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COMPARATIVE ANALYSIS OF ARMY AVIATION MAINTENANCE CONCEPTS

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COMPARATIVE ANALYSIS OF ARMY AVIATION MAINTENANCE CONCEPTS

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prepared for

HEADQUARTERS, DEPARTMENT OF THE ARMY
Office of the Deputy Chief of Staff for Logistics
Washington, D.C.

by

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PREFACE

Materiel readiness is the end product of the Army's logistic system. It is a yardstick for comparing alternative courses of action to determine the one yielding the required level of readiness in the most efficient and economical manner.

Current operations in Vietnam offer an unusual opportunity for a side-by-side comparison of aircraft maintenance concepts, methods, and results in the ROAD Divisions, The First Cavalry Division (Airmobile), and the independent aviation companies, as the basis for selecting the field maintenance concept best adapted to Army operations in the field.

The APJ approach was to assess comparative readiness and utilization relative to the resources required in terms of personnel, equipment and parts. Although the entire maintenance chain is significant, guidance from the DCSLOG Project Officer properly emphasized the role of the DS level. Available analysis effort was, therefore, focused on those tasks leading to recommendations for the best way to accomplish field level support. Detailed attention was given to DS level because of its direct impact on aircraft readiness; GS is considered only insofar as readiness is directly affected.

This study, in support of DA Project 35, is part of a sequence in which a series of individual tasks are undertaken, each having a direct payoff to the Army in terms of increased readiness. Grateful acknowledgment is made for the support of Mr. J. P. Cribbins, DCSLOG Project Officer, and of the Commanders and men of the aviation units in Vietnam.

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CHAPTER 1

SUMMARY

OBJECTIVE

The objective of this study is to accomplish, in the context of recent Army experience in Vietnam, a comparative evaluation of the three principal concepts of Direct Support level aircraft maintenance:

1. The Conventional Direct Support (DS) concept as employed by the ROAD Infantry Divisions,
2. The Airmobile concept as employed by the 1st Cavalry Division (Airmobile),
3. The DS Detachment concept as practiced in the aviation companies of the 1st Aviation Brigade.

Findings and recommendations derived from this evaluation are furnished to provide bases for decisions on the optimum concepts for this important aspect of management of Army Aviation resources.

These concepts are analyzed in terms of:

1. Effectiveness, as reflected in reported aircraft readiness and utilization.
2. Efficiency of support operations as indicated by NORM (Not Operationally Ready, Maintenance) rates, NORS (Not Operationally Ready, Supply) rates, supply performance and ratio of manpower to aircraft supported.

3. Investments in resources to include equipment, personnel, facilities, and parts stockage.

This Report describes the structure of the problem, the evaluation parameters, and the results of the analysis.

SCOPE AND DATA BASE

The basis of this study program is an analysis of the Army Aviation operations and maintenance supply support within the United States Army Vietnam, with particular emphasis on the 1st Cavalry Division (Air-mobile), the 1st Infantry Division, the DS Detachments and supported helicopter companies of the 1st Aviation Brigade, the two Aerial Surveillance Companies and the DS and GS companies of the 34th General Support Group (AM&S). The study covers data acquired and observations and interviews accomplished during 1966 and 1967.

Additionally, this study has been closely compared with the work accomplished by the Army Concept Team in Vietnam (ACTIV). The ACTIV Study, performed concurrently and independently, has led to conclusions which are consistent with those reached herein.

Major emphasis was given to establish a strong factual basis for the findings and conclusions reached in this study. Inputs from APJ field representatives in Vietnam, the analysis of the Daily Aircraft Status Record forms (R1 and R3) and the APJ data bank of Army Aviation Vietnam experience were utilized.

The DA Forms 1352 (Army Aircraft Flying Time and Status Report) provided a complete and authoritative measure. The continuing command emphasis on the quality of this form has produced a measure which is highly reliable and precise. Carefully sampled DA forms from the TAERS system, ASL/PLL supply performance reports, listings of AMMC and 34th GS Group (AM&S) were stratified to measure the cost and effectiveness of the respective concepts.

FINDINGS

The following are key findings resulting from this study.

1. The Detachment concept for providing Direct Support maintenance to Army aircraft in Vietnam was found to be superior to both the Airmobile concept (as exemplified by the operations of the 1st Cavalry Division, Airmobile), and the Conventional concept (as exemplified by the operations of a ROAD Division) for the following reasons:
 - a. The Detachment concept produced consistently higher readiness rates, in spite of the fact that aircraft supported by Detachments had a utilization rate 12 percent higher than aircraft under the other two concepts. The average readiness rates for detachment supported aircraft were higher for the period as a whole, and additionally were higher in 12 of the 14 months studied.

- b. The differential in operational readiness rates noted in a. above can be attributed directly to the maintenance support concept, as NORS rates were essentially the same under each of the three concepts studied.
- c. The Detachment concept provided a higher level of maintenance responsiveness. The rate at which aircraft were returned to service the same day they went into maintenance was higher under the Detachment concept than under the other two concepts studied. The overall reaction time based on an analysis of responsiveness indicators also showed the Detachment concept definitely superior.
- d. The Detachment concept produced higher readiness rates and better responsiveness through careful selection of the type of work performed. Emphasis at Detachment level was placed on rapid accomplishment of short turnaround work, which provided maximum support to aircraft readiness. Long turnaround jobs and component repair were evacuated to higher levels.
- e. The Detachments accomplished a higher total percentage of all support level work required than either of the other concepts. Detachments accomplished approximately 90 percent of all support level workload, as compared to slightly more than 82 percent for the other two concepts. Thus, a high percentage of support maintenance was brought to the aircraft, with lost time required for transfer of aircraft to a maintenance site held to a minimum.

- f. Although the Detachment concept required more direct productive personnel per maintenance equivalent than the other two concepts, the total number of personnel per maintenance equivalent was slightly lower. Administrative and housekeeping support provided by the supported units reduced the requirement for these types of personnel in detachments.
 - g. Investment costs in terms of supply stockage, equipment and personnel for the Detachment concept were equal to or less than the other two concepts.
2. Further reductions in the number of overhead and administrative personnel under the Detachment concept could be achieved by integrating the Detachments into the supported unit organizations. Under this concept, overhead and administrative support personnel required in Detachments could be reduced substantially.
3. The number of line items contained in the ASLs of UH-1 helicopter Detachments ranged from approximately 800 to 2200. No correlation could be found among the number of line items in the ASL and the supply performance of the Detachments in terms of NORS, demand accommodation, and demand satisfaction rates. This situation indicated a need for evaluation of the policies and procedures used in establishing ASLs for Direct Support Detachments.
4. Because of the superiority of the Detachment concept, as cited in Paragraph 1. above, this concept should be expanded to include Direct Support of Divisional aircraft in Vietnam. The feasibility of expansion of the concept to non-Divisional units not currently supported by Detachments, should also be studied.

5. Expansion of the Detachment concept, as described in Chapter 10 of this Report, will require an increased authorization of approximately 200-250 personnel for maintenance units in Vietnam over the number authorized at the time of this study. It is estimated that application of the concept of integrating Detachments into the supported unit organization structure would result in a total personnel requirement somewhat less than total authorizations for maintenance units in Vietnam at the time of this study.
6. Based on anticipated increases in aircraft readiness and utilization rates resulting from expansion of the Detachment concept, mission requirements can be met with fewer aircraft. Reductions in the total numbers of aircraft required are estimated at approximately 6 percent. Application of this cost reduction factor to the investment cost for aircraft in the Airmobile and Infantry Divisions recommended for inclusion under the Detachment concept produces major dollar savings.

RECOMMENDATIONS

It is recommended that:

1. The Detachment concept be expanded to include support of Divisional aircraft units in addition to the non-Divisional company sized units now supported. Detailed recommendations for expansion of the concept are listed in Chapter 10.
2. A study be made to determine the feasibility of expanding the Detachment concept to include non-Divisional aircraft units not currently supported by Detachments.

3. Consideration be given to integrating Detachments into the supported unit organization structure.
4. A detailed analysis be made of personnel savings which could be made based upon integration of Detachments and supported units.
5. An analysis be made of policies and procedures governing the establishment of ASLs for Detachments in Vietnam, leading to recommendations to produce more uniformity, better supply performance and dollar savings.

CHAPTER 2

CHAPTER 2

FIELD MAINTENANCE CONCEPTS AND THEIR OPERATION IN PRACTICE

GENERAL

A combination of rapidly moving technology and the desire to evolve a logistic doctrine which gives the Army the maximum use of its mobility resources has led to a continuing search for improved maintenance concepts and structure. Thus, the structure of maintenance evolved in Korea was further evaluated and defined by a series of investigations including the Howze Board, the 11th Air Assault Division Tests, as well as the COSTAR and TASTA-70 Doctrinal Studies. All concepts represent "ideals" and are adapted to the realities of time, place and resources when reduced to actual practice. It is in the "real" environment of Vietnam operations that this study is performed.

Vietnam offers a unique opportunity to observe and compare three of the most important concepts currently applied to the support of Army Aviation:

1. The "Conventional" aspect as embodied in ROAD Divisions.

2. The "Airmobile" support concept as embodied in the First Cavalry Division Airmobile
3. The application of "Maintenance Detachments" in the independent units operating under the USARV Aviation Command.

The non-divisional helicopter companies designated as the Assault Helicopter Company (UH-1), and the Assault Support Helicopter Company (CH-47), as presently assigned to the 1st Aviation Brigade in Vietnam, have DS maintenance detachments attached as described below. The Division 1 aircraft in Vietnam are supported by a Transportation Aircraft Maintenance and Supply Battalion in the 1st Cavalry Division (Airmobile) and by the Transportation Aircraft Maintenance Company (Company E) of the Maintenance Battalion in the ROAD Infantry Divisions, which will be referred to as the Conventional maintenance concept.

THE CONVENTIONAL MAINTENANCE CONCEPT

Maintenance Concept

This maintenance concept has the following major characteristics:

1. The aircraft operating unit contains within it the capability to perform, on-site, complete Organizational maintenance. Principal maintenance functions performed include:
 - a. All scheduled and designated special inspections
 - b. Minor airframe repairs

- c. Minor component replacement
 - d. Designated MWOs to airframe and components.
2. DS maintenance units, located in the Division base or Corps support area, provide backup support to the operating units. The aircraft or components requiring work are normally evacuated to the DS unit location, except as noted below. DS units normally support several operating units, and are usually required to schedule production according to their capabilities and workload. Principal maintenance functions assigned to DS level include:
- a. Major component build-up and replacement
 - b. Minor component repair
 - c. Extensive airframe repairs not requiring jigs or complex aligning equipment
 - d. Limited fabrication
 - e. Designated special inspections
 - f. Designated MWOs
 - g. Processing of aircraft to and from supported units
 - h. Overflow Organizational maintenance workload from supported units, to include assistance in performing major scheduled inspections.
- DS units may provide maintenance teams to supported units in forward areas to accomplish, on-site, certain of the above workload.
3. GS maintenance units, normally located in the Army Support Command area, provide backup support to DS units. Work

is normally evacuated to the GS unit location for accomplishment. GS companies normally support several DS companies, and workload scheduling is important at GS level. Principal maintenance functions allocated to GS level include:

- a. Major component test, inspection, and repair
- b. Minor component repair and overhaul
- c. Major airframe repairs
- d. Designated major MWOs
- e. Parts fabrication
- f. Overflow work from supported DS units.

Organizational maintenance units concentrate on inspections, minor repairs and replacements, and the preventive maintenance designed to keep the aircraft flying. Most work is accomplished directly on the aircraft, with little work done on components separate from the aircraft.

DS units provide the capability to do more extensive maintenance than at Organizational level. However, at DS most work is also done directly on the aircraft, with component work concentrated primarily in the areas of removal and replacement. Work is normally evacuated to the DS unit for performance.

GS units, unlike Organizational and DS units, are designed to concentrate on component repair and return. Work done directly on aircraft normally consists of long turnaround airframe repairs and modifications. The principal GS mission, therefore, is to support DS and Organizational units through component repair programs and relieve them of the

time and space consuming workload typified by extensive crash and combat damage repairs, major modifications, and similar work on whole aircraft.

Maintenance
Organization

The Conventional concept, as indicated, is typified by Corps Support DS Companies supporting separate aircraft operating units, and by Division DS Companies supporting Division aircraft operating units.

In the ROAD Infantry Division, Direct Support maintenance is accomplished by the Transportation Aircraft Maintenance Company of the Maintenance Battalion organized under TOE 55-89E. This Company has less than the capability of the standard Corps level DS Company and requires backup DS capability for its peak loads, in addition to General Support backup.

Supply

The supply function in the Infantry Division is principally limited to its own maintenance operations and assistance on emergency supply requirements of supported units. It has no authorization for a shop supply element and normally is authorized to maintain only a 3-day stockage level for its own maintenance requirements. Its main support platoon requisitions stock and processes aircraft items required for the DS maintenance function. In Vietnam, the standard organization has been augmented, at least in one Division with a supply platoon which performs a DS supply function similar to that of the backup Direct Support Company.

THE AIRMOBILE DIVISION MAINTENANCE CONCEPT

The Airmobile concept is similar to the Conventional concept in many respects. However, only major differences will be emphasized in this discussion.

Maintenance Concept

As with the Conventional concept, three levels of maintenance are included in the Airmobile Division concept. However, the extent of work accomplished at each level differs. The Airmobile concept requires that the Division, including its maintenance units, have a capability for rapid deployment through the use of Army aircraft. To insure this, maintenance capability and functions performed at Organizational maintenance level are less than under the Conventional concept. Aircraft requiring maintenance which require downtime beyond approximately twenty four hours (except periodic inspections), is passed to the DS unit to accomplish.^{1/} Tools and equipment provided are light-weight and limited to the extent of maintenance to be accomplished. Maintenance personnel are assigned in fewer numbers than in Conventional units, as will be discussed later.

^{1/} The "four-hour rule" was used as the guideline for evacuating Organizational maintenance to DS level in the 11th Air Assault Division Tests. Long-term observation of the 1st Cavalry in Vietnam suggests that the "four-hour rule" has been replaced by a "twenty-four-hour rule". Therefore, despite the admixture of Conventional concepts, there are real differences in the way the concept is implemented and hence, the 1st Cavalry Airmobile experience is considered separately in this study.

Scheduled inspection requirements have been modified under the Airmobile concept, with four rather than three inspections required. The daily and intermediate inspections correspond closely to the conventional concept. Periodic inspections, however, have been modified to provide for a somewhat lesser requirement at 100-hour intervals than under the Conventional concept. At 300-hour intervals, however, a thorough searching inspection is performed. The daily, intermediate, and 100-hour periodic inspections are performed at Organizational level. The 300-hour periodic inspection is performed at DS level.

Thus, Organizational level maintenance work performed under the Airmobile concept is less than under the Conventional. Air mobility is a primary objective and is attained by insuring that tools, equipment, personnel, and unserviceable aircraft in the operating unit are kept at a minimum. Work is confined almost exclusively to whole aircraft. Organizational level units are authorized a relatively lower ratio of mechanics to aircraft.

At the Organizational level, maintenance is limited to the performance of light preventive maintenance services, such as:

1. Lubrication
2. Cleaning
3. Securing loose nuts, bolts, screws
4. Replacement of easily replaced parts and assemblies
5. Minor repairs requiring, for the most part, light hand tools
6. Relatively simple adjustments and calibrations.

Although periodic inspections are performed at the Organizational level, considerable dependence is placed on the performance of a high percentage of periodic inspection at the DS level to assure quality control and to clean up deferred maintenance items.

In actual operations in Vietnam, the DS function in the Airmobile Division is accomplished by the Transportation Aircraft Maintenance and Supply Battalion consisting of four companies with a total strength of 1,428 men, as compared with the 181 men in an infantry division aircraft maintenance company. This Battalion is organized under TOEs 55-405T, -406T, and -407T; and is authorized the capability to accomplish 85 percent of the entire DS function, including the DS supply activity. Additionally, as compared with other Direct Support Field Maintenance organizations, it relieves the supported units of a greater amount of what is normally considered the Organizational maintenance load. This permits the supported elements to maintain the higher degree of air mobility as required under the Airmobile concept.

Under current SOPs, the Division DS Companies perform every third (or 300-hour) periodic inspection on supported aircraft. These companies are not authorized the heavier equipment provided the backup DS companies. In accordance with Airmobile concepts, they use only lighter equipment which is transportable by Army aircraft. Nevertheless, a review of recent workloads disclosed no significant passing of requirements to Corps level DS companies. Visits to the Airmobile Division indicated

that the companies of the 1st Cavalry Division have acquired additional equipment beyond that authorized in the TOE. Since the Division's base camp has remained static for the last two years, the use of any acquired heavier non-TOE equipment would appear to be practical and desirable. Additionally, with the 610th GS Company in immediate support, some of the heavier requirements that might otherwise go to a backup DS company can be accomplished there.

GS units under the Airmobile concept operate essentially in the same way as under the Conventional concept.

