studied were found to be significant. It was then recommended that a microlevel study be conducted to determine the impact of DFD on the Army's force structure.

1-2. DFD STUDY

a. Tasking. The US Army Concepts Analysis Agency (CAA) was tasked by AMC to conduct the recommended detail-level study. The DFD Study was planned to be incorporated as an excursion to the Support Force Requirements Analysis Study - 1996 (SRA-96), CAA's part of the Total Army Analysis - 1996 (TAA-96) process. The study would include the top maintenance workload generators, i.e., those systems encompassing 50 percent of the direct support (DS) and general support (GS) maintenance workload. The list of systems was expanded to include those making up 60 percent of DS and GS maintenance. This was done to allow for potential data problems and/or lack of data so that the systems actually studied would make up at least 50 percent of the maintenance workload. Component parts of these end items which are currently coded for repair but could become candidates for discard were the subject of the study. These items were to be compared against criteria developed by AMSAA. For items meeting the criteria, reductions in workload factors were to be applied using the Force Analysis Simulation of Theater Administrative and Logistic Support (FASTALS) Model to determine potential force structure savings. The savings, if any, were to be identified in terms of military spaces (by MOS) and standard requirement code (SRC). These spaces could then be applied toward other combat service support (CSS) functions or combat/combat support (CS) spaces.

b. Purpose The purpose of the DFD Study was to determine the impact of the DFD concept on the Army's force structure.

c. Scope. The DFD Study was based on the Defense Guidance (DG) Illustrative Planning Scenario (IPS) and the 1996 TAA/Table of Organization and Equipment (TOE) Army. The study focused on the reparable components of 60 major end items which constitute a large percentage (about 60 percent) of the total maintenance workload. Currently, MARC factors account for only combat mission essential repairs of equipment, not including any associated with combat damage. Only those components with maintenance tasks of repair, test, or overhaul at the DS and GS levels were considered. (This is explained in Chapter 3.) An economic criteria, projected lifetime replacement cost (PLRC), was used to determine which items were candidates for replacement rather than repair.

d. Essential Elements of Analysis (EEA). The EEA of the study were to:

(1) Identify existing reparable components for possible reclassification as throwaway components.

(2) Identify military spaces by MOS and SRC which could be realigned or converted to other MOSs.

(3) Determine the impact on the Army force structure of the DFD concept within the limits of the scope of this study.

The answers to these EEA, as determined in the DFD Study, are addressed in Chapter 4, Results and Analysis.

e. Assumptions. The assumptions applicable to the DFD Study were as follows:

(1) The sample of major end items used in the study provides a reasonable basis for an estimate of potential force structure savings which accrue from discarding and replacing components due to reliability, availability, and maintainability (RAM) failure in lieu of repair/overhaul of components.

(2) The leader MOS concept used in FASTALS for determining maintenance unit requirements still applies.

(3) Failure rates of components in wartime will not vary significantly from peacetime experience.

(4) Estimates used in place of missing data elements were reasonable (these estimates are described in Chapter 2, paragraph 2-5, Data Limitations).

1-3. CONTENTS OF THE REPORT. This chapter has provided the introductory information applicable to the DFD Study. Following chapters contain more detailed information concerning the data, methodology, and results of the study.

CHAPTER 2

DATA

2-1. DATA REQUEST. In June of 1988, AMC put out a data call for the DFD Study. The data request specified the required data elements and included record format specifications for data on 60 major end items by line item number (LIN). Each of AMC's major subordinate commands (MSCs) was required to provide the requested information for all reparable components by national stock number (NSN) of each end item managed by their command. The data was to be provided in dBase III compatible floppy disk files. The suspense date for submission of the data was 1 August 1988.

2-2. DATA PROBLEMS. Several problems were encountered with both the submission of data and the data itself. There were extensive delays in obtaining the data. The effort was not completed until February 1989. This forced the study to be separated from the SRA-96 Study, which it had originally been planned to supplement as an excursion. The DFD Study was then temporarily put on hold until March of 1989. When the study was resumed, several data problems were discovered. First, for some end items, no data was provided at all. Secondly, much of the data that was provided was not in the requested form. Most of it was provided on floppy disks as requested, but much of it was not in dBase III file format. Those that were not were either "flat" files (ASCII format) or in LOTUS 1-2-3 file format. The data not provided on floppy disk were either in hard copy form or on tape. Thirdly, some of the data was not in the required data format, e.g., data elements were not in the required fields, decimal formats were incorrect, etc. Lastly, there were many problems with missing or incomplete data elements. Many of these problems were resolved through phone calls, file conversion, and manipulation of the data files and the data, but some could not be resolved. Estimates were made for some of the data elements that remained incomplete. The resolution of these problems caused more delays in conducting the study. Actual FASTALS production runs for the DFD Study began in May 1989.

2-3. END ITEMS. At the outset of the DFD Study, it was decided that focusing on a small number of systems would not accomplish the study objectives. It was also not feasible to study all end items with reparable components, so a way of choosing the systems to be studied had to be determined. The total maintenance workload was used as the criteria for choosing the systems to be studied. The top 60 workload generators (out of a total of 2,135), which comprise 60 percent of the total DS and GS maintenance workload, were chosen. The end items studied and their associated LINs are listed in Table 2-1, along with the MSC responsible for management of each item.

Table 2-1. End Items
(page 1 of 2 pages)

LIN	LIN nomenclature	MSC
C10908	CARRIER CARGO: TRACKED AMMO MEDIUM 7-TON	TACOM
C12155	CARRIER PERSONNEL FULL TRACKED: ARMORED FIRE SPT	TACOM
C76335	CAVALRY FIGHTING VEHICLE: M3	TACOM/ AMCCOM
D11049	CARRIER CARGO: TRACKED 6-TON	TACOM
D11538	CARRIER COMMAND POST: LIGHT TRACKED	TACOM
D12087	CARRIER PERSONNEL FULL TRACKED: ARMORED	TACOM
E00533	CHARGER RADIAC DETECTOR: PP-1578/PD	CECOM
E56896	COMBAT VEHICLE ANTITANK: IMPROVED TOW VEH (W/O TOW WPN)	TACOM
E70064	COMP UNIT RCP: TRK 2 WHL PNEU TIRES GAS DRVN 5 CFN 175 PSI	TACOM
H02300	ELECTRONIC TELETYPEWRITER SECURITY EQUIPMENT: ISEC/KW-7	CECOM
J35813	GEN ST DSL ENG: 5KW 60HZ 1-3PH AC 120/208 120/240V TAC UTIL	TACOM
J35825	GEN ST DSL ENG: 10KW 60HZ 1-3PH AC 120/208 120/240V TAC UTIL	TACOM
J42100	GEN ST GAS ENG TM: 10KW 60HZ 1-3PH AC 120/240 120/208V PU-619/	TACOM
J43918	GEN ST GAS ENG: 1.5KW 60HZ 1PH 2 WIRE AC 120V SHOCK TAC UTIL	TACOM
J44055	GEN ST GAS ENG: 1.5KW DC 28V SHOCK TAC UTIL	TACOM
J45699	GEN ST GAS ENG: 3KW 60HZ 1-3PH 120/240 120/208V SKD TAC UTIL	TACOM
J46110	GEN ST GAS ENG: 3KW DC 28V SKD-SHK TBLR FRAME MTD TAC UTIL	TACOM
J47617	GEN ST GAS ENG TM: 5KW 60HZ 2EA MTD ON M116 PU-260	TACOM
J81750	INFANTRY FIGHTING VEHICLE	TACOM/ AMCCOM
J95533	GUIDED MISSILE SYSTEM INTERCEPT AERIAL CARRIER MTD: (CHAP)	MICOM
K29694	HEL ATTACK: TOW MISSILE	AVSCOM
K31042	HEL OBSERVATION: OH-58A	AVSCOM
K31795	HEL UTILITY: UH-1H	AVSCOM
K32293	HEL UTILITY: UH-60A	AVSCOM
K56981	HOWITZER HVY SELF-PROPELLED: 8 INCH	AMCCOM
K57667	HOWITZER MED SELF-PROPELLED: 155 MM	AMCCOM
P45003	POWER UNIT UTIL PACK: GAS TURBINE ENG DRVN (MUST)	TACOM
Q90100	RADIO TELETYPEWRITER SET: AN/GRC-122	CECOM
Q90120	RADIO TELETYPEWRITER SET: AN/GRC-142	CECOM
R50544	RECOVERY VEH FULL TRACKED: LT ARMORED	AMCCOM
R50681	RECOVERY VEHICLE FULL TRACKED: MEDIUM	TACOM
R94977	RIFLE 5.56MM: M16A1	AMCCOM
T05028	TRUCK UTIL: TACTICAL 3/4 TON W/E M1009	TACOM

Table 2-1. End Items
(page 2 of 2 pages)

LIN	LIN nomenclature	MSC
T07543	TRUCK UTIL: S250 SHELTER CARRIER 4X4 W/E (HMMWV)	TACOM
T10138	SHOP EQUIP CONTACT MAINT TRK MTD	AMCCOM
T13168	TANK COMBAT FULL TRACKED: 120MM GUN	TACOM
T13169	TANK COMBAT FULL TRACKED: 105MM GUN (TTS)	TACOM
T13374	TANK COMBAT FULL TRACKED: 105MM M1 (ABRAMS)	TACOM
T34437	TRACTOR WHEELED: DSL 4X4 W/EXCAVATOR AND FRONT LOADER	TACOM
T49119	TRUCK LIFT FORK: DSL DRVN 10000 LB CAP0 48-IN LD CTR ROUGH TERRAIN	TACOM
T49255	TRUCK LIFT FORK: DSL DRVN 4000LB CAP ROUGH TERRAIN	TACOM
T59346	TRUCK CARGO: TACT 5/4 TON 4X4 W/COMMO KIT	TACOM
T59482	TRUCK CARGO: TACT 5/4 TON 4X4 W/E M1008	TACOM
T61494	TRUCK UTIL: CARGO/TROOP CARRIER 1-1/4-TOW 4X4 W/E (HMMWV)	TACOM
T92242	TRUCK UTIL: ARMT CARRIER ARMD 1-1/4-TON 4X4 W/E (HMMWV)	TACOM
V12141	TANK & PUMP UNIT LIQ DISPENSING TRUCK MOUNTING	TACOM
V31211	TELEPHONE SET: TA-312/PT	CECOM
W76473	TRACTOR FULL TRACKED HIGH SPEED: ARMORED COMBAT EARTHMOVER	TACOM
W95537	TRAILER CARGO: 3/4 -TON 2 WHEEL W/E	TACOM
W95811	TRAILER CARGO: 1-1/2-TON 2 WHEEL W/E	TACOM
X23277	TRANSPORTER BRIDGE FLOATING	TACOM
X40009	TRUCK CARGO: 2-1/2-TON 6X6 W/E	TACOM
X40146	TRUCK CARGO: 2-1/2-TON 6X6 W/WINCH W/E	TACOM
X40794	TRUCK CARGO: DROP SIDE 5 TON 6X6 W/E	TACOM
X40831	TRUCK CARGO: 5 TON 6X6 LWB W/E	TACOM
X43708	TRUCK DUMP: 5-TON 6X6 W/E	TACOM
X44403	TRUCK DUMP: 20-TON DSL DRVN 12 CU YD CAP (CCE)	TACOM
X59326	TRUCK TRACTOR: 5-TON 6X6 W/E	TACOM
X60833	TRUCK UTILITY: 1/4-TON 4X4 W/E	TACOM
X63299	TRUCK WRECKER: 5-TON 6X6 W/WINCH WE	TACOM

2-4. DATA ELEMENTS. Three types of data records were required for each end item. The following paragraphs discuss each record type and its data elements.

a. Task Record. The first record type was the task record. Table 2-2 specifies the data elements included in each task record.