Maintenance
Organization

The four Divisional DS Companies are authorized a total of 20 DS sections. These sections provide teams to accompany supported units into the field. They perform all possible DS maintenance in the operational area to reduce the downtime which evacuation back to the DS company area would occasion. Working with the supported units' maintenance personnel and crew chiefs, the teams increase the readiness posture of the supported units with quicker turnaround. They also considerably reduce the overall support man-hours required to accomplish a given amount of field maintenance.

Although the four companies of the division are all similarly organized under TOE 55-407T, in practice they have specialized to a large degree by aircraft type by virtue of their support assignments. Company A almost exclusively maintains CH-47 and OV-1 aircraft. Companies B and C are primarily concerned with UH-1 Helicopters, while Company D performs most of its maintenance functions in support of observation helicopters. In addition to the four companies, the radar repair section, authorized in the Headquarters Company under TOE 55-406T, is used in support of the surveillance equipment of OV-1 aircraft. Mission assignments of the four companies as of 26 July 1967 were as follows:

Company A 15th TC Bn (AM&S)

228th ASHB (CH-47A only)
1st Avn Detachment
11th GS Company (OV-1 and U-6 only)
E/82nd Artillery (O-1 only)
382nd Trans Det (Tech Supply only)

Company B 15th TC Bn (AM&S)

229th AHB
11th GS Company (except OV-1 and U-6)
E/82nd Artillery (except O-1)
15th Medical Battalion

Company C 15th TC (AM&S)

227th AHB
2/20th Artillery
HHC 15th TC Bn
3rd Brigade
Support Command
Company A 15th TC Bn

Company D 15th TC Bn (AM&S)

1st Sqdn/9th Cavalry
1st Brigade
2nd Brigade
228th ASHB (except CH-47A)

THE DS DETACHMENT MAINTENANCE CONCEPT

Maintenance
Concept

Under this concept, the units' organization and functional allocation are essentially those described for the Conventional Maintenance Concept. The principal difference is that the DS Detachment is permanently assigned to the supported company and physically accompanies it in the field. This avoids any requirement for the evacuation of aircraft to the DS Maintenance unit, or any conflict of priorities for use of its capabilities. These detachments are employed with the various companies of the 1st Aviation Brigade. The O-1 and U-1 companies supported under the Detachment concept are not specifically discussed in this study since the analysis of other companies covered the bulk of the Brigade aircraft and involved the same concepts. The discussion here concerns itself with the UH-1 and CH-47 companies. The Aerial Surveillance Company (OV-1) is discussed separately.

DS Detachments can, in general, accomplish most of the types of maintenance the Company performs, limited only by time, manpower, and some items of test equipment. Thus, the DS Detachment workload consists of the following principal functions:

1. Major component replacement
2. Airframe repairs

3. MWO accomplishment
4. Major scheduled inspection assistance
5. Designated special inspections
6. Minor component repair.

Extensive airframe work, work requiring diagnostic testing equipment (zyglo, magnaflux), and overflow work of other types is evacuated to the DS Company.

Under this concept, the operating unit has within its immediate area a complete Organizational maintenance capability augmented by a capability for accomplishment of most DS maintenance required.

GS maintenance, under this concept, is identical to that described under the Conventional concept.

Maintenance
Organization

In actual operations in Vietnam, the DS Detachment supporting UH-1 companies is basically as authorized under TOE 55-500R, W/C 10 with a strength of 72. The CH-47 DS Detachment is organized in accordance with the AB Team of TOE 55-510T with a strength of 82. In practice, these TOEs have been variously modified both by the Theater and their previous CONUS home stations. As under the Conventional Maintenance concept, the DS Detachments require backup DS maintenance from their Corps DS companies amounting to approximately 10 percent of the DS workload. These detachments have overall DS capability limited only by time, manpower, and some items of test equipment, particularly diagnostic, non-destructive testing equipment such as zyglo and magnaflux.

The quantity of maintenance workload returned by these detachments to their backup DS companies is not only controlled by the level of work required, but is also a function of the amount of workload placed on them by the supported company. During a period when the supported unit is involved in large scale operations with severe hostile action, there will be a substantial increase in work orders back to the DS Companies for repair of crash and combat damages, particularly when there is a heavy requirement for sheet metal repairs and replacement of airplane structural components. In those cases where most of the repair function could be accomplished by component replacement, the work is accomplished at the detachment level.

Organizationally, all reported information indicates that the detachment commander is under the effective command control of the supported company commander. In all cases, the detachments are co-located with the company and dependent on it for administrative support for messing, security, vehicle maintenance, housing, and most of their organizational supply and administrative support. Some detachments maintain their organizational integrity and operate a completely separate maintenance function, whereas others are completely integrated with the company, the detachment commander acting as the company's maintenance officer. This high level of integration certainly enhances responsiveness at the Organizational level, although there is the possibility of less intensive technical maintenance supervision from higher echelons.

In this area of technical supervision, it is particularly significant to note that the command channels for these detachments pass through operating companies, battalions, and groups to an operational brigade. These do not have authorized staff sections which specialize in aircraft field maintenance support.

Obvious benefits resulting from this integration include mission orientation and responsiveness to the operating requirements, specialization in one type and model of aircraft, intimate knowledge of the specific aircraft and crews, and immediate accessibility of the aircraft in the unit area. In units checked, almost all of the aircraft (by serial numbers) remained assigned to the units until replaced by attrition or, in a few cases, by exchange for a later series aircraft. This provided for both a continuity of familiarity with the peculiarities of specific aircraft and a continuing responsibility for these aircraft.

• FIELD MAINTENANCE IN THE AERIAL SURVEILLANCE COMPANY

Field maintenance in the two Corps Aerial Surveillance Companies in Vietnam is accomplished under the Detachment Maintenance concept, but the distinct difference in the workloading warrants a separate discussion.

Operationally, the Aerial Surveillance Companies are organized under the provisions of MTOE 1-128T. In addition, they are

augmented by the JE Team of MTOE 55-500E and the RX and RL Teams authorized by MTOE 11-500D. These teams provide for the field maintenance support of aircraft, avionics, and the infrared and radar surveillance systems. These teams are variously supplemented by civilian technical representatives and technicians.

A check of the workload of DS and GS units behind these companies disclosed that only a few items were repaired, such as some servos and one aileron. A check of supporting ASLs disclosed only two or three items, such as hydraulic seals peculiar to the OV-1 Mohawk. The only other DS and GS maintenance requests for OV-1s were for the accomplishment of inbound servicing, transfer inspections, and outbound preparation of aircraft for CONUS depot repair.

In view of the foregoing, the maintenance support of the Aerial Surveillance Companies will not be discussed in the portions of this study dealing with workload distribution or comparative workloads.

CHAPTER 3

CHAPTER 3

EVALUATION PARAMETERS AND METHODOLOGY

An optimum maintenance organization provides the commander with the aircraft he needs in a timely manner, and does so with the minimum resources requirement consistent with meeting the mission objective. Accordingly, the APJ approach to this problem consists of studying the results obtained in terms of readiness and utilization versus the resources implications in terms of personnel, equipment, and parts.

This produces an effectiveness and cost study in which the respective decision factors are set forth in physical, rather than dollar terms. The results can, of course, be translated into dollar terms but it is clearly essential to assess the factors both of effectiveness and cost in physical terms.

Finally, it is necessary to consider the substantive content of maintenance operations to insure the soundness of the findings and recommendations. Accordingly, this is the third aspect of evaluation.

CAPABILITIES OF MAINTENANCE UNITS

The relative capabilities of the maintenance units and elements were evaluated in terms of the maintenance support workload actually experienced in Vietnam operations. To compare capabilities and costs across units supporting different aircraft, it was necessary to develop a method for comparing the support workload generated. To relate these

diverse equipments, the method had to provide for using a common denominator in quantifying the workloads. For this purpose (and for use only in this study), the concept of maintenance equivalents (with some variation in the details of its development) was applied to each TMS, each echelon of maintenance, and each maintenance concept.

In the application of the maintenance equivalent concept, the first step was to develop the man-hour per flying hour rate by maintenance echelon for each TMS of aircraft from an analysis of data from the APJ data bank sample studies. The next step consisted of a further refinement of the analysis to develop the portion of the work accomplished at each echelon for the UH-1 and the CH-47 helicopters for use in this study. These ratios were further differentiated by the several concepts used. The flying hours were then obtained from the DA Form 1352 Reports for sample units of the various types under consideration. Applying the maintenance man-hours per flying hour by TMS and using the ratios developed on distribution of the work between echelons, maintenance equivalents were established for the aircraft supported by each maintenance element. These included multiple factors for the back-up DS companies which supported aircraft under more than one concept. The maintenance equivalents as established based on Vietnam experience are set forth in Figure 3-1.

As seen in Figure 3-1, the total maintenance for the high density UH-1D is used as the basic unit. It is noted that this application of the maintenance equivalent factor concept represents a departure from the more

TMS	DISTRIBUTION OF MAINTENANCE				DISTRIBUTION OF DS BY CONCEPT					
					Detachment			ROAD		
					DS Det	Backup DS Co	DS Co	Backup DS Co	DS Co	Backup DS Co
O-1	0.28	0.20	0.02	0.50	0.18	0.02	-	-	0.20	-
OV-1**	0.38	0.35	0.07	0.80	0.35	-	0.35	-	0.35	-
U-6	0.19	0.11	0.04	0.34	0.10	0.01	-	-	-	-
U-8	0.70	0.24	0.01	0.95	-	-	-	-	-	-
U-1	0.74	0.25	0.12	1.11	0.23	0.02	-	-	-	-
OH-13	0.28	0.28	0.12	0.68	-	-	0.26	0.02	0.28	-
OH-23	0.24	0.20	0.08	0.51	-	-	0.19	0.01	-	-
UH-1B/C	0.42	0.32	0.02	0.76	0.29	0.03	0.26	0.06	0.32	-
UH-1D	0.58	0.36	0.06	1.00*	0.32	0.04	0.30	0.06	0.36	-
CH-47	2.31	0.63	0.05	2.99	0.61	0.02	-	-	0.63	-

*223.5 man-hours per month is basis for unity

**Excludes avionics

Figure 3-1. Maintenance Equivalents for Types of Aircraft Supported

common usage of applying it within each echelon of maintenance, independently. In this application, the concept is applied in a three-dimensional matrix, so that the capabilities of DS can be measured on an equivalent basis with Organizational and GS maintenance. In this way, workload measurements and redistributions can be equated across echelons with no conversion factors.

The relatively high factor resulting for the OH-13 is produced primarily by the mission profile of the aircraft. This profile operates the aircraft a larger percent of the time at the upper limits of its flight envelope and concurrent exposure to considerable hostile action. At the GS and DS levels, these aircraft generate heavy workloads on extensive repair of combat and crash damage which, on other types, would be accomplished in CONUS depots after evacuation. It is expected that this will continue in view of the large requirements for these observation helicopters, necessitating their repair and return to service to the maximum extent feasible. No valid data has been developed to predict the extent to which the OH-6 will generate a similar workload as it phases in to replace the OH-13.

The high factor on the U-1 is a function of its relatively high flying hour performance and recent avionics modification. However, fluctuations in its rate of maintenance generated will average out for the purposes of this study with some of the other low density types and its overall impact is not considered significant.

In the final analysis, it is considered reasonable that the quantitative capability of maintenance units can be expressed as the relative number of maintenance equivalents that they support.

Qualitative capabilities will be discussed in more detail in succeeding sections of this Report in terms of equipment and MOS skills authorized in the TOE, as modified, and the supply levels authorized in ASLs and PLLs.

EFFECTIVENESS

Two principal measures of effectiveness in this study were the readiness rates of aircraft systems (percentage of their assigned time during which they are mission ready) and the utilization rates (in flying hours flown per month). These data were obtained from DA Form 1352. They are presented in Chapter 5 of this Report on a monthly basis differentiated by concept for UH-1, OV-1, and CH-47 for one year ending 31 May 1967.

In the comparative evaluation of the three concepts, it was necessary to look beyond the overall readiness rates to the NORS and NORM rates. By normalizing NORS rates, the causes of the NORM rates can be evaluated and compared directly. This approach to the determination of effectiveness provides a matrix of relationships which can establish the differences among the three concepts. In addition, it can also provide for detailed investigation of the underlying reasons for the differences in rates.

The aircraft operating under each of the three concepts have essentially similar missions, permitting a valid comparison of utilization and readiness rates. Consequently, the analysis of utilization provides a useful check on readiness comparison among the various concepts. Accordingly, that concept is best which pays dividends in both utilization and readiness or which attains higher readiness for the same level of utilization.

RESPONSIVENESS

Responsiveness can reasonably be considered as a concomitant of effectiveness. However, for the purpose of this evaluation, responsiveness is separately analyzed as the reaction time of the support element or, in other words, the turnaround time of aircraft for repair, inspection, or other maintenance actions.

In establishing the parameters for this analysis, items 23-27 of DA Form 2407 were used and equivalent entries from DA Forms 2405, i.e., Date Submitted, Date Received, Date Started, Date Inspected, and Date Accepted. Determining the differences in these dates, the total turnaround time of aircraft in and out of DS maintenance was established. Additionally, a breakout can be derived to show the length of time aircraft are awaiting entry into the shop and the time spent in the shop. For purposes

of this evaluation, histograms were established on the distributions of days involved in each of these parts of the maintenance cycle, and are shown in Chapter 6 of this study as percentages of the distribution by numbers of days and the average number of days that aircraft are in work. This provides for a reaction time comparison among the three concepts under study. Obviously, this element of responsiveness cannot be taken out of context since it does not establish the quality nor the degree of maintenance performed; these, in the final analysis, are more the function of readiness and utilization. However, from the commander's viewpoint, this evaluation reflects the adequacy of the supporting unit to satisfy established requirements for maintenance and return to service of an end item.

WORKLOAD DISTRIBUTION

A major problem in this portion of the analysis lies in the fact that neither the Detachment nor the ROAD Division Maintenance Company does all of the DS maintenance required by its supported units. Both of these maintenance elements evacuate certain of their maintenance to backup DS companies in addition to that which goes to the backup GS Companies. Accordingly, for this purpose, it is necessary to ascertain the percentage of work distributed to the supporting DS maintenance organization as previously discussed. This distribution is needed to establish the maintenance equivalents supported, and to cost out the investment in equipment parts and personnel.

The distribution of workload by types of work performed at the various levels is also required. This is needed to evaluate the qualitative capabilities of a maintenance organization and to establish ultimate requirements under the experienced operating conditions for MOS skills and specific types of maintenance equipment. This information is required to appraise the stratification of workloads by echelon of maintenance organization.

This analysis required an individual study of each DA Form 2407 in the samples used to break out the work reported into skill areas quantified by the man-hours charged thereto. For this analysis, the time charged on the given DA Form 2407 was broken out by man-hours for replacement of major components, airframe repairs, inspection, MWO accomplishment, avionics, armament, and other work on aircraft parts and components. This information can then be interpreted to establish requirements for these workloads in the various skill areas. These results are set forth in Chapter 7 of this Report.

SUPPLY PERFORMANCE

Supply performance effectivity was analyzed in this study using NORS rates, times to fill for EDP requisitions, and the utilization of ASLs and PLLs to include percentages of zero balances, supply accommodation from the ASL, and supply response from the ASL.

The NORS rates, as previously mentioned, are those reported in the DA Form 1352 report. ASIs and PILs were evaluated from a review of the actual documents and from supply performance reports for the organizations concerned. For these purposes, supply performance reports were reviewed for 24 DS Detachments, the two Aerial Surveillance Companies, seven DS Companies, one Infantry Division, one GS Company, and the four DS Companies of the 1st Cavalry Division (Airmobile). Further analyses included relating the number of line items on the ASIs of various units within one type of maintenance group to the NORS rates for these units. Additionally, the number of line items on a DS ASI were related to the number of maintenance equivalent aircraft supported to establish relative investment and management cost. The results of this evaluation are set forth in Chapter 8 of this Report.

RELATIVE INVESTMENT AND PERSONNEL REQUIREMENTS

In developing the relative investment cost of equipment for several types of units, the first step was to cost out the high cost items individually. The nomenclature and line item number were extracted from the pertinent TOE. For those TOEs using the old 6-digit line item numbers, the conversion was made to the new line item numbers. These items then were costed according to SP 700-20 to the extent that they were listed and cost given. For the items not so listed, prices were obtained from other supply catalogues and manuals and from National Inventory Control Points. A sampling technique was used for items of low cost. For purposes

of comparison, the total cost for the various units were allocated to the number of maintenance equivalents which they support.

In establishing the relative cost of parts stockage, the number of line items on the respective ASL or PLL were used. These line items were broken down into aircraft parts, avionics, and armament. To accomplish a comparative evaluation among the various maintenance concepts, the number of line items were related to NORS rates, demand satisfaction (percentage of requests filled from the ASL), and number of EDPs processed.

Personnel requirements were developed in this study from the latest modified TOE, and broken down into direct, indirect, and overhead to establish relationships among these groups.

For further comparison among the concepts and the units involved, the number of direct workers and total personnel were related to the number of maintenance equivalents supported. Direct workers were totaled on a one-for-one basis except for crew chiefs identifiable with utility and cargo helicopters (other than medical detachment). These were counted at a ratio of 50 percent based on observation and reports indicating that these crew chiefs spend considerable time airborne where they can accomplish little, if any, maintenance and, in many cases, additionally function as door gunners.

CHAPTER 4

CHAPTER 4

COMPARISON OF SPECIALIZED RESOURCES AND CAPABILITIES IN MAINTENANCE UNITS

The first investigation in depth was the comparison of resources available to DS units as they are organized in TOEs of the various maintenance concepts. Past experience with operational organizations in Vietnam indicated that the units are usually fully staffed, although not necessarily in the proper grade nor used in the prescribed MOS spaces. This point will be further discussed below.

Included in this analysis was an evaluation of MOS skills and equipment authorizations among the three major DS maintenance concepts studied.

MOS SKILL COMPARISONS

A direct comparison of the number of productive labor personnel spaces made available in each maintenance concept is adequate for general management analyses, but not for detailed evaluation of the capability of the units. Therefore, this analysis consisted of a detailed review of the Tables of Organizations and Equipment under which typical units presently in operation in Vietnam were organized and authorized spaces. The MOS spaces have been identified by broad categories and, within each, further detailed as to whether the spaces pertain to maintenance personnel (wrench-turning), an inspector or a supervisor. In addition, the supply personnel have been identified to assess their capability to support the

maintenance function. No attempt was made to review the supply functions within the units which are required for their self-support.

MOS
Categories

The primary categories used in this investigation include the following:

1. 26 Series - Radar and Microwave Maintenance
2. 34G Series - Fire Control Computer Repairmen
3. 35 Series - Electrical/Electronic Devices Maintenance
4. 41 Series - Precision Devices
5. 44 Series - Metal Working (welders, and machinists)
6. 45 Series - Armament Maintenance
7. 67 Series - Aircraft Maintenance
8. 68 Series - Aircraft Components Repair.

Each of the respective unit TOEs investigated were reviewed. These included (under the DS Detachment concept), the UH-1 DS Detachment (55-500R, W/C 10); CH-47 DS Detachment, (TOE 55-510T); and the OV-1 DS Detachment (TOE 11-500D and TOE 55-500E).

The DS Company, organized under the Conventional ROAD Division, uses TOE 55-89E, while the Airmobile DS Company is organized under TOE 55-507T. The DS capability of the Airmobile Division also includes a Radio and Radar Repair unit organized under TOE 55-406T. The Corps DS Companies used in the backup of Divisional units are organized under TOE 55-457E.

For comparative purposes, the GS backup has also been included in the analysis, organized under TOE 55-458E.

The complete detailed listing of all MOSs selected in this study effort is given in Annex B to this Report. However, Figure 4-1 presents a consolidation of this information, relating the number of spaces in each of the MOS groups to each type of DS maintenance unit being considered. The MOS categories are further broken out into inspectors, supervisors and all others, as discussed above.

Significant Differences

The following significant points of differences among the respective concepts may be noted. In the three Detachments, the total number of aircraft mechanics (aircraft and aircraft components), is approximately equal, the OV-1 with a total of 37, the UH-1 with 54, and the CH-47 with 55. The predominant difference lies in the avionics and electronics maintenance personnel. It will be noted the OV-1 has an additional 21 spaces in the Signal Detachment (TOE 11-500E). The CH-47 Detachment provides four additional electrical/electronic devices maintenance spaces.

A review of the staffing of the DS Companies under the ROAD and Corps Backup concepts reveals that there are few significant differences. The primary difference is in the number of armament maintenance personnel, (nine in the Corps Backup shop as opposed to only one in the ROAD), while the ROAD concept provides for additional aircraft maintenance personnel. However, a comparison of these two concepts with the Airmobile concept shows that the Airmobile Division has approximately 50 percent more personnel en toto. This is primarily due to

Authorized Personnel	OV-1 DS Det 11-500D 55-500E	CH-1 DS Det 55-500R	CH-47 DS Det 55-510T	ROAD DS Co 55-89E	Airmobile DS Co 55-407T	Avionics Repair Section 55-406T	Corps DS Co 55-457E	GS Co 55-458E
Radar & Microwave Maintenance								
MOS 26 - Mech	14	-	-	1	-	7	-	8
26 - Insp	-	-	-	-	-	2	-	-
Total	14			1		9		8
FC Computer Rpr								
MOS 34G	1	-	-	-	-	-	-	-
Elec & Electronic Devices Maintenance								
MOS 35 - Mech	5	-	4	4	12	-	6	12
35 - Insp	-	-	-	-	-	-	1	2
35 - Spv	1	-	-	-	1	-	-	2
Total	6		4	4	13		7	16
Precision Devices								
MOS 41 - All Mech	3	-	-	1	-	5	-	2
Metall Working								
MOS 44 - All Mech	1	1	1	2	2	-	2	3

Figure 4-1. Maintenance Function MOS Authorizations - DS & GS Units
(Continued on Next Page)

Authorized Personnel	CV-1 DS Det 11-500D 55-500E	UH-1 DS Det 55-500R	CH-47 DS Det 55-510T	ROAD DS Co 55-89E	Airmobile DS Co 55-407T	Avionics Repair Section 55-406T	Corps DS Co 55-457E	GS Co 55-458E
Armament								
MOS 45 - Mech	-	1	-	1	4	-	8	7
45 - Spv	-	-	-	-	-	-	1	1
Total		1		1	4		9	8
Aircraft Maintenance								
MOS 67 - Mech	15	31	26	75	85	-	53	62
67 - Insp	2	2	2	4	16	4	12	4
67 - Spv	2	3	5	9	16	-	5	8
Total	19	36	33	88	117	4	70	74
Aircraft Comp Rpr								
MOS 68G (Airfr Rpr)	4	6	6	14	25	-	18	22
68 - Mech(Less 68G)	15	15	18	31	54	-	35	65
68 - Insp	-	-	-	-	-	-	-	2
Total	19	21	24	45	79		53	89
Totals	63	59	62	142	215	18	141	200

Figure 4-1. Maintenance Function MOS Authorizations - DS & GS Units
(Concluded)

the large number of the more sophisticated aircraft that are supported by the Airmobile Division compared to the ROAD and Corps Back-up units.

It is even more significant to develop the comparison between the DS Detachment concept and the Airmobile concept. In general, each DS Detachment, with about 55 maintenance associated personnel, supports one operating company of approximately 25 aircraft. The Airmobile Division, with a total population of over 400 aircraft, has four DS maintenance companies. Thus, each DS Company supports approximately 100 aircraft, with 215 maintenance associated personnel. In general, the distribution of MOS spaces between the Detachment and the Airmobile concept is closely similar. The majority of MOS spaces are in the aircraft and aircraft components maintenance area, with adequate provision for electronics, armament, and other skill areas.

The GS Company used in the backup of all DS has a composition not unlike that of the Airmobile Division DS Company, including, as will be shown later, the skill levels indicated by the personnel grades. These skill areas are illustrated in Figure 4-2.

Maintenance
Personnel
Grades

In the review of grades for maintenance personnel in each of the organizations, it is noted that the DS Detachments have grades 4 and 5 predominantly, with very few in the higher grades. On the other hand, the DS companies, and in particular the GS Company, have a very significant number of E6s and E7s.

	E1	E2	E3	E4	E5	E6	E7	E8
OV-1 Det								
11-500D Signal Service Org	-	-	-	-	21	1	-	-
55-500E DS Detachment	-	-	7	14	16	2	1	1
UH-1 Detachment 55-500R	-	-	12	22	20	3	1	1
CH-47 Detachment 55-510T	-	-	8	27	24	2	1	-
Airmobile 55-407T DS Co	-	-	25	78	81	26	4	1
55-406T Avionics Repair Section	-	-	-	3	9	6	-	-
ROAD DS Co 55-89E	-	-	19	58	52	12	1	-
Corps DS Co 55-457E	-	-	21	53	48	15	4	-
GS Co 55-458E	-	-	27	71	82	15	5	-

Figure 4-2. Distribution of Maintenance Personnel
by Grade for MOS's 67---, 68---,
44---, 35---, 41---, 26---

A careful review of the MOS structures in Figure 4-1 will indicate the primary reason for the lack of higher grades in the Detachment. It will be noted that the Detachments are provided very few inspectors and supervisory personnel, the organizations depending primarily on the parent unit to which they are satellited for this service.

The lack of inspector and supervisory personnel in the Detachments is not necessarily advantageous. In many instances, field results have indicated that there is a critical shortage of tech inspectors at these units, and very often aircraft await the availability of the inspector after completion of the work. Of course, supervisory personnel provided by the parent organization should be adequate. This is not the case for tech inspectors.

Therefore, it might be stated that the Detachments were provided adequate maintenance functional capability in comparison with the full-sized DS Companies, particularly with the Airmobile Division concept.

However, the relative effect of this distribution of personnel depends completely upon the nature of the workload which they assume for themselves, and that which they forward to the backup DS Companies. Chapter 7 of this Report is a detailed investigation of the distribution of the workload among the various levels of maintenance concept and their backup, in both the DS and GS areas.

Supply
Support

The last investigation in MOS categories was in the differences in supply support being provided the various DS units. Figure 4-3 represents the results of this evaluation.

In the analysis of the supply support provided each of the units, consideration was given, not only to the MOS category for the general supply personnel (76 series), but also to parallel functions which might be performed in the larger-sized units by specialized MOSs, but would ordinarily be expected of supply personnel in the smaller units. Thus, each TOE was reviewed to establish the total shop support personnel being provided and, as appropriate, subdivided into Shop Supply, Storage and Issue, Parts Requisition and Records, and the Supply Platoon Headquarters. It will be noted that supply personnel in the three Detachments were included under Shop Supply. However, the personnel spaces in the TOEs were assigned within the Detachment as supply clerks who are expected to provide the necessary services for Requisitioning, Recording, Storage and Issue, including the appropriate administrative requirements carried in parallel by the Detachment administrative personnel.

The Conventional maintenance DS concept, applicable to the ROAD DS Company, provides supply personnel in a Shop Supply Section. However, as set forth in the TOEs, the basic ROAD DS company does not, in itself, contain a supply function. This is provided by a consolidated supply activity operated by the maintenance and support battalion. It should be pointed out, however, that one

	Total Shop Support Personnel	Shop Supply	Storage & Issue	Parts Req & Records	Supply Platoon Hqs
OV-1 DS Det 11-500D 55-500E	7	7	-	-	-
UH-1 DS Det 55-500R	4	4	-	-	-
CH-47 DS Det 55-510T	8	8	-	-	-
ROAD DS Co 55-89E 55-89G*	4 18	4 9	- 9	- -	- -
Airmobile DS Co 55-407T**	43	11	14	15	3
Corps DS Co 55-457E	28	6	11	-	11
GS Co 55-458E	14	14	-	-	-

*MTOE 55-89G under which a Vietnam ROAD Division aircraft maintenance company is now organized
 **Includes 4 men from Bn Aircraft Supply Section

Figure 4-3. Supply Support Personnel

of the Divisions organized and operating in Vietnam at the present time, has divorced the aviation supply function from the consolidated supply, and established an Aviation Supply Support activity within the DS Company. Organized under MTOE 55-89G, a total of 18 personnel are assigned to this section, nine in Shop Supply and nine in Storage and Issue. This more closely approximates the level of supply support required in this Divisional unit.

The Airmobile Division, with its four DS Companies organized under an Aviation Support Battalion, has a more sophisticated support section. Each of the DS Companies has seven men in Shop Supply, 14 men in Storage and Issue, 15 men in Parts Requisitioning and Records Section, and three in Supply Platoon Headquarters. In addition, 16 men are provided at the Battalion Supply level directly associated with aviation support, an average of four men per DS Company. This provides a total of 43 supply support personnel for each DS Company organized under the Airmobile concept.

The Corps Backup DS Company has a total of 28 supply support personnel. Six are assigned to a Shop Supply Section, 11 in Storage and Issue and 11 in the Supply Platoon Headquarters. Although the number assigned to the Headquarters appears to be excessive in comparison to the total platoon, many of the functions that are ordinarily performed in the Parts Requisitioning and Record section of the Airmobile concept are performed by the Platoon Headquarters personnel.

In comparison, the GS Company is authorized 14 spaces in the Supply Support in a Shop Supply Section.

Many of the personnel within the units investigated do not necessarily carry 76 series MOSs. Forklift operators, packaging clerks, requisitioning specialists, key punch operators, etc., are included in the more sophisticated supply support activities due to the volume of work involved. The 15th TC (AM&S) Bn. for example, receives approximately 16 to 18 tons of spare parts daily and retrogrades approximately 7 to 9 tons daily. However, these same functions must be performed by the Shop Supply Sections in the smaller units not provided the same degree of sophistication in organization due to the relatively low workload in their maintenance facilities.

On this basis, the true comparison should be made in the total shop support personnel provided each of the maintenance units. The Airmobile concept DS Company, with its total of 43 personnel, has the largest number. The Corps Backup DS Company and the Conventional Maintenance DS Company fall into a secondary level, with a range from 18 to 28 personnel in supply support. The three Detachments are provided the smallest number of supply support personnel, seven for the OV-1, eight for the CH-47, and four for the UH-1. However, it must again be reiterated that the Detachment will, in most cases, receive the support of the parent unit on which it is satellited to supplement its functional requirements in supply support. In many instances, in actual operations in Vietnam, the Detachment personnel were merged with the Organizational units, supplementing

the Organizational units to a level for which they can provide the necessary support. However, due to the relative proportion of the workload that is performed by the Detachments, a reassessment of the total number of spaces required might be necessary.

The primary criteria to be used in assessment of the adequacy of the supply personnel spaces are the volume of supply handled and the frequency with which requisitions must be placed in order to provide parts for maintenance personnel. As will be pointed out later in this Report, the Detachments are serving a function of rapid aircraft turnaround, with the primary effort concentrated in the remove and replace effort rather than repair and return to use. On this basis, it might be anticipated that the relative number of requisitions to be supported by the supply personnel would be high in comparison to those DS activities which support a repair function. This analysis of the distribution of type of work is covered in Chapter 7 of this Report.

EQUIPMENT - MAINTENANCE ITEMS

A detailed investigation of the maintenance items associated with the support of aircraft is included in Annex B of this Report. In this investigation, the complete Tables of Equipment for every maintenance unit investigated were reviewed and all equipment associated with the maintenance function of the aircraft identified. Furthermore, each of these lines were then

related to a particular categorization of equipment in the following sets:

- A Analyzers
- B Helicopters
- C Shelters
- D Shop Sets
- E Generators - Signal
- F Maintenance Tool Sets & Kits
- G Test Sets
- H Simulators.

The equipment carried in the Tables of Equipment were grouped in accordance with- in the above structure and summarized in numerical quantities of maintenance items in Figure 4-4.

No attempt was made to distinguish the differences between various types of items that fall within these major categories. The primary purpose was to investigate the variation in the types of equipment to obtain an indication of the major maintenance functions to which these units could be applied.

From the data presented in Figure 4-4, the type of work and the extent to which these units are capable of completing a task of aircraft maintenance support becomes apparent. The CH-47 and OV-1 Detachments, with their analyzers, signal generators, test sets and simulators are quite capable of sophisticated component tests, check out and repair. On the other hand, the UH-1 DS Detachment with tool sets, shop sets, and a few test sets are limited to the primary functions of removal, minor test and check out (depending on the equipment in the shop sets), and the replacement of components which have been isolated as problem areas.

	Analyzers A	Helicop- ters B	Shelters C	Shop Sets D	Gener- ators Signal E	Maint Tool Sets & Kits F	Test Sets G	Simulators H
OV-1 DS Det								
11-500D	2	-	-	5	14	17	49	3
55-500E	-	-	-	8	-	-	39	-
CH-47 DS Det								
55-510T	2	-	-	12	16	49	27	2
UH-1 DS Det								
55-500R	-	-	-	7	-	-	17	-
Airmobile DS Co								
55-406T	2	1	8	36	19	18	65	2
55-407T	5	2	17	86	14	222	87	7
ROAD DS Co								
55-89E	2	2	-	10	18	121	25	-
Corps DS Co								
55-457T	-	2	-	55	21	129	52	-
GS Co								
55-458E	20	2	-	25	46	125	146	10

Figure 4-4. Direct Support - Major Maintenance
Significant Items Summary

The DS Companies, on the other hand, are well equipped for major types of component repair, rebuild, check out, etc. The degree to which the equipment is used, of course, will depend on the distribution of workload between the Divisional units and the Backup DS Companies. It will also depend, to a large degree, on the extent to which the GS Company is used within the context of its application to the support of Army aviation.