Table 2-2. Task Record Data Elements

Data element descriptor	Data element
LIN	Line item number of end item
NSN	National stock number of reparable component
TASK	Maintenance task performed on component: repair, replace, overhaul, test, adjust
ECH	Echelon at which task performed: ORG, IDS, IGS, DEP
MOS	Primary military occupational specialty code for task
HRM	Manhours to perform task
NUMP	Number of people required on task
IDEF	Deferability of task: immediately (IMM), 1st opportunity (FOP), indefinite (IND)

b. End Item Record. Table 2-3 lists the data elements in the end item record.

Table 2-3. End Item Record Data Elements

Data element descriptor	Data element
LIN	Line item number of end item
NAME	Nomenclature of end item
DENS	Total density of all end items in LIN averaged to a per-year basis over projected lifetime
YRS	Projected number of years remaining in life of end item
PCD	Program code: M = mileage, R = rounds, H = hours, F = flying hours
PROG	Projected average yearly usage program for all end items in LIN
BASE	Base usage program upon which failure factors are computed for all end items in LIN

c. **NSN Record.** Within each LIN, there were several NSNs. The NSN record includes all data elements associated with each of the NSNs for one LIN. The data elements are listed in Table 2-4.

Table 2-4. NSN Record Data Elements

Data element descriptor	Data element
NSN	National stock number of reparable component
NAME	Nomenclature of reparable component
FF1	Failure factor for peacetime usage
FF2	Failure factor for wartime usage
PCD	Program code: M = miles traveled, R = rounds fired, H = hours operated, F = flying hours
UP	Unit price
WGT	Weight (pounds)
CUBE	Volume (cubic feet)
MTD ORG	Maintenance task distribution - organizational: percentage of repair of this component conducted at ORG level
MTD IDS	Maintenance task distribution - intermediate direct support: percentage of repair of this component conducted at IDS level
MTD IGS	Maintenance task distribution - intermediate general support: percentage of repair of this component conducted at IGS level
MTD DEP	Maintenance task distribution - depot: percentage of repair of this component conducted at DEP level
REPR	Replacement factor - percentage of removal components which cannot be repaired
FGC	Functional group code assigned to group of NSNs to which this component belongs for purposes of MARC taskings
SMR	Source, maintenance, and recoverability code

Note: from this point on in this report, the data element descriptors shown in the first column of Tables 2-2 through 2-4, rather than the entire data element name, will be used to refer to each data element.

2-5. DATA LIMITATIONS

a. Reduction in Number of End Items Studied. As mentioned in paragraph 2-2, some data problems were encountered at the outset of the DFD Study which could not be resolved. Data was incomplete or unusable for 14 end items. Therefore, the original list of 60 end items to be studied (which make up 60 percent of the total maintenance workload) had to be reduced to 46. Those 46 items constitute 48 percent of the total workload. Although this did not quite meet the goal of studying systems that make up 50 percent of the workload, it was very close. The 14 end items that had to be dropped from the study were those shown in Table 2-5.

Table 2-5. End Items Dropped from Study

LIN	LIN nomenclature
E00533	CHARGER RADIAC DETECTOR: PP-1578/PD
H02300	ELECTRONIC TELETYPEWRITER SECURITY EQUIPMENT: ISEC/KW-7
J95533	GUIDED MISSILE SYSTEM INTERCEPT AERIAL CARRIER MTD: (CHAP)
Q90100	RADIO TELETYPEWRITER SET: AN/GRC-122
Q90120	RADIO TELETYPEWRITER SET: AN/GRC-142
R50681	RECOVERY VEHICLE FULL TRACKED: MEDIUM
T10138	SHOP EQUIP CONTACT MAINT TRK MTD:
T34437	TRACTOR WHEELED: DSL 4X4 W/EXCAVATOR AND FRONT LOADER
T49119	TRUCK LIFT FORK: DSL DRVN 10000 LB CAP0 48IN LD CTR ROUGH TERRAIN
V31211	TELEPHONE SET: TA-312/PT
W76473	TRACTOR FULL TRACKED HIGH SPEED: ARMORED COMBAT EARTHMOVER
W95537	TRAILER CARGO: 3/4 TON 2 WHEEL W/E
W95811	TRAILER CARGO: 1-1/2 TON 2 WHEEL W/E
X60833	TRUCK UTILITY: 1/4 TON 4X4 W/E

b. Data Estimates. It was stated in paragraph 2-2 that some data elements were missing or questionable and had to be estimated. The following paragraphs specify these elements and explain the estimates used.

(1) Data Element BASE. In almost all of the data files, the data element BASE was either missing or equal to the PROG element. Since this problem was so prevalent, all missing BASE elements were also set equal to their corresponding PROG elements. This effectively eliminated the use of these elements in the study because they were to be used in a formula where PROG is divided by BASE and the result multiplied by other data elements. The result of the division would always be equal to one and the calculation would have no effect on the result of the formula.

(2) **Data Element YRS.** The data element YRS was missing in several data files. In these cases, an estimate of 20 years was used.

(3) **Data Element PCD.** In a majority of the data files, the element PCD was either missing or the same throughout the file. It was decided that this data was not useful as it was and that it was not feasible to try to recollect the data. Therefore, this data element was not used in the study.

c. **Data Elements Not Used.** There were several data elements that were included in the data call which did not enter directly into study calculations or analysis. Many of these elements were used implicitly, as they were inherent in other elements. For example, NUMP is implicitly a part of the HRM. Also, the FASTALS methodology and associated workloads provided a means of estimating the impact of DFD without the need for some of the requested elements. The items not used explicitly in the study were the following: NUMP, IDEF, FF2, WGT, CUBE, MTD ORG, MTD IDS, MTD IGS, MTD DEP, REPR, FGC, and SMR.

CHAPTER 3

METHODOLOGY

3-1. TWO-PART METHODOLOGY. There were two major parts to the methodology used in the DFD Study. The first part, which will be referred to as the economic methodology, involved the calculations required to determine whether a component of an end item met the criteria to become a discardable item. The second part of the methodology was the force structure methodology. This involved the use of the FASTALS Model to assess the potential savings in force structure due to the DFD concept. Both methodologies are discussed in detail in this chapter.

3-2. ECONOMIC METHODOLOGY

a. Data Processing. The first step in the study was to reconcile the data. Since the data arrived in various file formats, one had to be chosen as the preferred format. LOTUS 1-2-3 was chosen, and all data that was not already in LOTUS 1-2-3 format was converted. When this was finished, there existed three LOTUS files for each end item (LIN): a task file, an end item file, and an NSN file. These three files were aggregated for each LIN. This was done by simply combining the end item file and the NSN file and then matching on NSN to incorporate the task file (the NSN appeared in both the NSN file and the task file). The next step was to reduce the number of NSNs to be considered as throwaway candidates by checking them against certain criteria.

b. Echelon and Task Criteria. The first criteria against which each component was checked was the echelon criteria. Only those components whose tasks are performed at either the DS or GS echelon were used, since FASTALS does not directly consider maintenance tasks to be performed at organizational or depot levels. Components meeting this test were then checked for the types of tasks to be performed on them. Those with tasks of repair, test, or overhaul were chosen. The next step was to calculate the projected lifetime replacement cost (PLRC) for each LIN/NSN combination. This calculation is the subject of the following paragraph.

c. PLRC Calculation. The first part of the PLRC calculation is the computation of projected lifetime failures (PLF). The formula used to compute PLF is as follows (using the data element descriptors that appeared in Tables 2-2 through 2-4):

$$PLF = FF1 * (PROG/BASE) * (DENSITY/100) * YRS$$

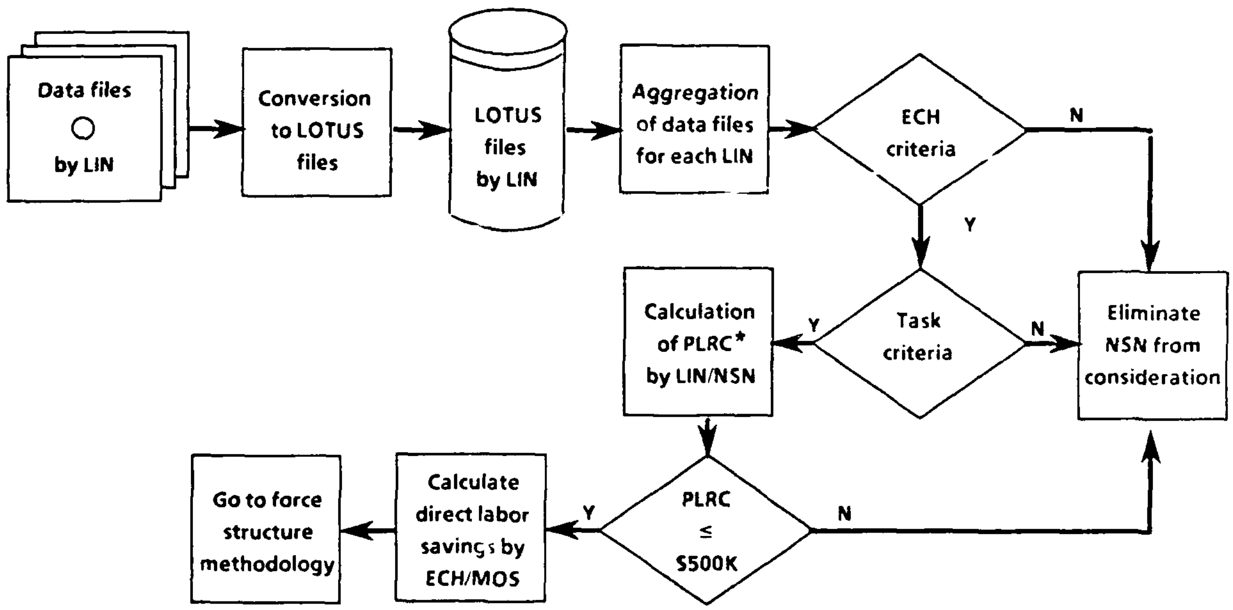
(In this formula, the PROG/BASE portion of the equation was effectively eliminated from the calculation because it was always equal to 1, as explained in paragraph 2-5a.) To determine the PLRC, the PLF is then multiplied by the unit price (UP):

$$PLRC = PLF * UP$$

These formulas were provided to CAA for the DFD Study by IRO.

d. **Economic Criteria.** The PLRC is the criteria used to separate reparable components into potential discard candidates and those with prohibitive costs which would remain reparable items. IRO provided a cutoff point of $500,000 to be used as the factor to make this determination. The PLRC for each LIN/NSN pair was computed and checked to see if it was either less than or equal to $500,000 or above $500,000. Those above were no longer considered as throwaway candidates. Those below or equal to $500,000 went on to the next step in the process. (The sensitivity of the results to the $500,000 cutoff was examined, as described in paragraph 3-4.)

e. **Calculation of Labor Savings.** Labor savings were computed for all components meeting each of the criteria discussed above. This was done by summing the HRM (manhours to perform task) over all components for each end item by ECH (echelon) and MOS. This was the last step in the economic portion of the methodology. A summary of the economic methodology is shown in Figure 3-1, and an example is provided in the next paragraph. The second part of the DFD study methodology, the force structure methodology, is discussed in paragraph 3-3.



*PLRC = projected lifetime replacement cost

Figure 3-1. Economic Methodology

f. Example

(1) An example using a typical end item is discussed in this paragraph to illustrate the methodology to this point. The end item chosen for the example was the M1A1 tank, LIN T13374. The data provided for this end item included 248 NSNs (reparable components). Of the 248, there were 111 with tasks to be performed in the DS and GS echelons. When checked against the task criteria, the number of NSNs decreased to 99, i.e., 99 NSNs had tasks of repair, test, or overhaul. The PLRC for each of these 99 NSNs was then calculated and matched against the $500,000 economic criteria. The result of this check reduced to 30 the number of NSNs to be considered as throwaway candidates. For these remaining 30 NSNs, the reduction in maintenance manhours (labor savings) by ECH and MOS was calculated. The results per tank per year were as shown in Table 3-1.

Table 3-1. M1A1 Tank Example

Echelon	MOS	MOS name	Labor savings (manhours)
DS	45G 45K	Fire Control Systems Repairer Tank Turret Repairer	55.2 5.1
GS	45K	Tank Turret Repairer	3.8
Total			64.1

(2) The labor savings of 64.1 manhours were subtracted from the original manhours required to perform the relevant tasks. The original requirement was for 895.8 manhours at the DS and GS levels for MOSs 45G and 45K. This total was reduced to 831.7 with the savings in manhours due to DFD. This represents a decrease in annual maintenance effort per tank of 7.2 percent. The labor savings achieved for each of the 46 end items studied were applied in the second phase of the methodology, the force structure methodology.

3-3. FORCE STRUCTURE METHODOLOGY. The FASTALS Model was the tool used in the DFD Study to assess the impact of the DFD concept on the Army's force structure. An overview of the FASTALS Model is provided in the following subparagraphs as an introduction to the force structure methodology used in the DFD Study. A more detailed description of FASTALS is provided in Appendix D.

a. FASTALS Overview

(1) Introduction. The FASTALS Model is a tool used by CAA to compute the logistics workloads for planning theater support unit requirements in a relatively short period of time. It is primarily used in force planning analyses where balanced, time-phased, geographically distributed force requirements are desired. Given a tactical situation, logistics capabilities, and theater policies, FASTALS can be used to determine the total force necessary to support the situation logistically. The FASTALS Model has been used extensively in the preparation of input for the Army Program Objective Memorandum (POM), the Army contribution to the Joint Strategic Planning Document (JSPD) analyses and many other studies. The results produced have achieved wide acceptance throughout the Army Staff.

(2) Background. FASTALS was developed in 1971 by the Research Analysis Corporation (RAC) as part of a large system of models known as the Forces and Weapons (FOREWON) System. As used in a typical study, FASTALS is part of a system of integrated models. Given specific scenario and defined force, the Transportation Model (TRANSMO) computes deployment schedules, based on movement requirements in terms of tonnage, cargo types, and available transport. The warfighting model then computes the combat results based on a supplied scenario and TRANSMO's force movement schedule. FASTALS, using the warfighting results, a scenario, and a master file of available units, computes the support force requirements necessary to round out the combat force. The scenario and master files are the primary input files to FASTALS. FASTALS output is compared to the original force definition in a matching process to check the availability of the roundout force. FASTALS outputs are further analyzed (depending on the particular study) by a system of postprocessors.

(3) General Model Description. The purpose of the FASTALS Model is to compute administrative and logistical workloads and to generate the theater-level support force structure requirements necessary to round out a combat force in a postulated confrontation. The trooplist produced by FASTALS is said to be balanced when the individual units comprising the list are capable of accomplishing the various workloads generated by the total force. Trooplists are said to be time-phased when unit requirements are prescribed for each time period in the simulation. Support to combat units is defined as the logistical and administrative service support necessary to support a tactical activity. The major elements of support are maintenance, construction, supply, transportation, hospitalization and evacuation, and personnel replacement. Requirements for units performing these functions are derived from workloads which are generated as a function of the combat force deployment, theater structure, and the tactical operations as developed in the campaign simulation model.

b. FASTALS in Force Structure Methodology. In the DFD Study, FASTALS was used to determine the change in force structure by theater in the DG IPS due to DFD. The methodology used to do this is described in the following paragraphs.

(1) Application of Labor Savings. The labor savings (totals by ECH and MOS for each end item), which were calculated in the economic methodology, were subtracted from the corresponding ECH and MOS in the MARC file to reflect the reduction in maintenance workload due to DFD for each end item studied. The MAPC file was then used as an input file to a FASTALS Model run to determine the savings in force structure attributable to the reduced maintenance manhours. The FASTALS process, which makes up the remainder of the force structure methodology, is discussed in the next paragraph.

(2) **FASTALS Runs.** Two FASTALS runs were used in the second step of the force structure methodology. The basic procedure used was to compare the output from a base run of the FASTALS Model with the results of a second run which used as input the reduced MARC maintenance workload file produced in the first step of the force structure methodology. (All other inputs remained the same.) The base run used was the SRA-96 design case, which was based on the DG IPS and the 1996 TAA/TOE Army. The output of primary interest from these two runs was a comparison between the two which shows the difference in personnel strength required, i.e., the potential change in force structure. This comparison is broken down by theater (North Atlantic Treaty Organization (NATO), Southwest Asia (SWA), and Northeast Asia (NEA)) and SRC. (The original runs and the resultant comparison will be referred to as the base case set of runs from this point on in this report.) After these runs were completed, the FASTALS results were analyzed. Results are discussed in Chapter 4. A summary of the DFD force structure methodology is shown in Figure 3-2.

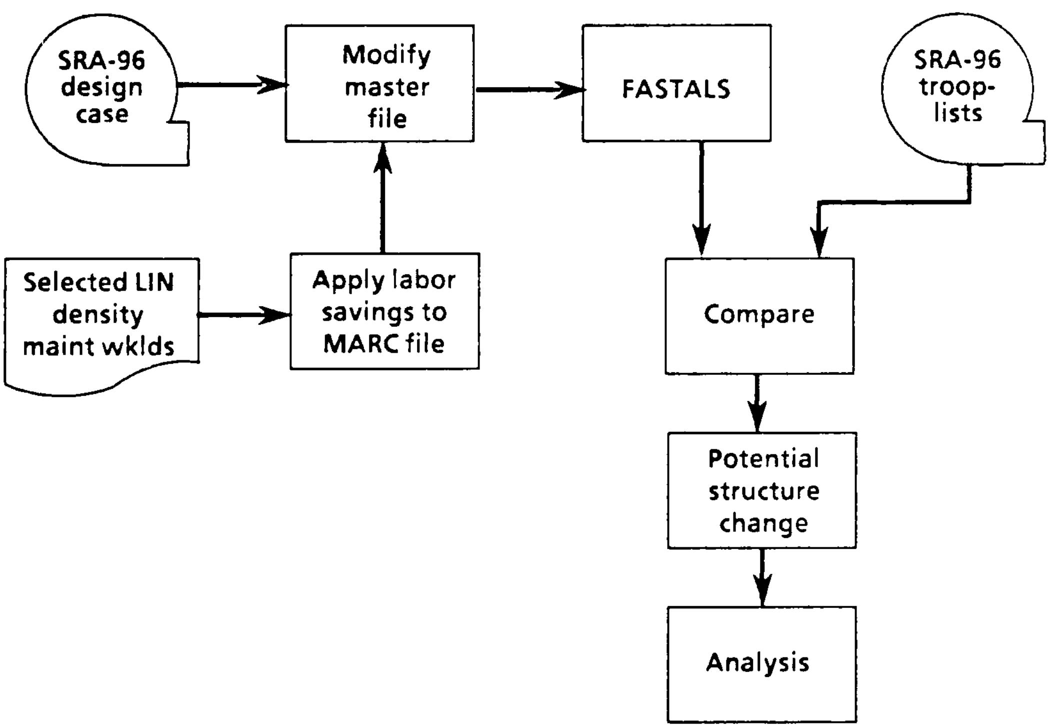


Figure 3-2. Force Structure Methodology

3-4. SENSITIVITY ANALYSIS. After the initial base case FASTALS runs were complete, several others were done. The initial runs were unconstrained, i.e., true unit requirements as generated by FASTALS were used in the runs. In other words, FASTALS in the unconstrained mode builds support to component code (COMPO) 4 units. In a constrained run, COMPO 4 units are not supported; total unit requirements are limited by a maximum quantity for each SRC in the master file. A second set of base case runs (by NATO, SWA, and NEA theater) was conducted in the constrained mode. Then, in order to test the sensitivity of the results to the economic criteria used ($500,000 cutoff), four more sets of runs were conducted. A constrained and an unconstrained run (each including all three theaters) were done using $250,000 as the criteria, or one-half of the original $500,000 criteria. This set of runs will be called the first excursion. The second excursion constituted the last set of runs (constrained and unconstrained, all three theaters in each), which was done using twice the original economic criteria, or $1 million. The results of all of these runs were analyzed in terms of their impact on the original (base case) study results. The next chapter contains the results of each set of runs and the analysis of the results.

CHAPTER 4

RESULTS AND ANALYSIS

4-1. INTRODUCTION. In this chapter, the results of the DFD base case runs will be discussed first, followed by the results of all sensitivity runs.

4-2. LABOR SAVINGS. The last step in the economic methodology was to compute labor savings in terms of annual maintenance manhours by LIN, ECH, and MOS. These decrements in manhours, which were applied through the use of the FASTALS Model, were the drivers for any force structure savings to be realized. Table 4-1 shows the labor savings derived for each major end item studied. The savings are presented in LIN/ECH/MOS sequence. The original maintenance manhours (from the MARC file) required for each LIN are shown in the next to last column of the table, and the reductions in manhours from the original requirement are listed in the last column. (The numbers shown are annual savings per item.) For some major end items, there were no labor savings. Those items are not listed in the table.

4-3. RESULTS OF BASE CASE RUNS. Table 4-2 presents the study results based on the labor savings shown in Table 4-1. These are the results of the original unconstrained FASTALS runs based on the economic criteria of $500,000. The results are presented by theater in terms of the change in force structure between the two base case runs. The SRCs which dropped out due to the savings attained by using the DFD concept are listed along with a short description of each. As Table 4-2 indicates, only maintenance units were affected. The impact of the labor savings was not large enough to affect any other area, such as medical, supply, etc. The NATO theater realized the greatest impact. The effects in the SWA and NEA theaters were small, with only one unit being saved in NEA and none in SWA.