As will be shown later in this Report, the Airmobile Division is independent of almost all, except a very small element, of GS maintenance. This is illustrated by the extent to which this DS Company has been provided sophisticated test and check out equipment, tool sets, etc. The Corps Backup DS Company is not too far from the Airmobile DS Company with regard to allocation of sophisticated equipment, e.g., signal generators, maintenance kits, test sets, etc. Considering the fact that the Corps Backup DS Company is to be used in the support of both Divisional and non-Divisional aircraft, its capabilities are quite apparent.

The ROAD DS Company capabilities are not too different from the Corps DS Company, with a slightly smaller quantity scale. The GS Company, on the other hand, is very heavily oriented to the more complex maintenance equipment because it handles both component repair and airframe work. With a total of 20 analyzers, 46 signal generators, 146 test sets, and miscellaneous other items, the GS Company has an extremely well rounded capability.

This review, of course, cannot be considered out of context with the overall maintenance function as it is applied in actual operations in Vietnam. Therefore, the real significance of the distribution of maintenance equipment among the concepts studied cannot be assessed without further investigation into the actual investment cost in equipment, the workload distribution, and the maintenance functions performed by each of the units organized under these concepts. These additional areas of investigation are covered below.

CHAPTER 5

CHAPTER 5

EVALUATION OF OPERATIONAL EFFECTIVENESS

READINESS

The operational readiness of unit aircraft is the "pay off" function which is the key measure of effectiveness. However, in using the readiness rate to compare relative effectivenesses of maintenance units, consideration must also be given to the related utilization rates. Units of equal effectiveness could have different readiness rates if there were a substantial difference in the utilization rates. This factor will be covered in the final evaluation in this Chapter.

Figures 5-1 through 5-4 present graphic comparisons among the three maintenance concepts, of the monthly readiness rates and their trends for the four aircraft studied for the year ending 31 May 1967. As can be seen, the readiness rates for detachment supported aircraft are consistently higher than for those supported under the other two concepts. Figure 5-5 provides a summary of this information, comparing the average readiness rates for a 14-month period which clearly reflects the higher readiness rates generated by the detachment supported aircraft.

The helicopters in the Airmobile Division had a higher readiness rate than those in the Infantry Division, although the Infantry Division OV-1 aircraft had significantly higher readiness rates than those of the Airmobile Division. It is also significant to note that the Airmobile CH-47 fleet was processed through the 600-hour PE during the period July 1966 through April 1967.