Table 4-1. Labor Savings - Annual Maintenance Manhours
(page 1 of 2 pages)

LIN[a]	ECH	MOS	MOS name	Original manhours	Manhours subtracted
C10908	DS	63H	Track vehicle repairer	556.6	108.2
C12155	DS	63H	Track vehicle repairer	200.9	9.9
C76335	DS	45K	Tank turret repairer	85.8	83.0
		63G	Fuel & elec sys repairer	220.4	5.0
D11049	DS	63H	Track vehicle repairer	279.0	2.7
D11538	DS	63H	Track vehicle repairer	201.0	0.6
E56896	DS	63H	Track vehicle repairer	200.2	2.6
J35813	DS	52D	Power generation equip repairer	140.0	2.0
	GS	52D	Power generation equip repairer	73.2	1.3
J35825	DS	52D	Power generation equip repairer	147.0	7.4
	GS	52D	Power generation equip repairer	85.4	2.0
J42100	DS	52D	Power generation equip repairer	260.4	5.2
	GS	52D	Power generation equip repairer	146.4	19.8
J43918	DS	52D	Power generation equip repairer	72.8	1.1
J44055	DS	52D	Power generation equip repairer	72.8	3.0
J45699	DS	52D	Power generation equip repairer	84.0	7.1
J46110	DS	52D	Power generation equip repairer	161.0	7.1
J47617	DS	52D	Power generation equip repairer	224.0	4.6
	GS	52D	Power generation equip repairer	146.4	4.8
J81750	DS	45K	Tank turret repairer	85.8	80.3
K29694	DS	68F	Aircraft electrician	65.8	8.5
		68G	Aircraft structural repairer	109.2	17.8
		68H	Aircraft pneudraulics repairer	22.4	12.9
		68J	Aircraft fire control repairer	1455.9	11.8
K31042	DS	35M	Avionic navigational & flight control equip repairer	91.0	6.3
K32293	DS	35R	Avionic special equip repairer	147.6	8.1
K56981	DS	45L	Artillery repairer	492.8	13.4
K57667	DS	45L	Artillery repairer	588.0	143.4
	GS	45L	Artillery repairer	223.0	95.5

Table 4-1. Labor Savings - Annual Maintenance Manhours
(page 2 of 2 pages)

LIN[a]	ECH	MOS	MOS name	Original manhours	Manhours subtracted
P45003	DS	52F	Turbine eng drvn generator repairer	511.0	53.4
	GS	52F	Turbine eng drvn generator repairer	162.5	22.5
R50544	DS	44B	Metal worker	3.5	3.5
T05028	DS	63W	Wheel vehicle repairer	71.0	3.3
T07543	DS	63W	Wheel vehicle repairer	71.0	14.7
	GS	63W	Wheel vehicle repairer	47.1	21.6
T13168	DS	41C	Fire control instrument repairer	68.6	0.7
		45G	Fire control systems repairer	137.8	5.2
		45K	Tank turret repairer	476.0	33.6
	GS	45K	Tank turret repairer	322.0	2.8
T13169	DS	45K	Tank turret repairer	476.0	15.6
	GS	45K	Tank turret repairer	244.0	3.7
T13374	DS	45G	Fire control systems repairer	137.8	5.1
		45K	Tank turret repairer	477.0	55.2
	GS	45K	Tank turret repairer	281.0	3.8
T49255	DS	63W	Wheel vehicle repairer	319.1	10.3
	GS	63W	Wheel vehicle repairer	299.0	12.0
T59346	DS	63W	Wheel vehicle repairer	71.0	0.3
	GS	63W	Wheel vehicle repairer	54.0	0.4
T59482	DS	63W	Wheel vehicle repairer	71.0	0.3
T61494	DS	63W	Wheel vehicle repairer	71.0	2.5
	GS	63W	Wheel vehicle repairer	54.0	1.6
T92242	DS	63W	Wheel vehicle repairer	71.0	9.2
	GS	63W	Wheel vehicle repairer	54.0	11.6
V12141	DS	63J	Qtrmaster & chem equip repairer	92.4	6.0
X44403	DS	63W	Wheel vehicle repairer	275.0	8.5
	GS	63W	Wheel vehicle repairer	120.0	13.1

[a]Refer to Table 2-1 for corresponding LIN nomenclature.

Table 4-2. Base Case Results - Unconstrained

Theater	Change in strength due to DFD	SRCs	SRC descriptions
NATO	-554	43237J50010 43237J50510 43237J50810 43238J50010 43238J50210 43509LA0010 43509LG0010	CS CO LEMCO CS TM COMSEC CS TM TURB ENG REPAIR CS CO HVY EQP CS TM FLD ARTY REPAIR CS TM TURB ENG PWR GEN REPAIR MT TM WHEEL VEH
SWA	0		
NEA	-200	43209L00010	MT CO ORD (MAINT)

4-4. RESULTS OF CONSTRAINED BASE CASE RUNS. Table 4-3 presents the results of the FASTALS runs created in the constrained mode. These runs used the original base case inputs. As can be seen in the table, any savings accomplished in the unconstrained mode were eliminated in the constrained mode. There were no savings in force structure in this case. This implies that affordability considerations in the force structure process have already cut past the point of any potential savings.

Table 4-3. Base Case Results - Constrained

Theater	Change in Strength due to DFD	SRCs	SRC Descriptions
NATO	0		
SWA	0		
NEA	0		

4-5. EXCURSIONS

a. Labor Savings. As previously mentioned, two sets of excursion runs were produced as part of the sensitivity analysis. These excursions were done by varying the economic criteria used in the economic methodology. All other factors were held constant. In Excursion 1, a PLRC cutoff of $250,000 was used as the economic criteria, and in Excursion 2, $1 million was used. The variation in economic criteria created differences in labor savings and therefore produced different results in terms of force structure savings. Table 4-4 shows the labor savings in terms of the number of annual maintenance manhours subtracted from each LIN/ECH/MOS combination for the base case ($500,000) and the two excursions.

Table 4-4. Labor Savings - Base Case vs Excursions
(page 1 of 2 pages)

LIN[a]	ECH	MOS	MOS name	Exc 1 ($250K)	Base case ($500K)	Exc 2 ($1M)
C10908	DS	63H	Track vehicle repairer	102.2	108.2	108.2
C12155	DS	63H	Track vehicle repairer	3.2	9.9	14.1
C76335	DS	41C	Fire control instrument repairer	0.0	0.0	1.3
		45K	Tank turret repairer	76.9	83.0	85.8
		63G	Fuel & elec sys repairer	0.0	5.0	5.5
D11049	DS	63H	Track vehicle repairer	0.7	2.7	6.3
	GS	63H	Track vehicle repairer	0.0	0.0	2.0
D11538	DS	63H	Track vehicle repairer	0.0	0.6	5.5
E56896	DS	63H	Track vehicle repairer	2.1	2.6	6.6
J35813	DS	52D	Power gen equip repairer	2.0	2.0	3.3
	GS	52D	Power gen equip repairer	0.0	1.3	2.1
J35825	DS	52D	Power gen equip repairer	6.0	7.4	7.4
	GS	52D	Power gen equip repairer	2.0	2.0	2.0
J42100	DS	52D	Power gen equip repairer	5.2	5.2	5.2
	GS	52D	Power gen equip repairer	19.8	19.8	19.8
J43018	DS	52D	Power gen equip repairer	1.1	1.1	2.1
J44055	DS	52D	Power gen equip repairer	2.1	3.0	3.0
J45699	DS	52D	Power gen equip repairer	5.9	7.1	7.1
J46110	DS	52D	Power gen equip repairer	5.9	7.1	7.1
J47617	DS	52D	Power gen equip repairer	4.6	4.6	4.6
	GS	52D	Power gen equip repairer	4.8	4.8	4.8
J81750	DS	45K	Tank turret repairer	73.0	80.3	85.8
K29694	DS	68F	Aircraft electrician	8.5	8.5	8.5
		68G	Aircraft structural repairer	17.8	17.8	17.8
		68H	Aircraft pneudraulics repairer	12.9	12.9	12.9
		68J	Aircraft fire control repairer	11.8	11.8	11.8
K31042	DS	35M	Avionic navigational & flight control repairer	4.0	6.3	6.3
K32293	DS	35R	Avionic special equip repairer	0.0	8.1	8.1
K56981	DS	45L	Artillery repairer	12.3	13.4	21.8
K57667	DS	45L	Artillery repairer	110.2	143.4	196.8
	GS	45L	Artillery repairer	75.5	95.5	141.5

Table 4-4. Labor Savings - Base Case vs Excursions
(page 2 of 2 pages)

LIN[a]	ECH	MOS	MOS name	Exc 1 ($250K)	Base case ($500K)	Exc 2 ($1M)
P45003	DS	52F	Turbine eng drvn generator repairer	53.4	53.4	53.4
	GS	52F	Turbine eng drvn generator repairer	16.0	22.5	22.5
R50544	DS	44B	Metal worker	3.5	3.5	3.5
T05028	DS	63W	Wheel vehicle repairer	0.0	3.3	3.3
	GS	63W	Wheel vehicle repairer	0.0	0.0	3.3
T07543	DS	63W	Wheel vehicle repairer	14.2	14.7	14.7
	GS	63W	Wheel vehicle repairer	16.6	21.6	25.6
T13168	DS	41C	Fire control instrument repairer	0.7	0.7	0.7
		45G	Fire control systems repairer	5.2	5.2	7.0
		45K	Tank turret repairer	32.2	33.6	43.1
	GS	45K	Tank turret repairer	2.8	2.8	2.8
T13169	DS	45K	Tank turret repairer	14.7	15.6	17.4
	GS	45K	Tank turret repairer	3.7	3.7	11.3
T13374	DS	45G	Fire control systems repairer	4.9	5.1	6.0
		45K	Tank turret repairer	51.4	55.2	65.8
	GS	45K	Tank turret repairer	3.8	3.8	7.0
T49255	DS	63W	Wheel vehicle repairer	9.3	10.3	10.3
	GS	63W	Wheel vehicle repairer	12.0	12.0	12.0
T59346	DS	63W	Wheel vehicle repairer	0.3	0.3	1.4
	GS	63W	Wheel vehicle repairer	0.0	0.4	3.2
T59482	DS	63W	Wheel vehicle repairer	0.0	0.3	0.3
	GS	63W	Wheel vehicle repairer	0.0	0.0	3.2
T61494	DS	63W	Wheel vehicle repairer	2.5	2.5	2.5
	GS	63W	Wheel vehicle repairer	0.0	1.6	1.6
T92242	DS	63W	Wheel vehicle repairer	3.5	9.2	12.7
	GS	63W	Wheel vehicle repairer	1.6	11.6	21.6
V12141	DS	63J	Qtrmaster & chem equip repairer	0.0	6.0	8.5
X40146	GS	63W	Wheel vehicle repairer	0.0	0.0	10.4
X44403	DS	63W	Wheel vehicle repairer	4.5	8.5	9.5
	GS	63W	Wheel vehicle repairer	13.1	13.1	13.1

[a]Refer to Table 2-1 for corresponding LIN nomenclature.

b. Results. The results of Excursions 1 and 2, based on the labor savings shown in Table 4-4, are presented in Tables 4-5 through 4-8. Tables 4-5 and 4-6 contain the unconstrained and constrained results for Excursion 1, respectively. Tables 4-7 and 4-8 present the same for Excursion 2.

Table 4-5. Results of Excursion 1 - Unconstrained

Theater	Change in strength due to DFD	SRCs	SRC descriptions
NATO	-519	43237J50010 43238J50010 43238J50210 43209LG0010	CS CO LEMCO CS CO HVY EQP MAINT CS TM FIELD ARTY REPAIR MT TM WHEEL VEH
SWA	0		
NEA	0		

(1) In Table 4-5, it is evident that changing the economic criteria from $500,000 to $250,000 did not have a great impact on the force structure savings. The total change in strength of 519 in NATO was only 35 people fewer than in the base case. There was no change in SWA, as expected. In NEA, the one unit of 200 strength that was saved in the base case dropped out in this excursion. As Table 4-6 indicates, the constrained results were the same as they were in the base case, with zero change in all theaters.

Table 4-6. Results of Excursion 1 - Constrained

Theater	Change in strength due to DFD	SRCs	SRC descriptions
NATO	0		
SWA	0		
NEA	0		

(2) Table 4-7 shows that doubling the cost criteria to $1,000,000 had only a small impact on results as well. In NATO, only nine additional people were added to the force structure savings over the base case. SWA results were the same as in the base case, as were the NEA results. Again, the constrained results remained at zero in all theaters, as shown in Table 4-8.

Table 4-7. Results of Excursion 2 - Unconstrained

Theater	Change in strength due to DFD	SRCs	SRC descriptions
NATO	-563	43237J50010 43238J50010 43238J50210 43509LC0010 43509LC00HI 43509LG0010 43509LG00HI	CS CO LEMCO CS CO HVY EQP MAINT CS TM FLD ARTY REPAIR MT TM TRACK VEH REPAIR MT TM TRACK VEH REPAIR MT TM WHEEL VEH MT TM WHEEL VEH
SWA	0		
NEA	-200	43209L00010	MT CO

Table 4-8. Results of Excursion 2 - Constrained

Theater	Change in strength due to DFD	SRCs	SRC descriptions
NATO	0		
SWA	0		
NEA	0		

(3) As can be seen from Tables 4-6 through 4-3, the decrements in maintenance manhours and the resultant force structure savings did not vary to a large degree between the DFD base case and the two excursions. In other words, the sensitivity analysis showed that variations in the economic criteria did not produce large differences in the results. Figure 4-1 shows, by theater, the difference in force structure savings for the base case and the two excursions. It demonstrates that the model results were not sensitive to changes in the cost criteria.

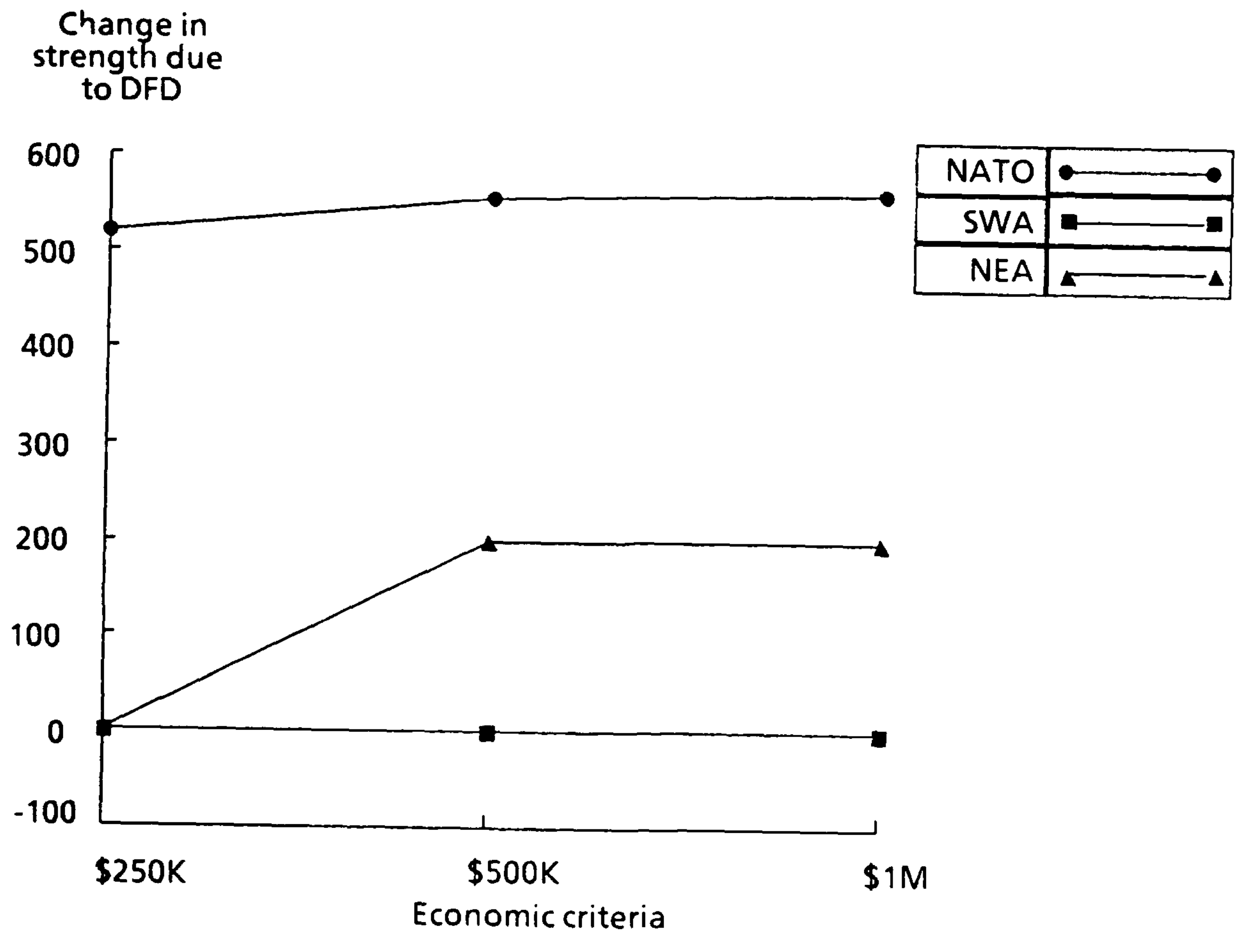


Figure 4-1. Results by Theater (unconstrained), Base Case and Excursions

4-6. **MAGNITUDE OF FORCE STRUCTURE SAVINGS.** Table 4-9 provides insight into the magnitude of the force structure savings achieved in this study. The largest drop in strength for each theater, which occurred in Excursion 2, is shown along with the beginning strength or total population in the theater at the outset of the FASTALS run. The percentage change between the beginning strength and the savings in strength due to DFD shows that the savings are not significant. Table 4-10 presents the same information, but, in place of the beginning strength, the beginning maintenance strength (a subset of the total population) is provided by theater. The drop in strength relative to the beginning maintenance population is also very small.

Table 4-9. Magnitude of Force Structure Savings
(relative to beginning strength)

Theater	Beginning total strength	Largest drop in strength	Percentage change
NATO	1,106,000	563	-.05%
SWA	408,000	0	0%
NEA	139,000	200	-.14%

Table 4-10. Magnitude of Force Structure Savings
(relative to beginning maintenance strength)

Theater	Beginning maintenance strength	Largest drop in strength	Percentage change
NATO	40,867	563	-1.4%
SWA	18,485	0	0%
NEA	6,557	200	-3.0%

4-7. ANSWERS TO EEA

a. EEA 1. The first EEA was to identify existing reparable components for possible reclassification as throwaway components. Table B-1 in Appendix B shows, by LIN and NSN, components currently classified as reparable which were identified in the DFD Study as throwaway candidates. (Note that NSN nomenclature fields were provided with a maximum width of 19 characters. Many of the names are cut off at that point.)

b. EEA 2. The second EEA was to identify military spaces by MOS and SRC which could be realigned or converted to other MOSs. The military spaces identified in the DFD Study as candidates for possible conversion are those listed in Table 4-1 by LIN, ECH, and MOS. The SRCs associated with these MOSs are those shown in Table 4-2 (for the base case).

c. EEA 3. EEA 3 was to determine the impact on the Army force structure of the DFD concept within the limits of the DFD Study. In terms of results produced in this study, force structure savings appear to be negligible. However, this determination was made on the basis of available tools and data. Discussion about what conclusions can be drawn from the results of this study and recommendations for further study are presented in the next paragraph.

4-8. CONCLUSIONS AND RECOMMENDATIONS. The purpose of the DFD Study was to determine the impact of DFD on the Army's CSS force structure. At face value, the results of the study indicate that force structure savings resulting from the use of the DFD concept are nonexistent to negligible. These results, however, were heavily dependent on the methodology used and the available tools. The study results are inconclusive in that they do not provide a strong basis for a decision as to the usefulness of the DFD concept. It is not felt that a decision regarding the implementation of the DFD concept should be made based *solely* on the study results. The reasons for this assessment are the following.

a. One of the fundamental concepts on which the DFD Study was based was the economic methodology. The PLRC was used as the basis for the decision as to whether a component would be considered for reclassification from a reparable component to a discardable item. Labor savings (the number of maintenance manhours that would be saved by reclassifying these components) were then computed for the items meeting the economic criteria. It is recommended that further study be done which would focus on the components which require the greatest number of manhours to repair, rather than using cost criteria as the primary consideration.

b. The only tool available at CAA to measure a change in CSS force structure is the FASTALS Model. FASTALS provided a means to assess savings in terms of entire units, based on reductions in maintenance manhours applied through the use of the MARC file. The changes made to the MARC file for the DFD Study were considered small in relation to changes made in other applications. Reductions in manhours amounted to about 8 percent (for the 46 end items making up 48 percent of the total maintenance workload). FASTALS is not sensitive to small changes in MARC data. That is, it is not unusual for a strength change of zero (i.e., no units "kick out") to result from small changes in MARC data. Also, FASTALS does not provide insights into force structure savings at any level less than unit level. This means that savings by SRC are available, but savings by MOS within SRC are not. Other inherent properties of the FASTALS Model that affect results are such things as rounding rules, allocation rules, and number of time periods considered. These properties had some effect on the results of the DFD Study as well.

c. It is recommended that further study of the DFD concept be conducted by TRADOC, possibly to include component replacement, in lieu of repair, resulting from combat damage. As long as the Army's maintenance structure remains as it is, it is felt that any assessment of force structure savings will have results similar to those of this study. The maintenance structure must be redesigned to allow for the DFD concept before any significant savings in force structure can be realized. Changes in unit design and allocation rules are necessary for the DFD concept to prove productive in the area of force structure savings.