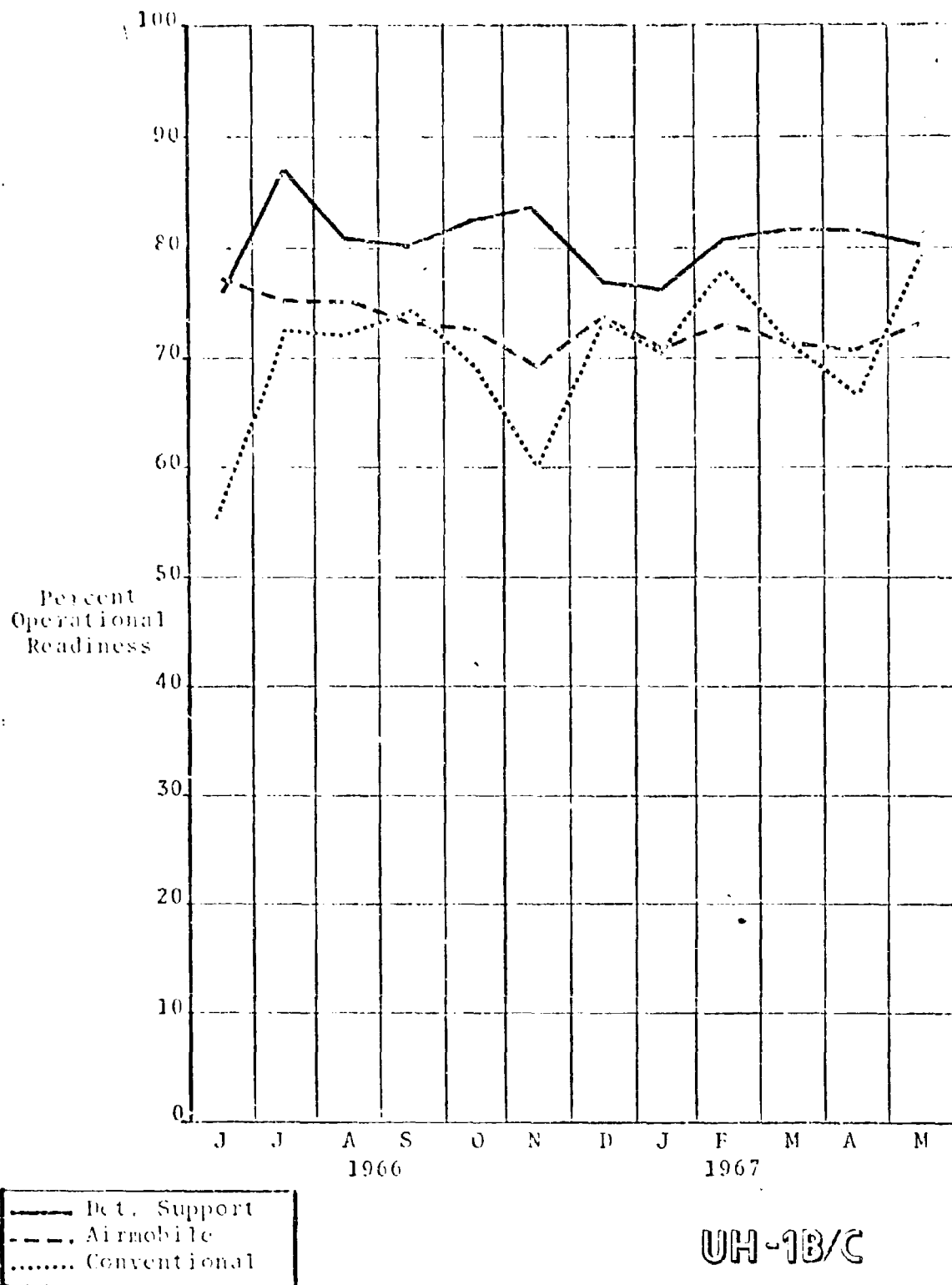


Figure 5-1. Comparison of Monthly Operational Readiness Rates

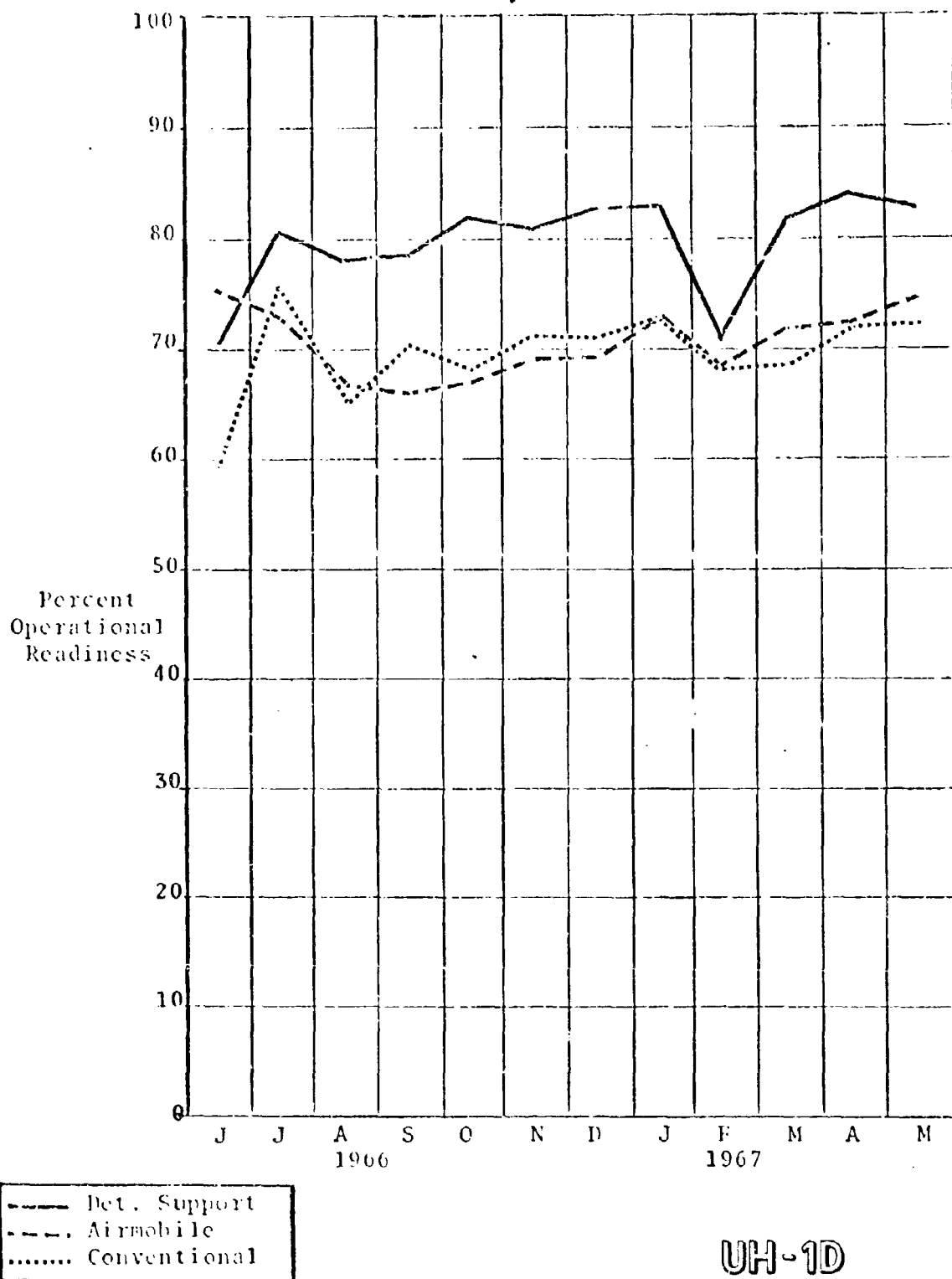


Figure 5-2. Comparison of Monthly Operational Readiness Rates

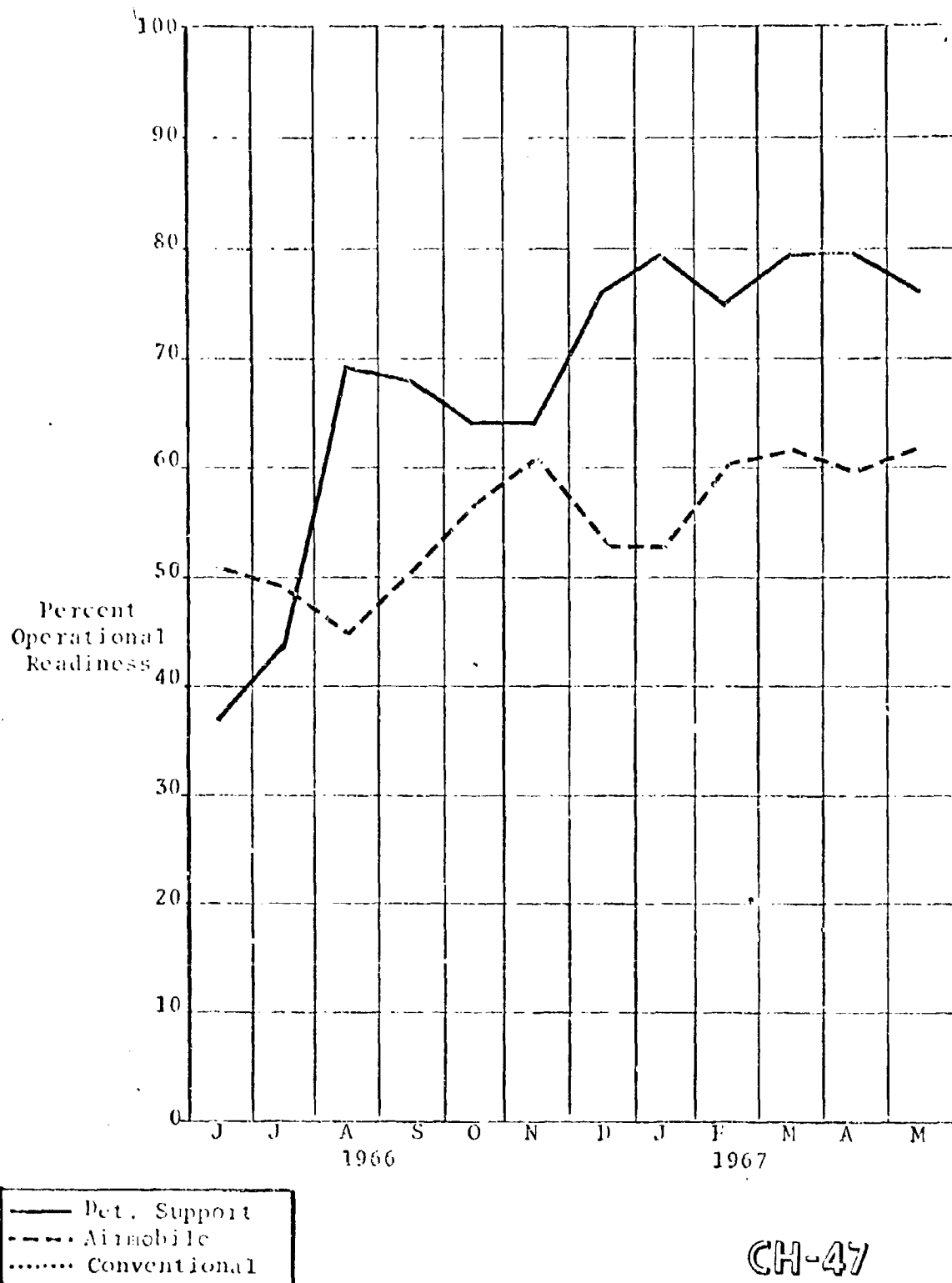


Figure 5-3. Comparison of Monthly Operational Readiness Rates

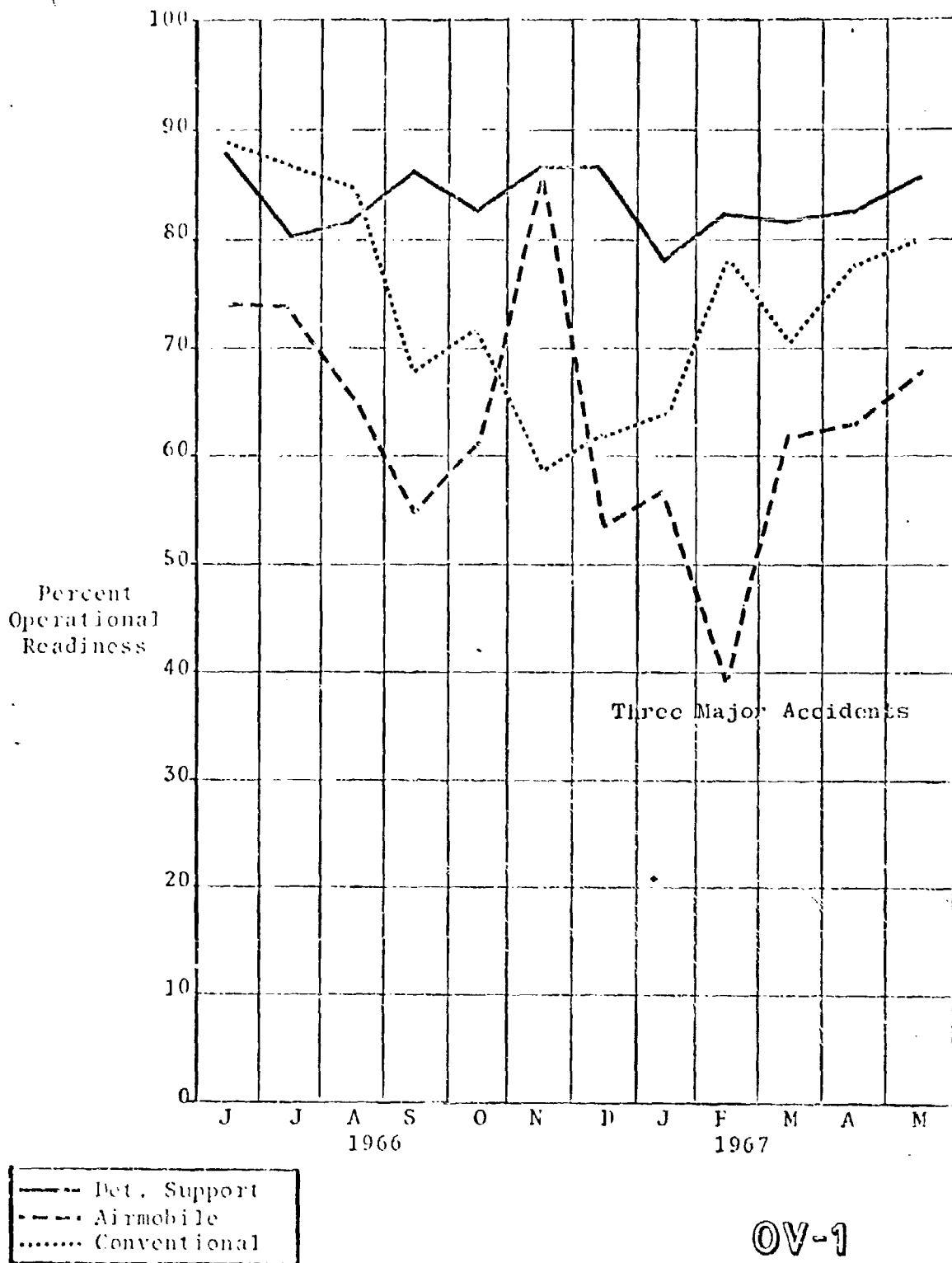


Figure 5-4. Comparison of Monthly Operational Readiness Rates

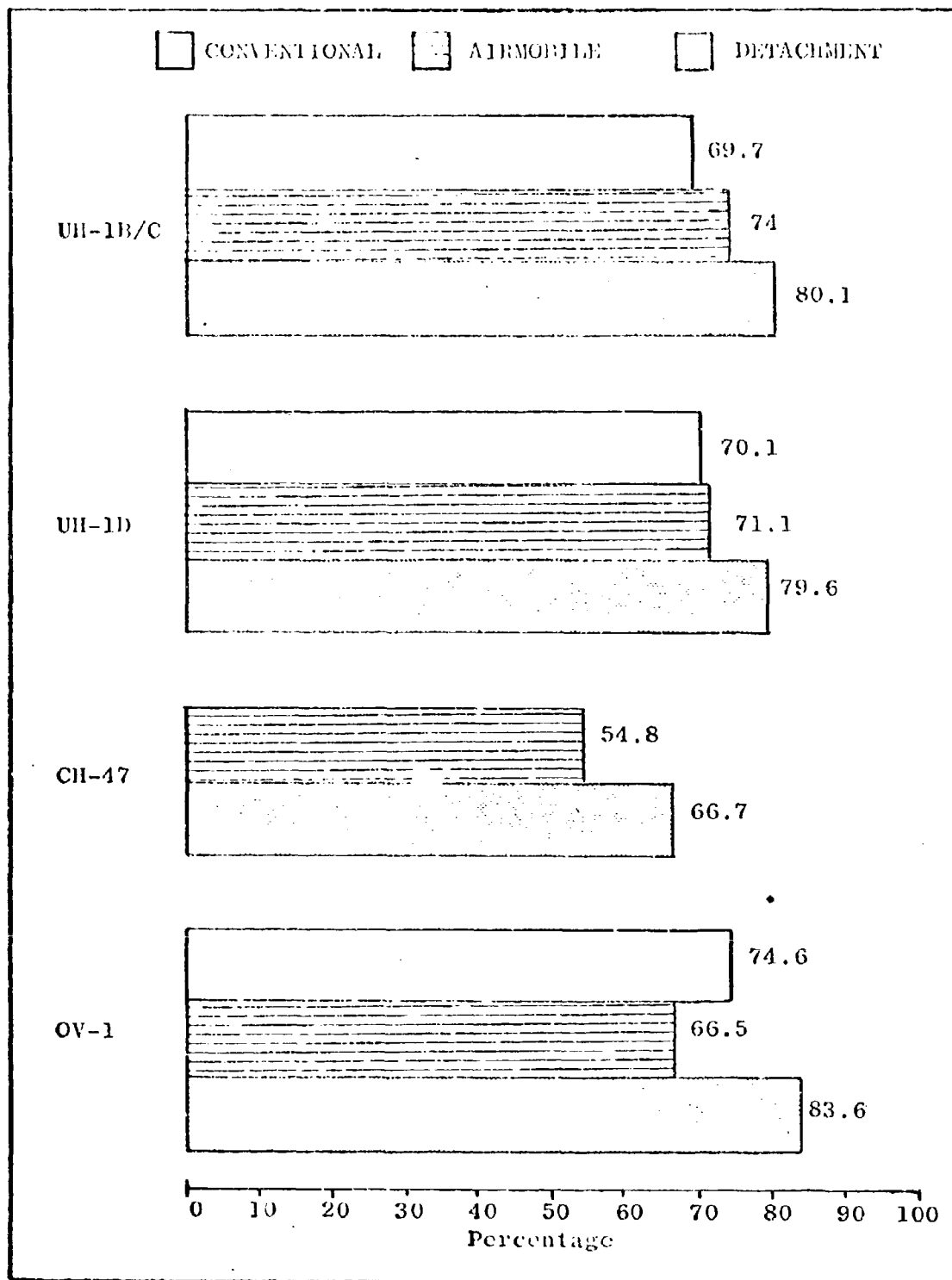


Figure 5-5. Comparison of Average Readiness Rates -
April 1966 Through May 1967

Figure 5-6 summarizes the results of the trend analysis on the monthly relationships between the readiness rates for detachment supported aircraft and those for aircraft supported under the other two concepts. Thus, the aircraft supported by the detachment not only had a higher average readiness rate than those supported by the other two concepts, but over the time period shown, had consistently higher rates on a month-by-month basis.

NOT OPERATIONALLY READY SUPPLY (NORS)

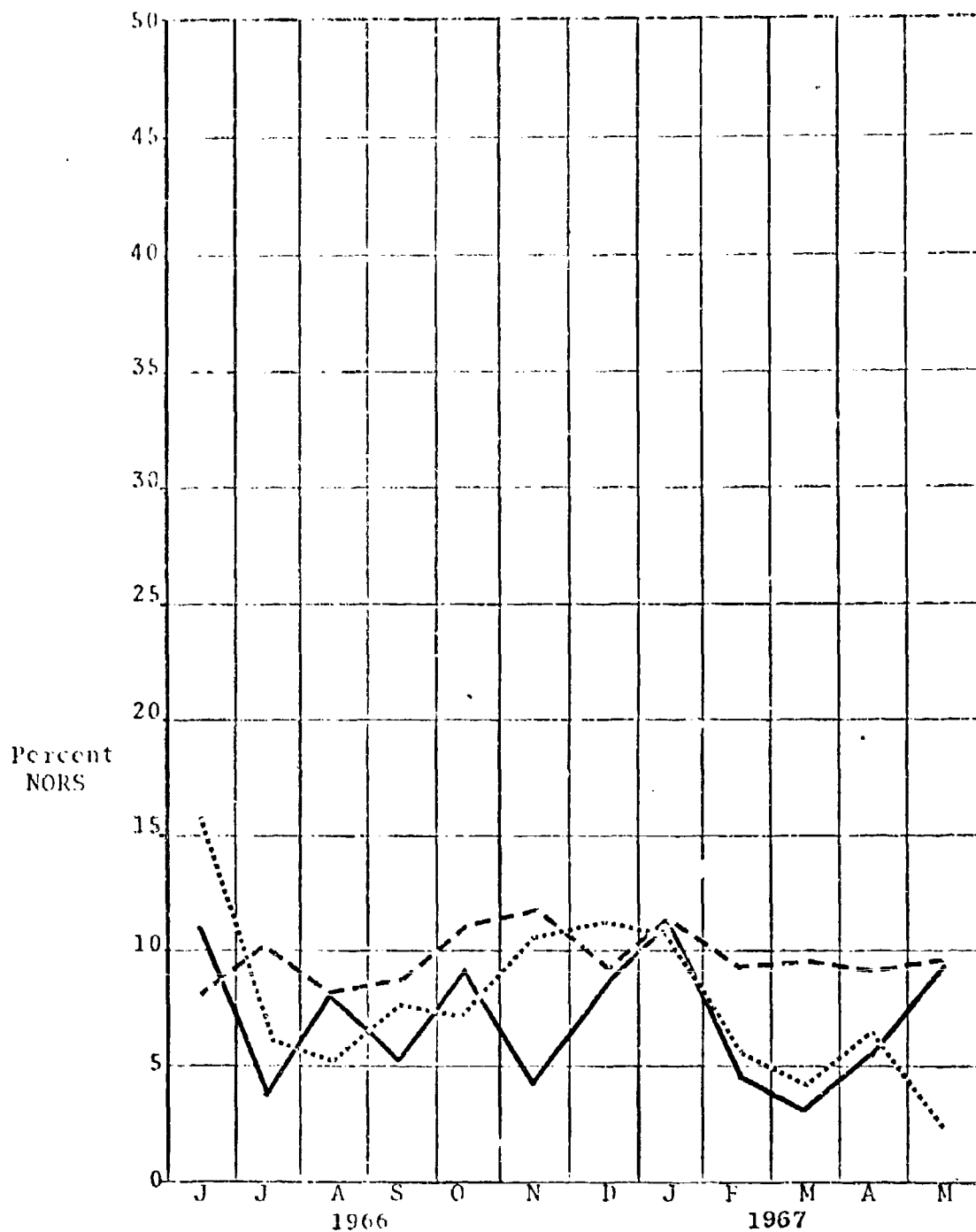
In using readiness rates as a measure of the operational effectiveness of maintenance units, it is also necessary to investigate the impact of those NORS aircraft. Accordingly, the NORS rates for each of the 12-months through May 1967 are presented in Figures 5-7 through 5-10 by maintenance concept and types of aircraft being studied. Averages of these rates for the 14-month period through 31 May 1967 are shown in Figure 5-11.

As can be seen, there was no particular significant difference among the concepts. The Detachments had better rates for two aircraft, the Conventional concept one, and the Airmobile concept the other.

To determine the interactive impact of Operational Readiness and NORS on the Readiness relationships between concepts, these two parameters are combined in Figure 5-12. The results disclosed no significant change in overall relationships among the concepts. Therefore, this study can properly compare NORM rates without further regard to the NORS rates.

Type Aircraft	Detachment Rate Higher Than Both Conventional <u>and</u> Armobile	Detachment Rate Lower Than Both Conventional <u>and</u> Armobile	Detachment Rate Lower Than Conventional <u>or</u> Armobile
UH-1B/C	11 Months	-	1 Month
UH-1D	11 Months	-	1 Month
CH-47	10 Months	-	2 Months
OV-1	9 Months	-	3 Months

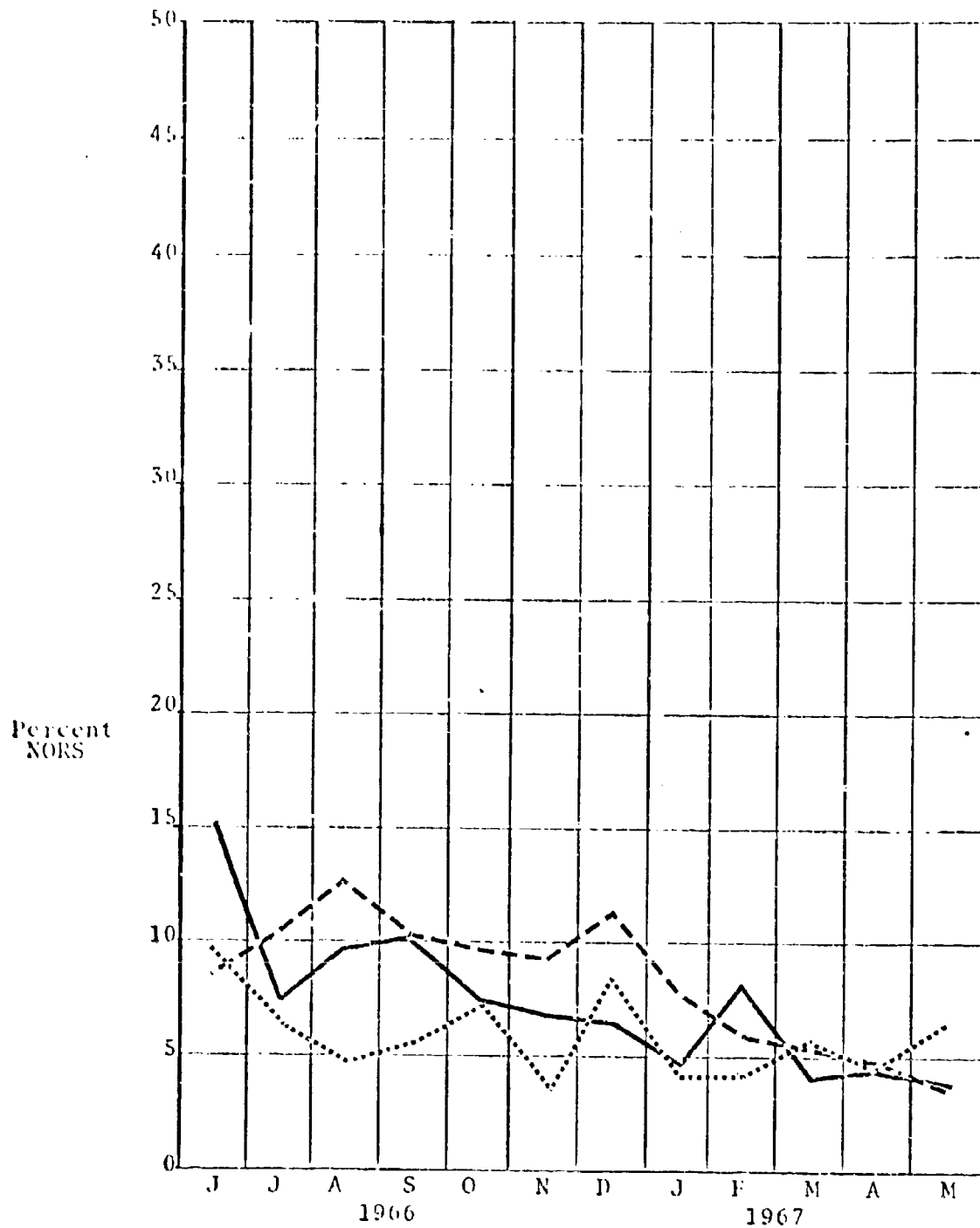
Figure 5-6. Readiness Rates of Detachment Supported Units
Related to Conventional and Armobile Concepts -
June 1966 Through May 1967



— Det. Support
 - - - Airmobile
 Conventional

UH-1B/C

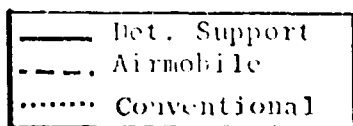
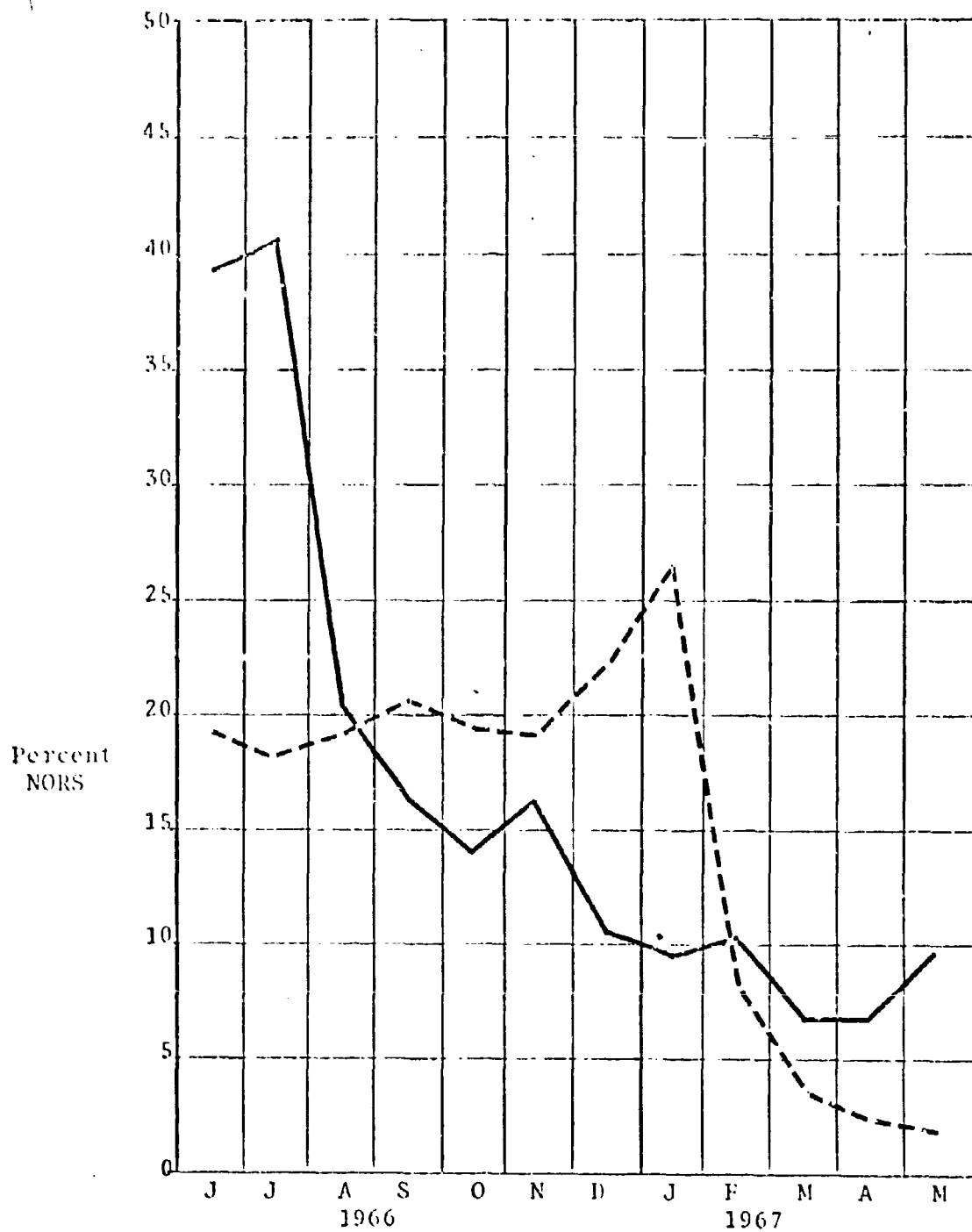
Figure 5-7. Comparison of Monthly Not Operationally Ready Supply (NORS) Rates



— Det. Support
 - - - Airmobile
 Conventional

UH-1D

Figure 5-8. Comparison of Monthly Not Operationally Ready Supply (NORS) Rates



CH-47

Figure 5-9. Comparison of Monthly Not Operationally Ready Supply (NORS) Rates

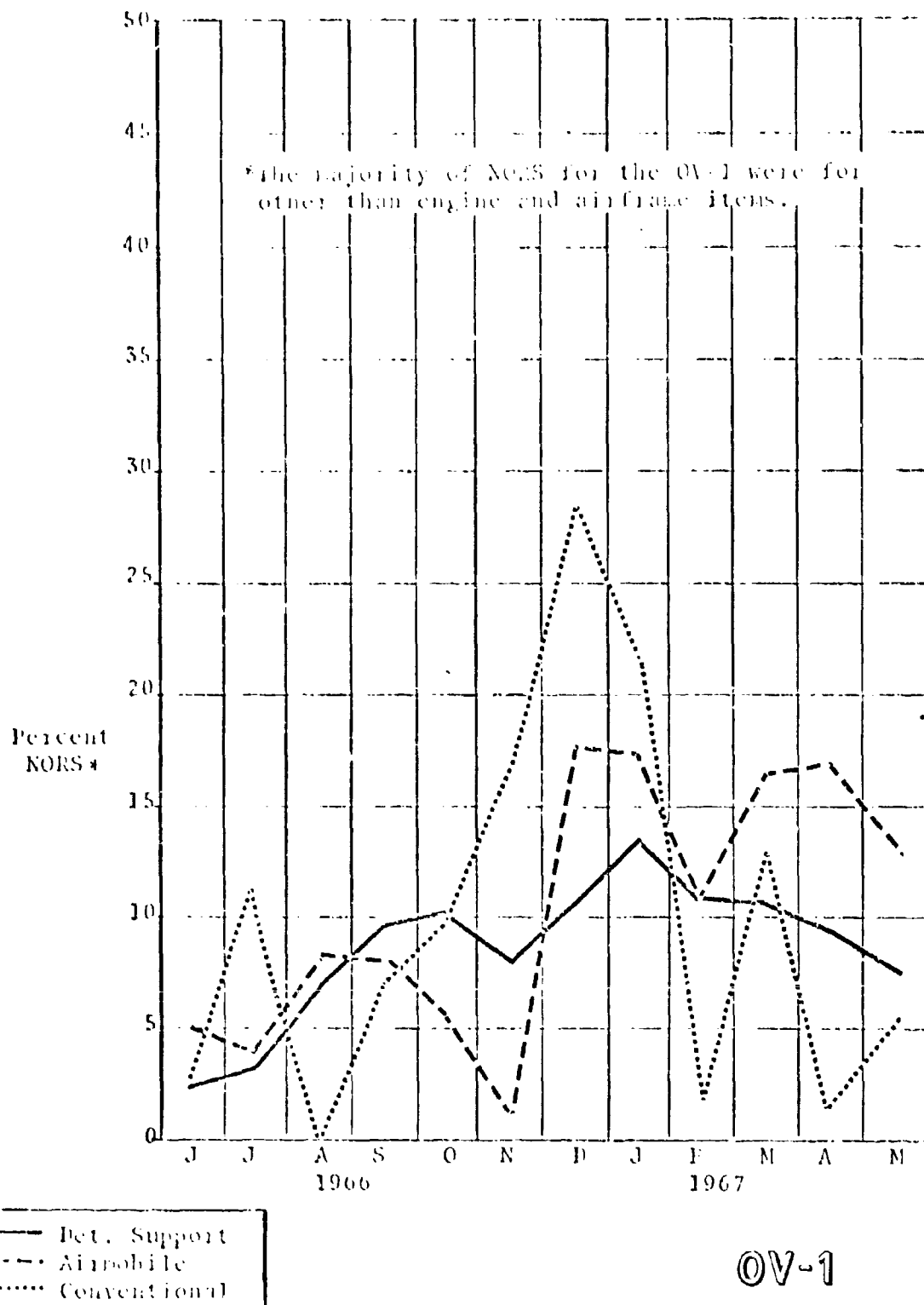


Figure 5-10. Comparison of Monthly Not Operationally Supply (NOES) Rates

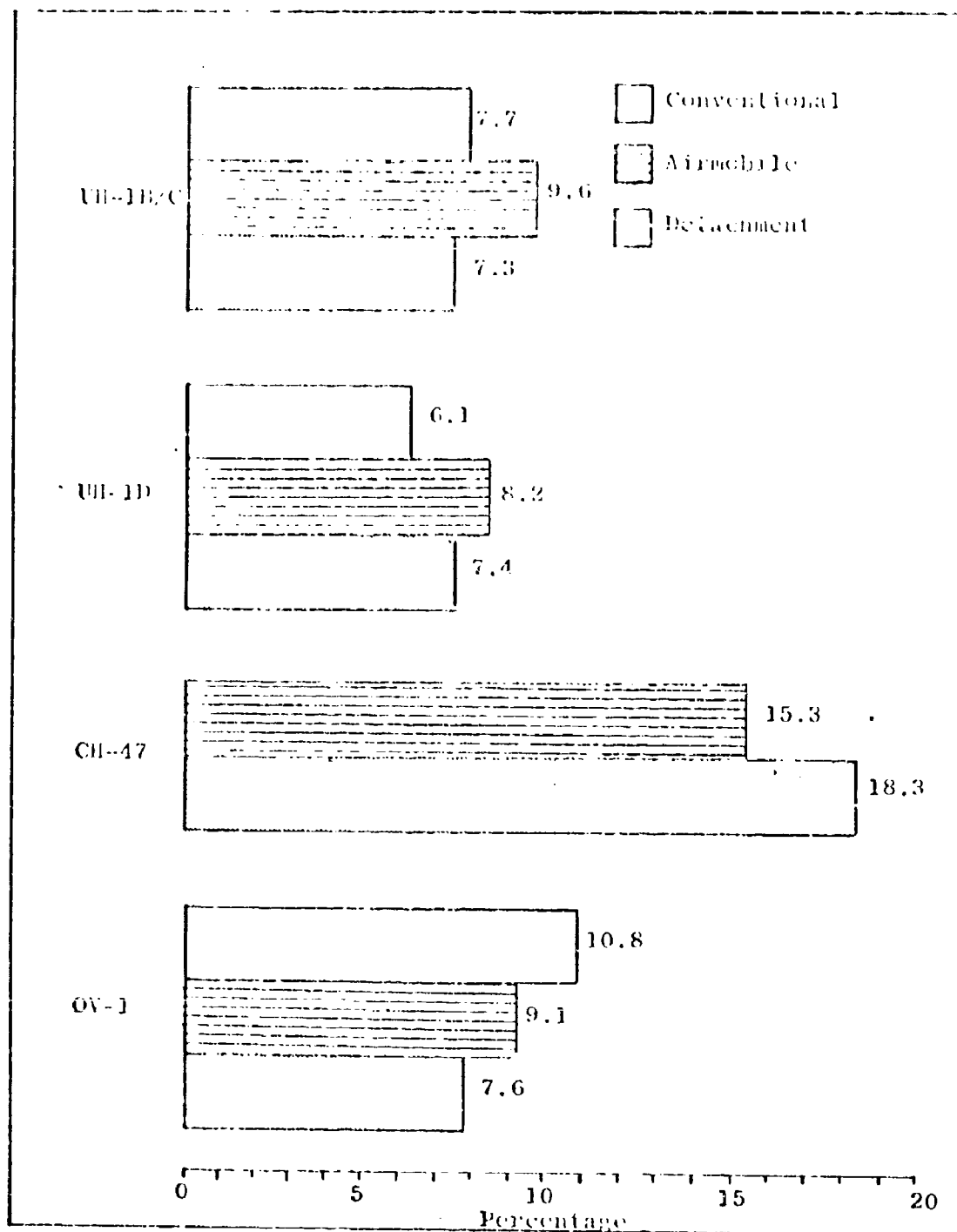


Figure 5-11. Comparison of Average MORS Rates -
April 1966 Through May 1967

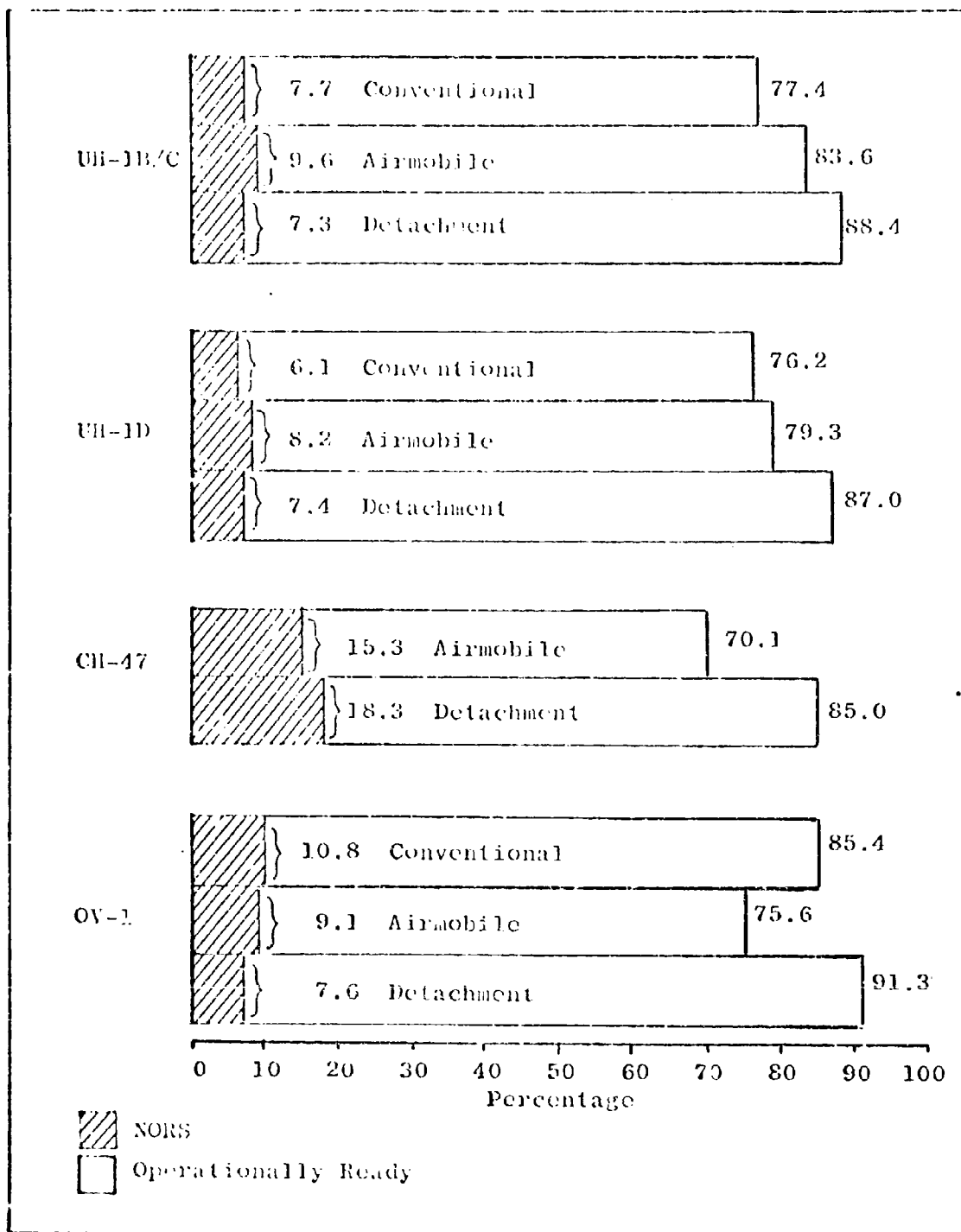


Figure 5-12. Comparison of Cumulative Average Readiness Rates Plus NORS - April 1966 through May 1967

NOT OPERATIONALLY READY MAINTENANCE
(NORM)

The NORM parameter studied included individual and combined comparisons of Organizational and DS Field Maintenance downtime rates.

The first part of the NORM evaluation is a comparative evaluation of the downtime rates resulting from NORM at Organizational level. Although this study deals primarily with a comparative evaluation of the DS concepts, the Organizational level is particularly sensitive to the relative effectivity of the DS elements. This reaction is reflected in both the extent to which Organizational level is workloaded and the relative NORM rates.

Figures 5-13 through 5-16 depict the monthly Organizational level NORM rates by maintenance support concept for the year ending 31 May 1967. For the UH-1 helicopters, the Organizational level NORM rates were significantly higher for the Conventional concept with not too much difference between the Detachment and Airmobile concepts. The Conventional concept also resulted in significantly higher NORM rates for the OV-1 Mohawk. The Detachment Supported Organizational NORM rates for the CH-47 and OV-1 were substantially lower than the rates in the Airmobile organizations. A summary of these results are illustrated in Figure 5-17.

It appears that both Airmobile and Detachment Supported concepts produced lower downtime rates for Organizational NORM than the Conventional concept. As discussed in Chapter 2, the Airmobile concept provides for a lesser workload at the Organizational

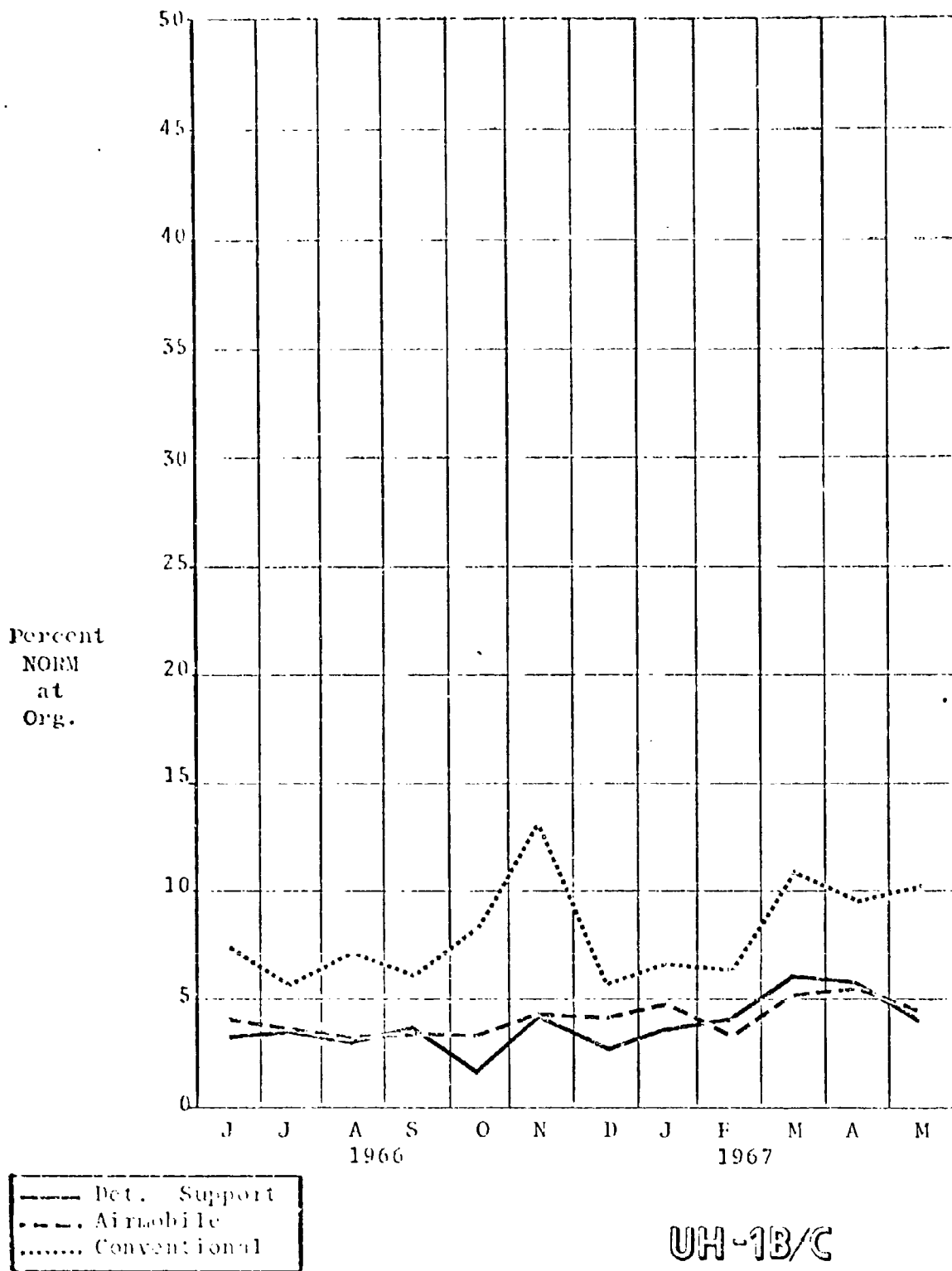


Figure 5-13. Comparison of Monthly Not Operationally Ready Organizational Maintenance Rates