APPENDIX A

STUDY CONTRIBUTORS

1. STUDY TEAM

a. Study Director

Ms. Julianne Allison, Office of the Special Assistant for Model Validation

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APPENDIX B

CANDIDATES FOR RECLASSIFICATION AS DISCARDABLE ITEMS

LIN/NSN*	NSN nomenclature
C10908	
2510010934311	WIRING HARNESS, BRAN
2520008949535	TRANSFER ASSEMBLY A
2520009649203	FINAL DRIVE WITH CO
2530001320842	ARM ASSEMBLY, PIVOT
2530005370372	ARM ASSEMBLY, PIVOT
2530005370434	ARM ASSEMBLY, SUSPEN
2530011885089	BRAKE, HYDRAULIC
2540007821169	FAN, PERSONNEL HEATE
2540011623834	HEATER, VEHICULAR, CO
2540011695159	HEATER, VEHICULAR, CO
2540011799024	SHROUD, DOOR
2590004463639	WIRING HARNESS, BRAN
2590008712834	PUMP, BILGE
2590011583087	ACTUATOR, HYDRAULIC
2815010403120	ENGINE W CONTAINER
2815011757342	ENGINE, DIESEL
2910000893947	TANK, FUEL, ENGINE
2910007821376	PUMP, FUEL AND HANGE
2910009377435	PUMP, FUEL, ELECTRICA
2910009379539	TANK, FUEL, ENGINE
2920004751446	GENERATOR, ENGINE AC
2930009216475	DRIVE ASSEMBLY, FAN
2930010383666	RADIATOR, ENGINE COO
4140000162615	FAN, CENTRIFUGAL
4140007563612	FAN, VANEAXIAL
4320008712834	PUMP, BILGE
6105010921484	MOTOR, DIRECT CURRENT
6105012005091	MOTOR, DIRECT CURRENT
6130009999825	RECTIFIER ASSEMBLY
6140012101964	BATTERY, STORAGE

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
C12155	
2540010870998	SUPPORT RING, COMMAN
3040010529047	BELL CRANK
6135010764282	BATTERY BOX
C76335	
1005010990163	TRAVEL LOCK ASSY
1005010991746	CABLE ASSEMBLY, 2W17
1005010991747	CABLE ASSEMBLY
1005010991748	CABLE ASSEMBLY
1005011091557	CAMSHAFT ASSEMBLY
1005011103420	BOX, FEEDER, AMMO
1005011114048	CIRCUIT CARD ASSY
1005011126331	CABLE ASSY
1005011128254	LEVER, REMOTE CONTRO
1005011128556	CAMSHAFT ASSEMBLY, T
1005011128571	CABLE ASSY SW, ELEC
1005011140072	CAMSHAFT ASSEMBLY E
1005011179821	CONTROL BOX, WEAPON
1005011408144	WIRING HARNESS, BRAN
1005011988684	GRIP ASSEMBLY, CONTR
1005011988685	GRIP ASSEMBLY, CONTR
1005012042418	GRIP ASSEMBLY, CONTR
1430010860932	CONTROL BOX, TOW
2540011077554	SEAT, GUNNERS
2540011114963	SEAT, COMMANDERS
2590011024655	WIRING HARNESS, BRAN
5340011400211	CLEVIS, ROD END
5905011295991	RESISTOR, STEP BY ST
5930011122489	SWITCH, SENSITIVE
5930011128500	SWITCH, SENSITIVE
6230012372953	LIGHT, EXTENSION
6350011122795	ANNUNCIATOR

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
D11049	
2590007409565	BRANKE BAND AND LINI
2920010319027	STARTER, ENGINE, ELEC
2940001035797	BODY, AIR CLEANER
D11533	
2990000741948	HEATER ASSEMBLY, AIR
E56896	
1005006108986	LOCK ASSEMBLY, PINTL
2520010764262	UNIVERSAL JOINT
2530010373310	ARM, TRACK IDLER
2590004462487	CYLINDER ASSEMBLY, A
J35813	
2910010472012	PUMP, FUEL, INJECTION
J35825	
2805012500039	GOVERNOR ASSEMBLY
2920012017370	MODULATOR ASSEMBLY,
2990010852554	DUCT AND SHUTTER AS
J42100	
2805004547511	CRANKCASE ASSEMBLY
5950007878615	TRANSFORMER, CURRENT
6110007647621	REGULATOR, VOLTAGE
6115002512087	CONTROL BOX ASEMBL
6115009407859	ROTOR ASSEMBLY, GENE
J43918	
6150009097339	WIRING HARNESS, BOXR
J44055	
2805012500039	GOVERNOR ASSEMBLY
2920012017370	MODULATOR ASSEMBLY,
6115007645464	FRAME
6150009097339	WIRING HARNESS, BOXR
J45699	
6110007647621	REGULATOR, VOLTAGE
6115009490604	HOUSING ASSEMBLY, GE
6115009995675	GENERATOR ASSEMBLY

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
J46110	
6110007647621	REGULATOR, VOLTAGE
6115009490604	HOUSING ASSEMBLY, GE
6115009995675	GENERATOR ASSEMBLY
J47617	
2805000178330	CYLINDER, ENGINE, GAS
6110007647621	REGULATOR, VOLTAGE
6110009139275	DISTRIBUTION BOX
6115011715858	HOUSING ASSEMBLY
J81750	
1005010990163	TRAVEL LOCK ASSY
1005010991746	CABLE ASSEMBLY, 2W17
1005010991747	CABLE ASSEMBLY
1005010991748	CABLE ASSEMBLY
1005011091557	CAMSHAFT ASSEMBLY
1005011103420	BOX, FEEDER, AMMO
1005011114048	CIRCUIT CARD ASSY
1005011126331	CABLE ASSY
1005011128254	LEVER, REMOTE CONTRO
1005011128556	CAMSHAFT ASSEMBLY, T
1005011128571	CABLE ASSY SW, ELEC
1005011140072	CAMSHAFT ASSEMBLY, E
1005011179821	CONTROL BOX, WEAPON
1005011408144	WIRING HARNESS, BRAN
1005011988684	GRIP ASSEMBLY, CONTR
1005011988685	GRIP ASSEMBLY, CONTR
1005012042418	GRIP ASSEMBLY, CONTR
2540011077554	SEAT, GUNNERS
5340011400211	CLEVIS, ROD END
5905011295991	RESISTOR, STEP BY ST
5930011122489	SWITCH, SENSITIVE
5930011128500	SWITCH, SENSITIVE
6230012372953	LIGHT, EXTENSION
6350011122795	ANNUNCIATOR

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
K29694	
1560001336224	FITTING ASSEMBLY, MO
1560008160790	DOOR, ACCESS
1560009731754	TANK, LUBRICATING OI
1615000701130	DAMPER ASSEMBLY, TRA
1630002470249	KID TUBE ASSY, LH
1650010596006	HYDRAULIC UNIT, MODU
1680001323364	PANEL, INDICATING, LI
2915000035904	FILTER, FLUID
2915011245222	PUMP, SUBMERGED, AIRC
K31042	
1560011101443	DOOR ASSEMBLY, CREW,
6220001795106	LIGHT, NAVIGATIONAL,
K32293	
1560011101443	SLIDE ASSEMBLY, WIND
K56981	
1025005570575	PIN, HINGE
1025010325114	TORQUE LOCK, DRIVE A
1025010325116	DIFFERENTIAL GEAR U
1025010414385	HEADLINK ASSEMBLY
1025012279770	CYLINDER ASSEMBLY, A
1030007910143	COUNTERBALANCE ASSE
2520010377279	FINAL DRIVE, TRAVERS
3010005362773	GEAR ASSEMBLY, SPEED
3040009811251	HEAD, LINEAR ACTUATI
3040012275546	CAM, CONTROL
5340010197144	LATCH SET, RIM
5340010311757	LOCK SET, RIM
K576670	
1015006093977	VALVE, SAFETY RELIEF
1025000195267	CRANK, OPERATING ASS
1025001150627	CYLINDER ASSEMBLY, L
1025001272921	ACCUMULATOR, HYDRAUL
1025001778345	VALVE ASSEMBLY
1025001797142	COVER ASSEMBLY, POWE

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
K576670 (cont)	
1025001837678	MANIFOLD ASSEMBLY
1025003320083	VALVE, SHUTTEL ASSY
1025004396541	LEVER, CAM ASSEMBLY
1025006893405	EYE ASSEMBLY, CYLIND
1025006893406	EYE ASSEMBLY, PISTON
1025008022465	HOUSING ASSEMBLY
1025008166592	BEARING UNIT, HAND D
1025008688060	GEARSHAFT ASSEMBLY,
1025009197277	RECUPERATOR CYLINDE
1025009197905	COVER, RECUPERATOR C
1025009298328	SHIM
1025009997931	HOUSING, FIRING MECH
1025010189182	SUPPORT ASSY, REAR
1025010552790	BODY ASSEMBLY
1025010561250	CYLINDER, BUFFER
1025010592488	VALVE ASSEMBLY RAMM
1025010643374	ROLLER ASSEMBLY
1025010703223	HANDLE ASSEMBLY
1025010710623	RETAINER ASSEMBLY
1025010927901	POWER PACK ASSEMBLY
1025010950899	MOUNT ASSEMBLY
1025012532033	FILTER, FLUID ASSEMB
1240003285623	M145 MT TEL
1240004888665	LEVEL ASSEMBLY
1240008640343	CELL ASSEMBLY, OPTIC
1240008640363	TEL P M 117A2
1240008715475	M15 QUAD FC
1240011495951	QUADRANT SUPPORT AS
1240011495952	COUNTER BOX ASSEMBL
1240011789752	LAMP ASSEMBLY, TELES
1290004707504	QUAD M1A1
1290008919999	QUADRANT, FIRE CONTR
1290008962236	QUADRANT, FIRE CONTRO

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
K576670 (cont)	
1290011484821	LIGHT, AIMING POST
2520004751278	BODY, VALVE, BYPASS
2520005080126	ACCUMULATOR
2520008883715	HANDLE, GUNNERS CON
2520009722625	VALVE, RELIEF, TURRET
2520009722627	MOTOR, HYDRAULIC
2590001797159	HARNESS, HANDLE GUNN
2590002694853	WIRING HARNESS, BRANC
2590008235586	LEAD ASSEMBLY, ELECT
3040009318206	CONNECTING LINK, RIG
4320001743439	PUMP, AXIAL PISTONS
4320009307862	PUMP ASSEMBLY
4810004706533	VALVE, LINEAR, DIRECT
4820004751272	BODY, SELECTOR VALVE
5315000852261	PIN, SHOULDER, HEADLE
5340001747758	PLUNGER ASSEMBLY, CA
5340010691591	DOOR, ACCESS
5355008986791	KNOB ASSEMBLY
5925008405393	CIRCUIT BREAKER
5935007388305	CONNECTOR, RECEPTICL
5935007751500	RECEPTICLE WIRING H
5975000531074	INTERCONNECTING BOX
6105010953087	MOTOR, DIRECT CURREN
6150000840240	LEAD ELECTRICAL, BRA
6150009673351	LEAD ELECTRICAL, BRA
6150010718507	WIRING HARNESS
9340004939060	WINDOW, OBSERVATION
K576671	
1015006093977	VALVE, SAFETY RELIEF
1025001150627	CYLINDER ASSEMBLY,L
1025001837678	MANIFOLD ASSEMBLY
1025003320083	VALVE, SHUTTLE ASSY
1025004396541	LEVER, CAM ASSEMBLY
1025006893405	EYE ASSEMBLY, CYLIND
1025006893406	EYE ASSEMBLY, PISTON

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
K576671 (cont)	
1025008022465	HOUSING ASSEMBLY
1025008166592	BEARING UNIT, HAND D
1025008688060	GEARSHAFT ASSEMBLY,
1025009197905	COVER, RECUPERATOR C
1025010552790	BODY ASSEMBLY
1025010592488	VALVE ASSEMBLY RAMM
1025010643374	ROLLER ASSEMBLY, CUR
1025010710623	RETAINER ASSEMBLY
1025010927901	POWER PACK ASSEMBLY
1025010950899	MOUNT ASSEMBLY
1025012532033	FILTER, FLUID ASSEMB
1240001150637	WIRING HARNESS, BRAN
1240004888665	LEVEL ASSEMBLY
1240008640343	CELL ASSEMBLY, OPTIC
1240008640363	TEL P M117A2
1240008642933	PERISCOPE
1240008688381	PRISM, DOVE, ASSEMBLY
1240008706277	GEAR-PRISM OPTICAL
1240011495951	QUADRANT SUPPORT AS
1240011495952	COUNTER BOX ASSEMBL
1240011506094	CELL ASSEMBLY, OPTIC
1240011518841	RETICLE ASSEMBLY, OP
1240011656247	SEGMENT ASSEMBLY, GE
1240011789752	LAMP ASSEMBLY, TELES
1290008919999	QUADRANT, FIRE CONTR
1290008962236	QUADRANT, FIRE CONTR
2520004751278	BODY, VALVE, BYPASS
2520005080126	ACCUMULATOR
2520008883715	HANDLE, GUNNERS CON
2520009722625	VALVE, RELIEF, TURRET
2590001797159	HARNESS, HANDLE GUNN
3040009318206	CONNECTING LINK, RIG
4810004706533	VALVE, LINEAR, DIRECT

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
K576671 (cont)	
4820004751272	BODY, SELECTOR VALVE
5315000852261	PIN, SHOULDER, HEADLE
5355008986791	KNOB ASSEMBLY
9340004939060	WINDOW, OBSERVATION
P45003	
2835004204332	DRIVE ASSY, DUAL PAD
2835008638496	GEAR BOX, ACCESSORY D
2910009081429	FUEL CONTROL, ASSY
2920009330578	WIRE HARNESS
2930003374818	COOLER/REG ASSY, OIL
4130008638549	WIRE HARNESS
4130009330570	FAN, RECIRCULATE ASSY
6115002479944	WIRE HARNESS
6115002479947	WIRE HARNESS
6115002489988	WIRE HARNESS
6115004557712	WIRE HARNESS
6115008337785	WIRE HARNESS
6115008437627	WIRE HARNESS
6115008437650	WIRE HARNESS, HEAT
6115008438605	WIRE HARNESS
6115008438621	WIRE HARNESS
6115008592382	WIRE HARNESS
6115008716658	WIRE HARNESS
6150002480063	WIRE HARNESS
R50544	
2510004381595	DOOR, HATCH, VEHICLE
2510004434864	DOOR, HATCH, VEHICLE
2510004434865	DOOR, HATCH, VEHICLE
2510004434879	DOOR, METAL SWINGING
2510004535448	TREAD, METALLIC, NONS
2510004535449	TREAD, METALLIC, NONS
2510004535450	TREAD, METALLIC, NONS
2510004535451	TREAD, METALLIC, NONS

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
T05028	
2530011479329	CALIPER, DISC BRAKE
2530011529305	DRUM ASM-RR BRK
2530011566190	CALIPER, DISC BRAKE
T07543	
2510011739316	TAILGATE, VEHICLE BO
2510011739347	HOOD, ENGINE COMPART
2520011491866	BODY ASSEMBLY, PUMP,
2520011885115	AXLE ASSEMBLY, AUTOM
2530011687876	PUMP ASSEMBLY, POWER
2530011856712	ROTOR
2530012042583	HOUSING ASSEMBLY, CA
2530012076256	HOUSING ASSEMBLY, CA
2540011975524	TOP ASSEMBLY, TRUCK
2540011975528	CURTAIN, VEHICULAR
2815011658216	CYLINDER HEAD, DIESE
2910011714636	PUMP, FUEL, METERING
2930011687870	DRIVE, FAN
2930011687911	COOLER, LUBRICATING
2930011992398	RADIATOR, ENGINE COO
T13168	
1015011815924	LOCK, BEARING
1015011815925	LOCK, BEARING
1015012032735	ROTOR, GUN MOUNT
1220010781138	BRACKET-RECEPTABLE
1230011586805	SHIPPING AND STORAG
1230011602953	SHIPPING AND STORAG
1240010761815	HOUSING
1240010787615	STOP
1240010787617	ARM, PIVOT
1240010787727	CONNECTING LINK, FOV
1240011816018	HOLDER, OPTICAL ELEM
1240011819069	HOUSING ASSEMBLY
1240011924058	OBJECTIVE AND RELAY
1240012546344	CELL, OPTICAL ELEMEN

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
T13168 (cont)	
2510010749011	DOOR, HATCH, VEHICLE
2520005080126	ACCUMULATOR
3040012746354	CONNECTING LINK, RIG
3040012752589	CONNECTING LINK, RIG
5340010761874	COVER, ACCESS
5340010766867	COVER, ACCESS
5340010781301	COVER, ACCESS
5340012746342	COVER, ACCESS
5935004084368	CONNECTOR,
5935010781292	CONNECTOR ASSEMBLY,
T13169	
1015001139602	HANGER, TURRET PLATE
1015005663827	SHAFT, OVERRIDE ELEV
1015005663840	SHAFT, OVERRIDING, TR
1015006093977	VALVE, SAFETY RELIEF
1015006466858	YOKE ASSEMBLY PUMP
1015007792532	SHIELD ASSEMBLY
1015010144716	BOX, ASSEMBLY, AMMUNI
1015010217266	HOUSING ASSEMBLY
1015010327144	HOUSING ASSEMBLY
1240004579370	HANDLE ASSEMBLY
1240011819069	HOUSING ASSEMBLY
2520004517713	BOX ASSEMBLY
5305008007261	SET SCREW
6130012692279	POWER SUPPLY SUBASS
T13374	
1015010749018	WIRING HARNESS, BRAN
1015010766722	ROTOR, GUN MOUNT
1015010766783	WIRING HARNESS
1015010766784	WIRING HARNESS
1015010766785	WIRING HARNESS
1015010766786	WIRING HARNESS
1015010766787	WIRING HARNESS
1015010766790	WIRING HARNESS

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
T13374 (cont)	
1015011084930	EXTRACTOR ASSEMBLY
1015011084931	EXTRACTOR, CARTRIDGE
1015012240081	PLATE, SPRING AND BU
1220010781138	BRACKET-RECEPTACLE
1230011586802	SHIPPING AND STORAG
1230011586805	SHIPPING AND STORAG
1230011602953	SHIPPING AND STORAG
1240010787615	STOP
1240010787617	ARM, PIVOT
1240010787727	CONNECTING LINK, FOV
1240011816018	HOLDER, OPTICAL ELEMEN
1240011819069	HOUSING ASSEMBLY
2520005080126	ACCUMULATOR
3040012746354	CONNECTING LINK, RIG
3040012752589	CONNECTING LINK, RIG
5340010766867	COVER, ACCESS
5340010781301	COVER, ACCESS
5340012746342	COVER, ACCESS
5935004084368	CONNECTOR,
5935010781292	CONNECTOR ASSEMBLY,
5995011054006	CABLE ASSEMBLY, SPEC
6150012718016	CABLE ASSEMBLY, SPEC
T49255	
2520011097958	VALVE ASSEMBLY, TRAN
2530012225482	CYLINDER ASSEMBLY,
2815000546945	OIL PUMP ASSEMBLY, E
2910011148608	PUMP, FUEL, METERING
2930011013047	RADIATOR, ENGINE COO
3040011013726	CYLINDER ASSEMBLY, A
3040011017460	CYLINDER ASSEMBLY, A
3040011017461	CYLINDER, ACTUATING
3040011024224	CYLINDER, ACTUATING
6110002781044	STARTER, MOTOR
6115011023063	GENERATOR, ALTERNATI
6140000572554	BATTERY, STORAGE

*Refer to Table 2-1 for LIN nomenclatures.

LIN/NSN*	NSN nomenclature
T59346	
2530011478556	PUMP ASSEMBLY, POWER
2530011482914	BRAKE DRUM
T59482	
2530011482914	BRAKE DRUM
T61494	
2510011739316	TAILGATE, VEHICLE BO
2520011491866	BODY ASSEMBLY, PUMP,
2530011856712	ROTOR
2530012042583	HOUSING ASSEMBLY, CA
2530012076256	HOUSING ASSEMBLY, CA
T92242	
2510011739316	TAILGATE, VEHICLE BO
2520011491866	BODY ASSEMBLY, PUMP,
2520011885115	AXLE ASSEMBLY, AUTOM
2530011687876	PUMP ASSEMBLY, POWER
2530011856712	ROTOR
2530012042583	HOUSING ASSEMBLY, CA
2530012076256	HOUSING ASSEMBLY, CA
2930011687870	DRIVE, FAN
2930011687911	COOLER, LUBRICATING
V12141	
4930011272219	REEL, LH
4930011362089	REEL ASSEMBLY, RIGHT
X44403	
2520010730056	TRANSFER TRANSMISSI
2520010904556	POWER TAKEOFF, TRANS
2520010996350	CARRIER ASSEMBLY, DI
2910010793452	TANK, FUEL, ENGINE
2910011127712	INJECTOR ASSEMBLY, F
2930010969035	PUMP, WATER, ENGINE
2930010969199	IDLER ASSEMBLY, WATE
4320010742917	PUMP, ROTARY

*Refer to Table 2-1 for LIN nomenclatures.

APPENDIX C

BIBLIOGRAPHY

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MISCELLANEOUS

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APPENDIX D

THE FASTALS MODEL

D-1. MODEL DESCRIPTION AND APPLICATIONS. The purpose of the FASTALS Model is to compute administrative and logistical workloads and to generate the theater level support force structure necessary to round out a combat force in a postulated confrontation. FASTALS, a requirements model, may be used in any force planning simulation to develop a force that is balanced, time-phased, and geographically distributed. A trooplist is said to be balanced when the individual units comprising the list are capable of accomplishing the various workloads generated by the total force. Trooplists are said to be time-phased when unit requirements are prescribed for each time period in the simulation. The major elements of support are maintenance, construction, supply, transportation, hospitalization and evacuation, and personnel replacement. Major Department of the Army (DA) studies utilizing FASTALS include TAA, OMNIBUS, and the Joint Strategic Planning Document Analysis (JSPDA). The model is also used in excursions to assess the impact of force modernization, logistic initiatives and host nation support contributions on US force structure requirements.

D-2. INPUTS. Each study has its own set of data files for each theater examined. The data must reflect the force being portrayed on the force tape, which has been prepared by the study proponent. The two major input files are described below.

a. Masterfile (MF). This file contains data necessary to allocate units and to prescribe unit support requirements. Key entries include:

(1) Logical Region (LR). Reflects a unit's normal echelon of operation in the theater (1 - division, 2 - corps, 3 - rear combat zone, 4 - COMMZ, 5 - ports, 6 - offshore). LRs are further delineated into three sectors which divide the LRs into horizontal borders. For example, in NATO, the three sectors generally represent Northern Army Group (NORTHAG) (Sector 1) and Central Army Group, Central Europe (CENTAG) (Sectors 2 and 3).

(2) Allocation Rules (AR). The most critical of all MF data. An AR is a statement of a unit's capability, mission and/or doctrinal employment and, in conjunction with other data, determines how many of a certain type unit will be reflected in the final trooplist of requirements. All rules are coordinated with the study sponsor and the TRADOC community. Three types of AR exist:

(a) Manual Entry. Units are placed directly into the scenario by time period and location. Almost all combat units are entered manually, as are a limited number of CS/CSS units that have a special mission or fixed quantity (i.e., petroleum pipeline companies that operate emergency pipelines in accordance with certain contingency plans).