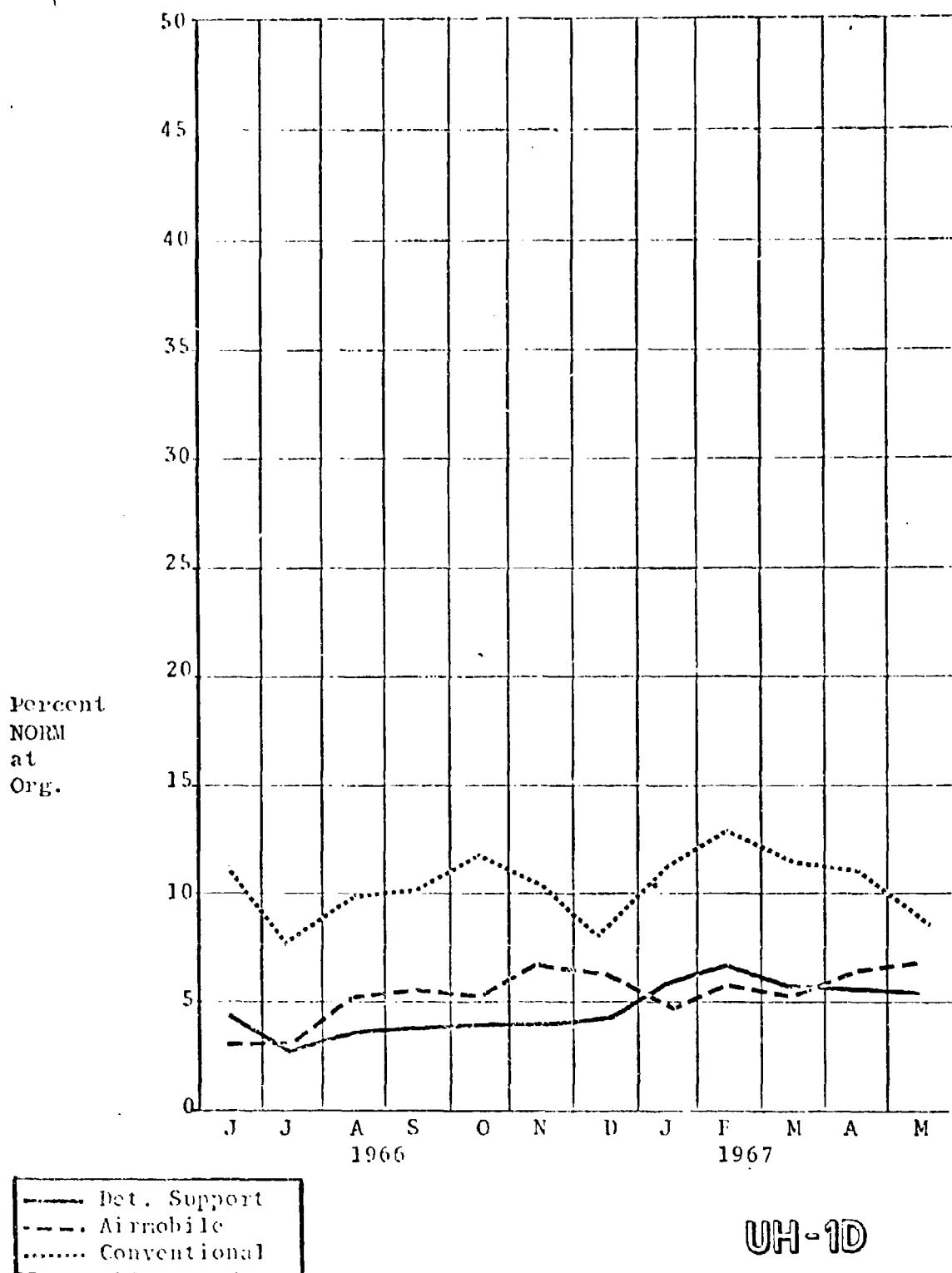


Figure 5-14. Comparison of Monthly Not Operationally Ready Organizational Maintenance Rates

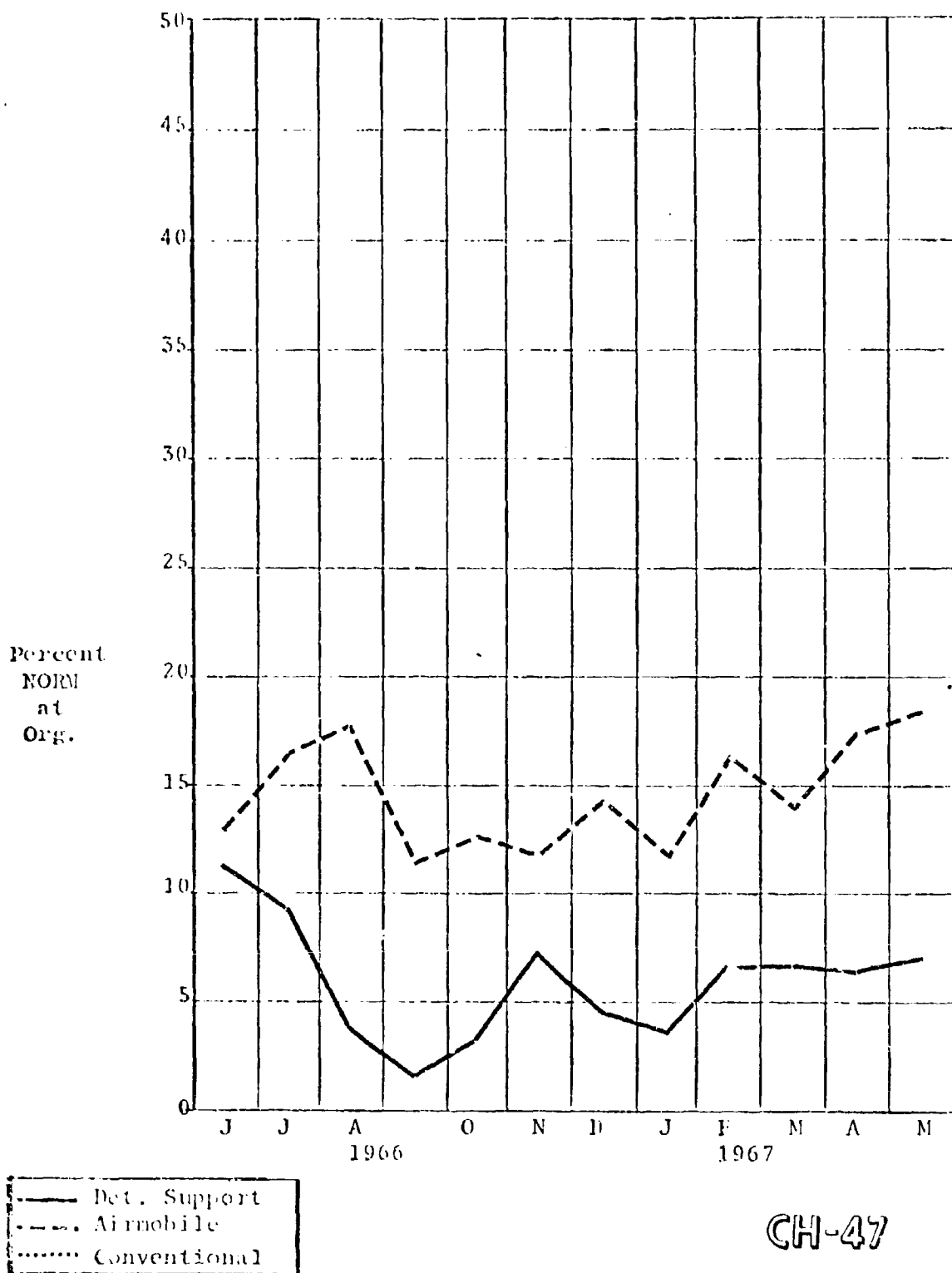


Figure 5-15. Comparison of Monthly Not Operationally Ready Organizational Maintenance Rates

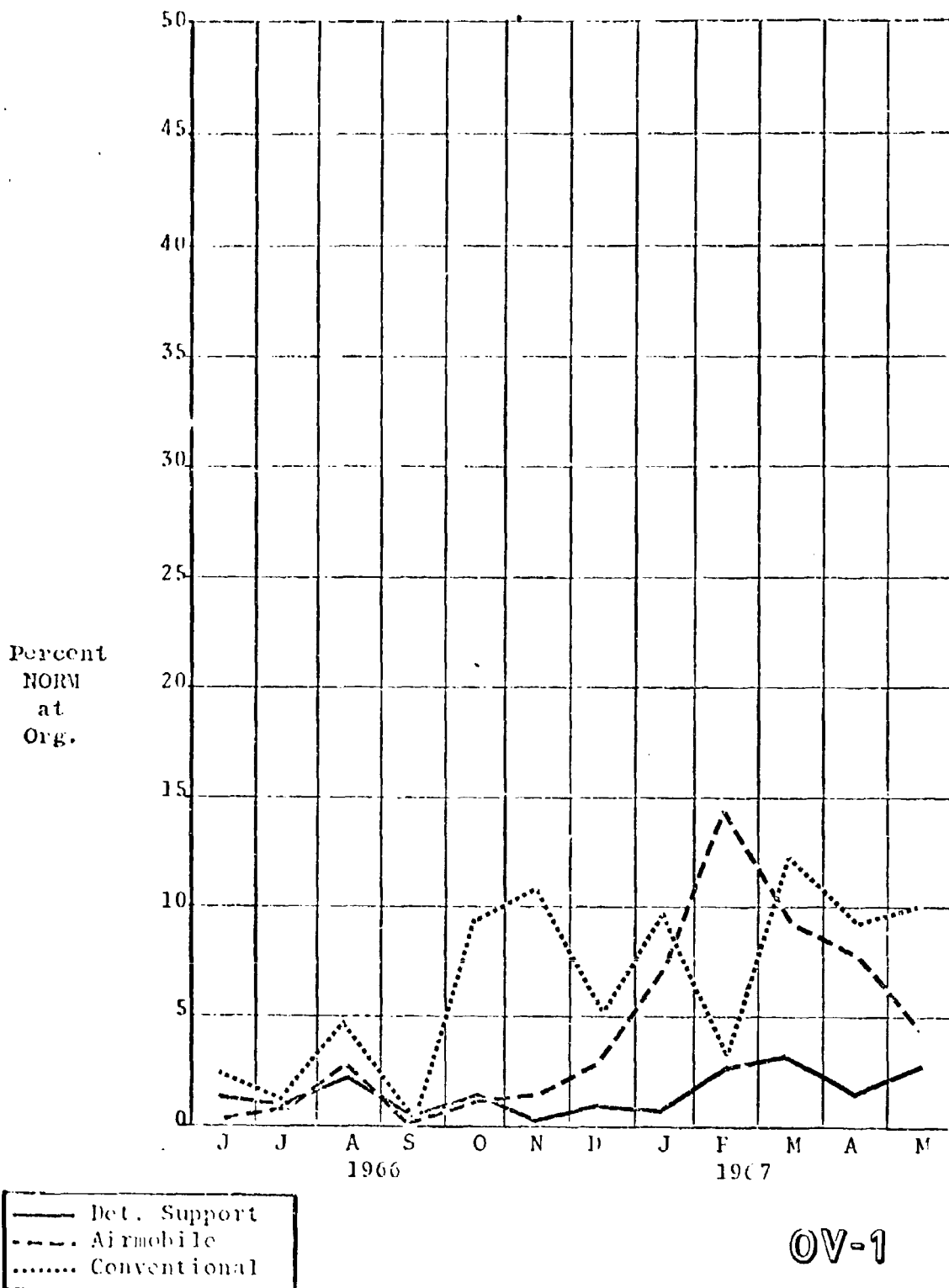


Figure 5-16. Comparison of Monthly Not Operationally Ready Organizational Maintenance Rates

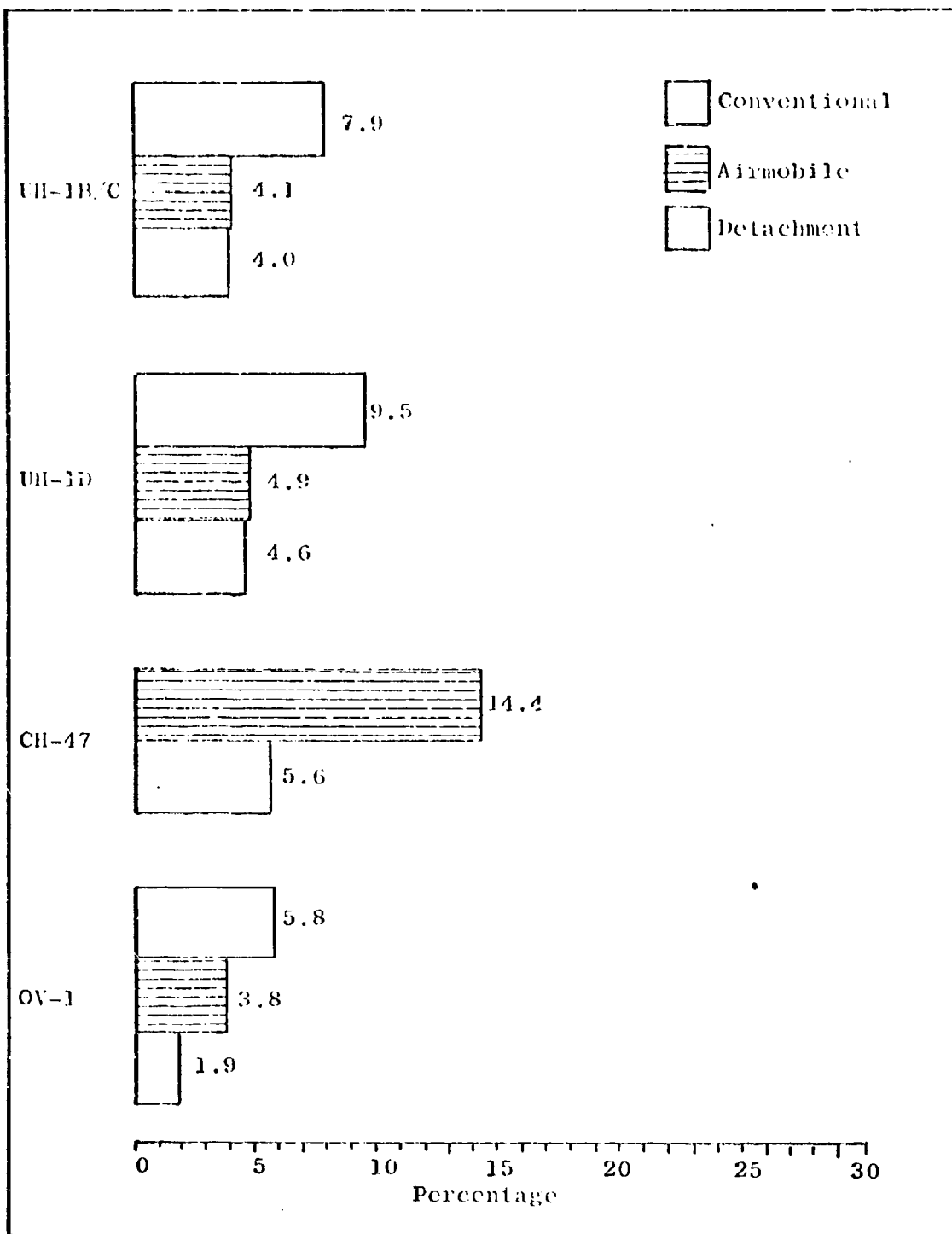


Figure 5-17. Comparison of Average NORM Rates
(Organizational Maintenance Only)
April 1966 Through May 1967

Maintenance level than the other concepts discussed. The Detachment concept, operating under direct control, of the aviation unit commander, also tends to reduce the Organizational level workload.