(b) Existence Rule. Units are allocated based on the existence of some other unit(s) in the theater. This allows the theater to be rounded out in accordance with normal TOE doctrine.

(c) Workload Rule. Units are allocated based on the capability to accomplish generated workloads.

Other data found in the MF include standard requirements codes, unit descriptions, strengths and weights of the units.

b. Scenario. This data set represents the major variable inputs which, when combined with the MF, generates the statement of support force requirements.

(1) Combat Simulation Data. The combat data required to run FASTALS include unit location and employment time, level of combat intensity, ammunition consumption, damaged and repairable tanks/armored personnel carriers (APCs), casualties, and changes in forward edge of the battle area (FEBA).

(2) Other Data. Other data provided include a layout of the theater's geographical structure; number of forward deployed and prepositioned materiel configured to unit sets (POMCUS) units; prepositioned war reserve materiel stock (PWRMS), stockage policy and supply data; engineer construction policy; and transportation data representing links, paths, and capacities for each mode (highway, railroad, waterway, pipeline).

D-3. EXECUTION. First, the combat units employed by the combat model are augmented by direct input units and by units that are implied by the organizational structure of the theater being analyzed (e.g., number of corps). Next, units that are required on the basis of the existence of other units in the theater are added to the list. The model then computes workloads generated by these units in terms of personnel replacements, hospital admissions, supplies, maintenance, construction, and transportation. These workloads are then used as a basis for adding units such as hospitals and medium truck companies. This new set of units generates another increment, and so the cycling process begins. Additional units increase the workloads which, in turn, generate a requirement for more units. This cyclic process, steps 5 through 13 in Figure D-1, continues until the model computes the same set of units (trooplist) that was computed on the previous cycle (requirements converge).

D-4. OUTPUTS. The principle output produced is the time-phased troop deployment list of theater requirements. Other reports provide consumption and stockage requirements for each category of supply. Additional reports include 48 workload summaries that relate to personnel replacements, medical, materiel, maintenance, construction, transportation, and casualties.

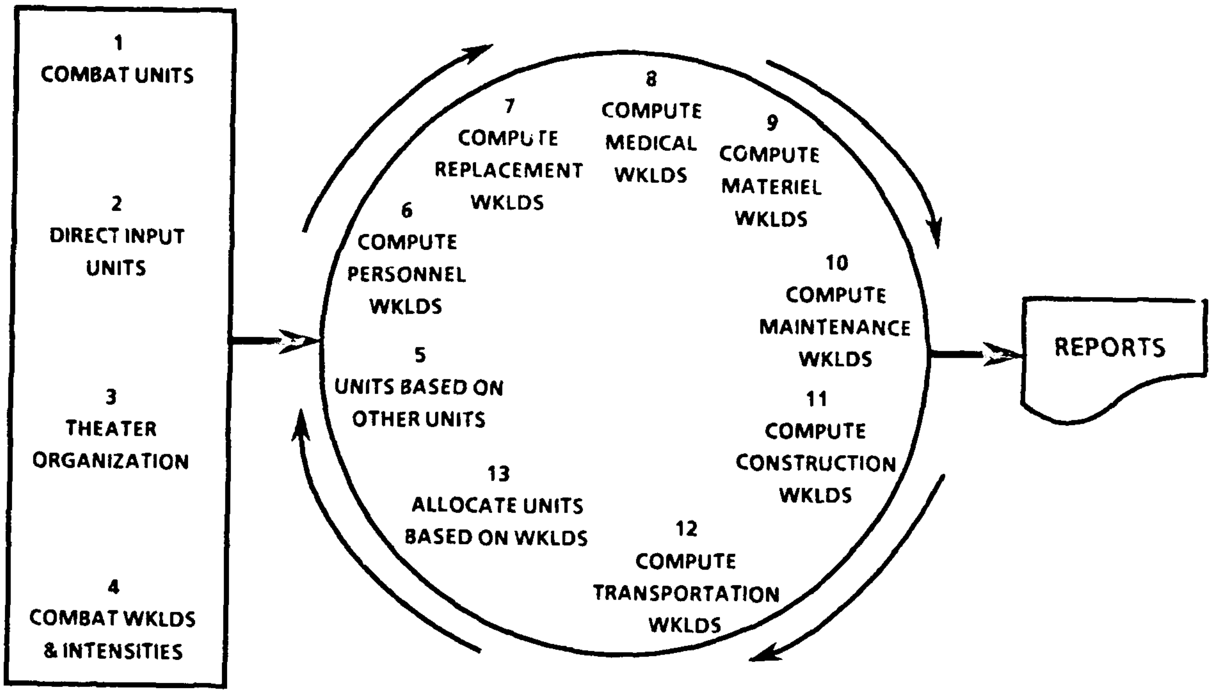

Figure D-1. FASTALS Logic Flow

APPENDIX E

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GLOSSARY

ABBREVIATIONS, ACRONYMS, AND SHORT TERMS

AMC	US Army Materiel Command
AMCCOM	US Army Armament, Munitions, and Chemical Command
AMM	ammunition
AMSAA	Army Materiel Systems Analysis Activity
APC	armored personnel carrier
AR	allocation rules
AVSCOM	Aviation Systems Command
CAA	US Army Concepts Analysis Agency
CECOM	Communications-Electronics Command
CENTAG	Central Army Group, Central Europe
COMMZ	communications zone
COMPO	component code
CS	combat support
CS CO	combat support company
CS HHC	combat support headquarters
CS TM	combat support team
CSS	combat service support
DA	Department of the Army
DENS	density
DEP	depot
DFD	Design for Discard (study)
DG	Defense Guidance
DS	direct support
ECH	echelon
EEA	essential element(s) of analysis

EQUIP	equipment
F	flying hours
FASTALS	Force Analysis Simulation of Theater Administrative and Logistic Support (model)
FEBA	forward edge of the battle area
FF1	Failure Factor 1
FF2	Failure Factor 2
FGC	functional group code
FOP	first opportunity
FOREWON	Forces and Weapons System
GEN	generation
GS	general support
H	hours
HEL	helicopter
HMMWV	high mobility multipurpose wheeled vehicle
HRM	hours to perform task
HVY	heavy
IDEF	deferability
IDS	intermediate direct support
IGS	intermediate general support
IMM	immediately
IND	indefinite
IPS	Illustrative Planning Scenario
IRO	Inventory Research Office
JSPD	Joint Strategic Planning Document
JSPDSA	Joint Strategic Planning Document Analysis
LIN	line item number

LR	logical region
LT	light
M	mileage
MAINT	maintenance
MARC	Manpower Requirements Criteria
MED	medium
MF	masterfile
MOS	military occupational specialty
MSC	major subordinate command
MT CO	maintenance company
MT TM	maintenance team
MTD	maintenance task distribution
NATO	North Atlantic Treaty Organization
NEA	Northeast Asia
NORTHAG	Northern Army Group
NSN	national stock number
NUMP	number of people required on task
ORG	organizational
PCD	program code
PLF	projected lifetime failures
PLRC	projected lifetime replacement cost
POM	Program Objective Memorandum
POMCUS	prepositioned materiel configured to unit sets
PROG	projected yearly program
PWRMS	prepositioned war reserve materiel stock
QM CO	quartermaster company
R	rounds

RAC	Research Analysis Corporation
REPR	replacement factor - percentage of removal components which cannot be repaired
SPT	support
SRA-96	Support Force Requirements Analysis - 1996 (study)
SRC	standard requirement code
SWA	Southwest Asia
TAA-96	Total Army Analysis - 1996
TAC	tactical
TOE	table(s) of organization and equipment
TACOM	Tank-Automotive Command
TRADOC	US Army Training and Doctrine Command
TRANSMO	Transportation Model
TRK	truck
UP	unit price
UTIL	utility
VEH	vehicle
WGT	weight
WHL	wheeled
WPN	weapon
YRS	years of life of end item

CAA	**DESIGN FOR DISCARD (DFD) STUDY**	**STUDY SUMMARY CAA-SR-89-21**

THE REASON FOR PERFORMING THE STUDY was to determine the impact of the Design for Discard (DFD) concept on the Army's force structure. DFD is an Army initiative to reduce materiel maintenance requirements by focusing on discard of system components in lieu of fault isolation and repair. It is an effort to identify parts which cost more to repair than to replace. The goal is to design or select system components which are easily diagnosed and isolated upon failure and, if possible, inexpensive enough to throw away at failure. The resultant avoidance of maintenance allows personnel spaces to be realigned or converted to other military occupational specialties (MOSs) and applied against force structure shortfalls.

THE STUDY SPONSOR was the US Army Materiel Command (AMC), AMCRE-C.

THE STUDY OBJECTIVE was to determine the force structure impact of the DFD concept on current Army maintenance support requirements.

THE SCOPE OF THE STUDY was as follows:

(1) The DFD Study was based on the Defense Guidance (DG) Illustrative Planning Scenario (IPS) and the 1996 Total Army Analysis (TAA)/Table of Organization and Equipment (TOE) Army.

(2) The study focused on the reparable components of 60 major end items which constitute about 60 percent of the total maintenance workload estimated using Manpower Requirements Criteria (MARC) factors. Currently, MARC factors account for only combat mission essential repairs of equipment, not including any associated with combat damage.

(3) Only those components with maintenance tasks of repair, test, or overhaul at the direct support (DS) and general support (GS) levels were considered.

THE MAIN ASSUMPTIONS of this work are:

(1) The sample of major end items used in the study provides a reasonable basis for an estimate of potential force structure savings which accrue from discarding and replacing components due to reliability, availability, and maintainability (RAM) failure in lieu of repair/overhaul of components.

(2) The leader MOS concept used in the Force Analysis Simulation of Theater Administrative and Logistic Support (FASTALS) Model for determining maintenance unit requirements still applies.

(3) Failure rates of components in wartime will not vary significantly from peacetime experience.

(4) Estimates used in place of missing data elements were reasonable.

THE BASIC APPROACHES used in this study were to:

(1) Include those systems encompassing 60 percent of the DS and GS maintenance workload.

(2) Focus on the component parts of these end items which are currently coded for repair but could become candidates for discard.

(3) Compare these items against criteria developed by the US Army Materiel Systems Analysis Activity (AMSAA).

(4) Apply reductions in workload factors for items meeting the criteria, using the FASTALS Model to determine potential force structure savings. Identify the savings, if any, in terms of military spaces by MOS and standard requirement code (SRC).

THE PRINCIPAL FINDINGS of the work reported herein are as follows:

(1) Many components of major end items could be reclassified as discardable items based on the economic methodology used in the study.

(2) Force structure savings based on the labor savings achieved through the use of the DFD concept and applied through the study methodology were negligible.

(3) Further study should be undertaken by the US Army Training and Doctrine Command (TRADOC), possibly to include replacement (versus repair) of components due to combat damage. No significant savings in force structure will be realized through the use of the DFD concept unless the Army's maintenance structure is realigned. Changes in unit design and allocation rules are necessary for the DFD concept to prove effective in reducing required force structure.

THE STUDY EFFORT was directed by Ms. Julianne Allison, CSCA-MVD, 295-5225.

COMMENTS AND QUESTIONS may be sent to the Director, US Army Concepts Analysis Agency, ATTN: CSCA-MV, 8120 Woodmont Avenue, Bethesda, Maryland 20814-2797.

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