Field maintenance level NORM rates for the year ending 31 May 1967 are reflected in the trend charts in Figures 5-18 through 5-21. The averages of these data for a 14-month period are presented in Figure 5-22. The downtime rates for Detachment supported aircraft were consistently lower than those for aircraft maintained by the other two field maintenance concepts. Otherwise, for the UH-1 helicopters, Conventional and Airmobile concepts produced similar overall downtime rates at the field maintenance level. For the OV-1, the NORM field maintenance rate under the Conventional concept was only slightly higher than under the Detachment concept, but the rate under the Airmobile concept was substantially higher, (three times the rate realized under the Detachment Support concept). As discussed earlier, the higher NORM rates of the Airmobile concept reflect its requirement that more maintenance be accomplished at field maintenance or DS level.

Figures 5-23 through 5-26 present overall NORM rates for combined organizational and field maintenance, with a summarization averaged for a 14-month period in Figure 5-27. These data verify that the high readiness rates for the Detachment supported units were directly related to the maintenance effectivity of the maintenance detachments. Additionally, these data provide indicators that the Airmobile concept results in availability rates superior to those experienced in organizations supported

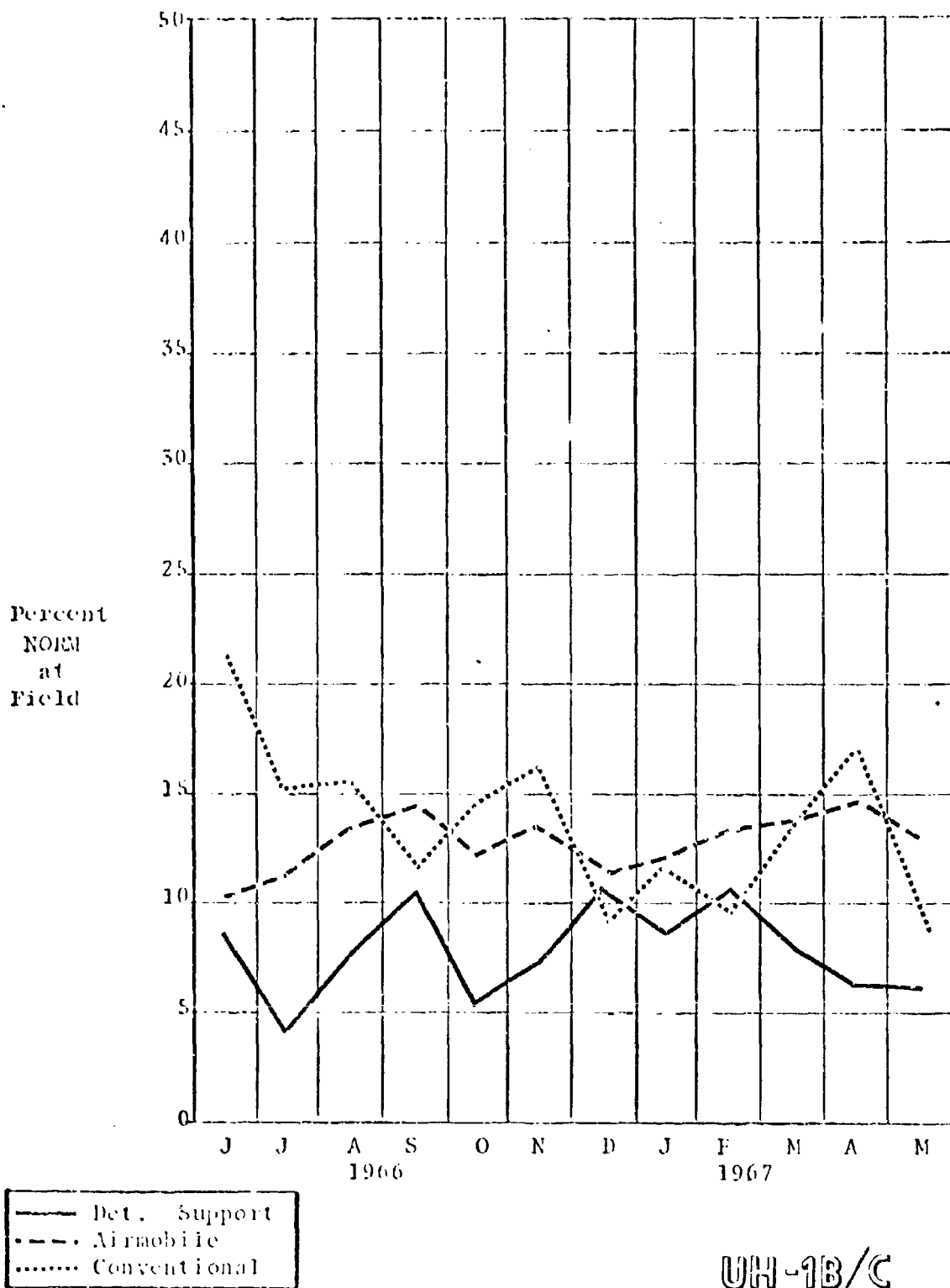
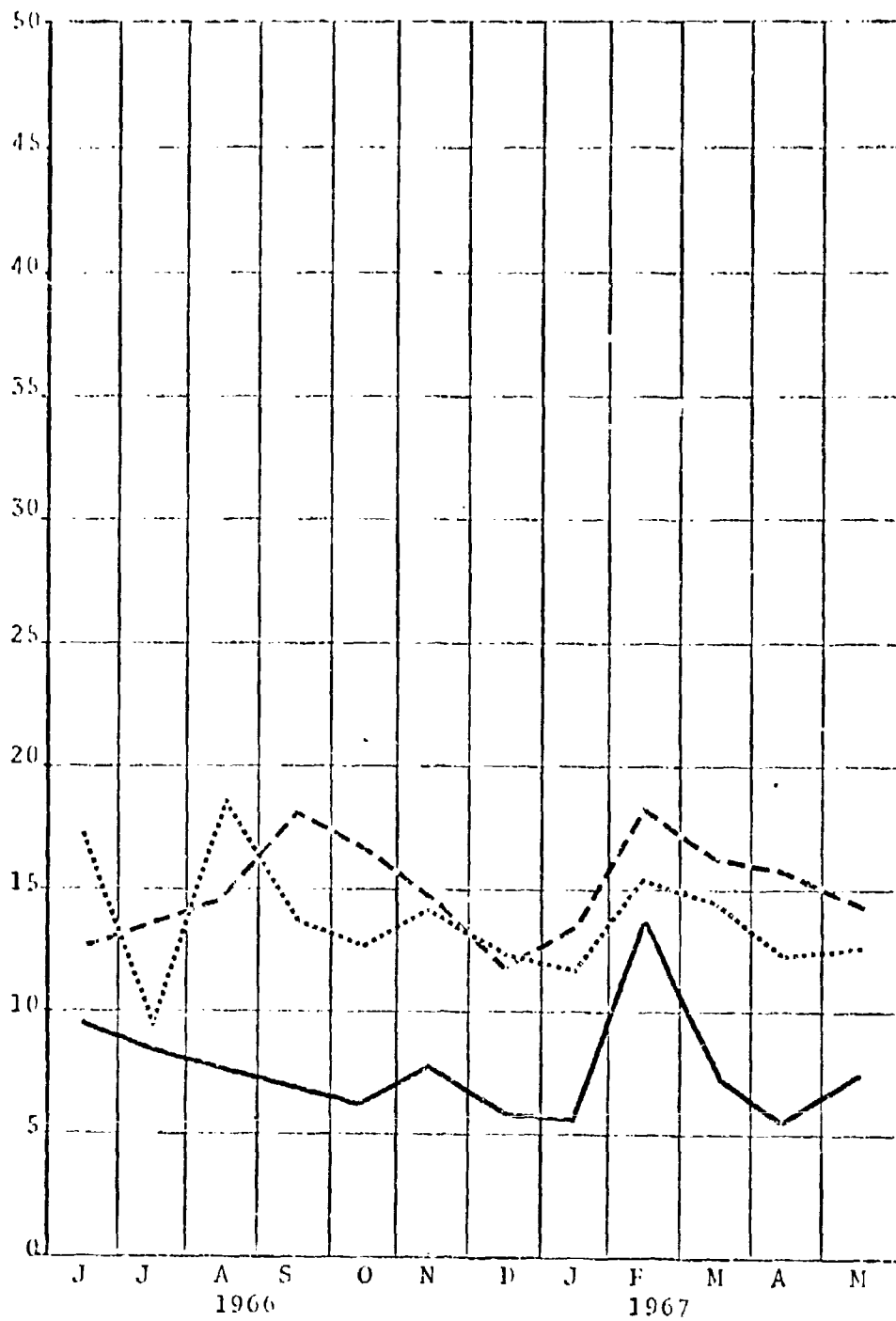


Figure 5-18. Comparison of Monthly Net Operationally Ready Field Maintenance Rates

Percent
NORM
at
Field



- - - - - Det. Support
 - - - - - Airmobile
 Conventional

UH-1D

Figure 5-19. Comparison of Monthly Not Operationally Ready Field Maintenance Rates

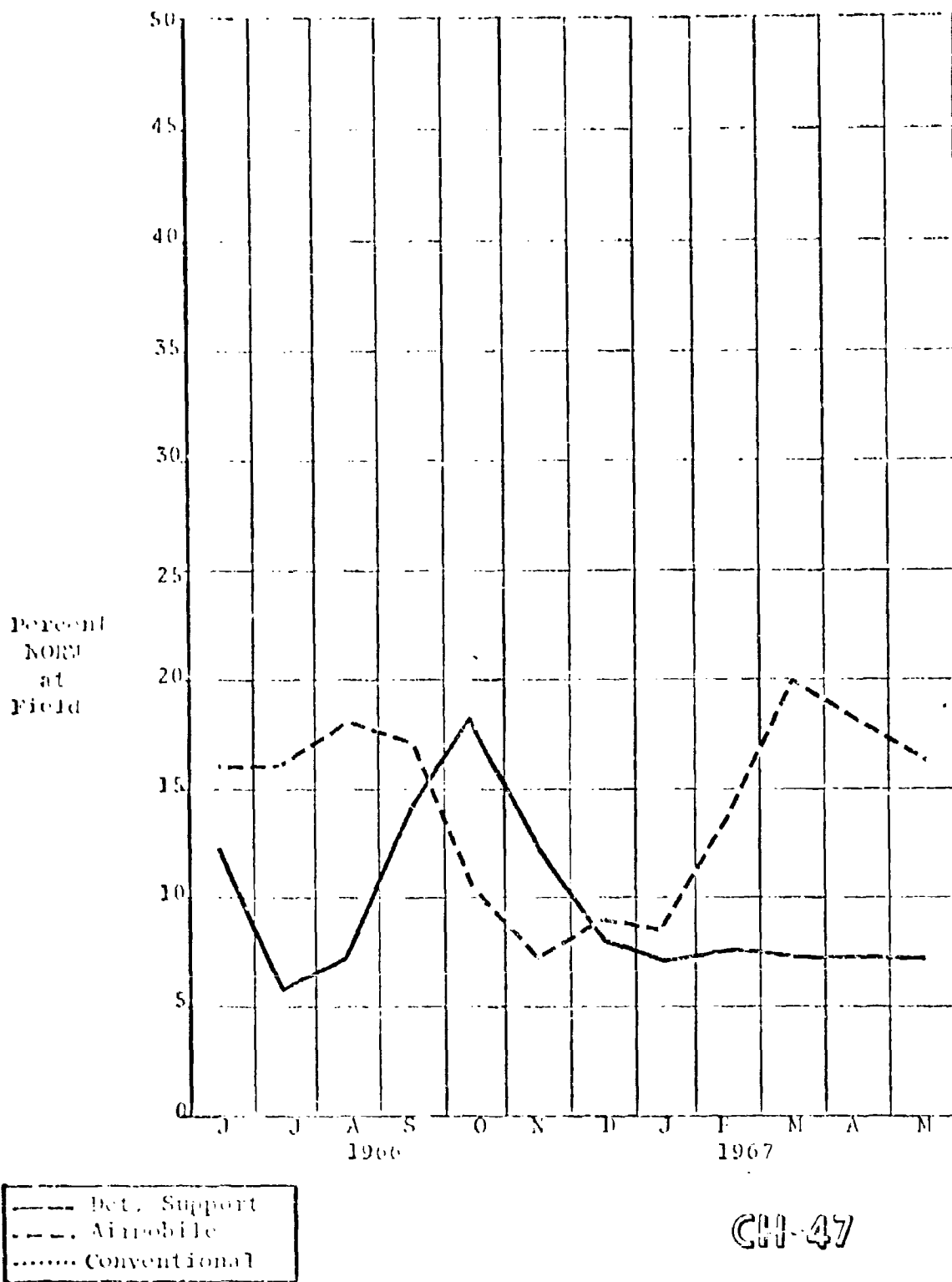


Figure 5-20. Comparison of Monthly Not Operationally Ready Field Maintenance Rates

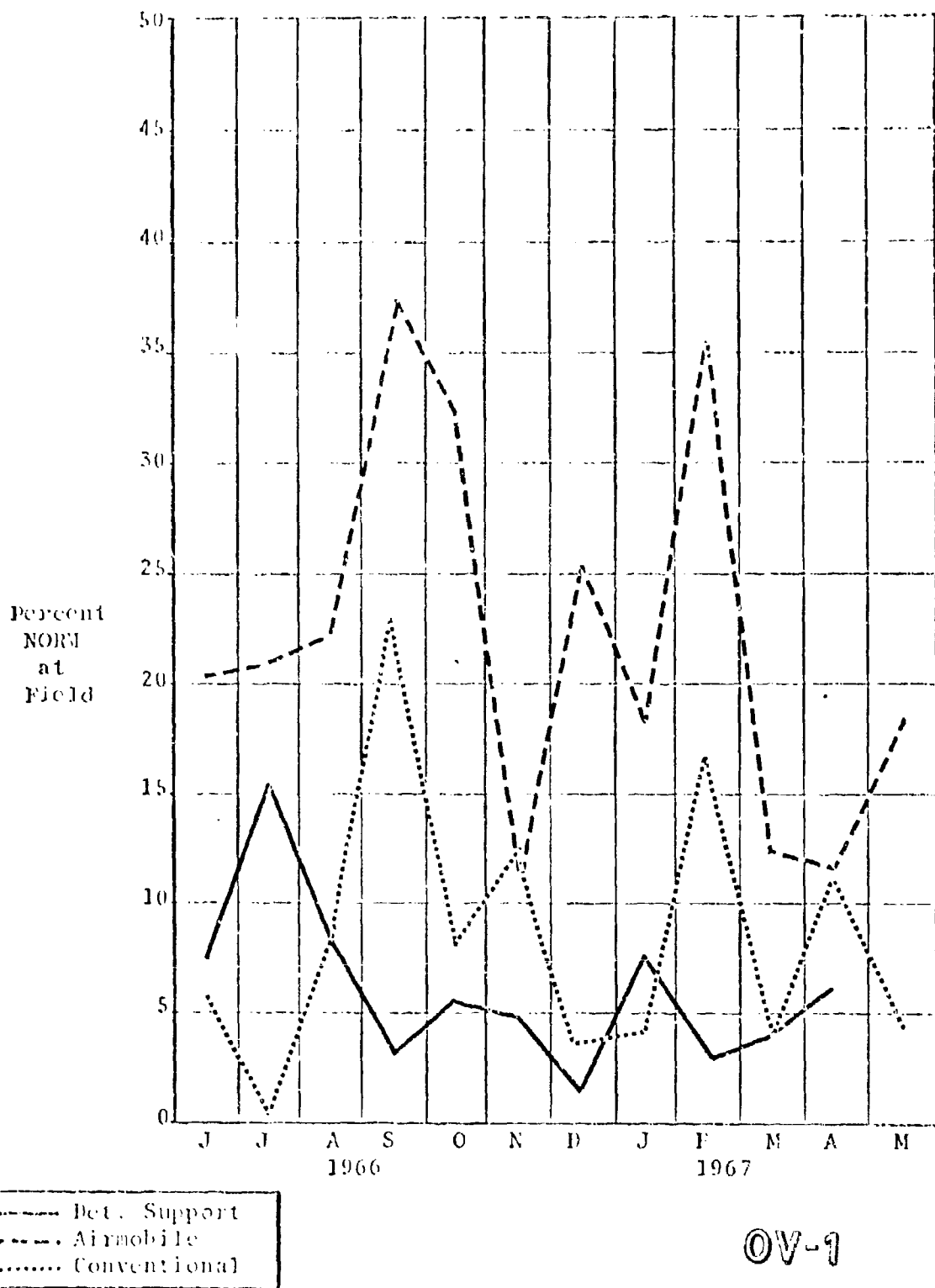


Figure 5-21. Comparison of Monthly Net Operationally Ready Field Maintenance Rates

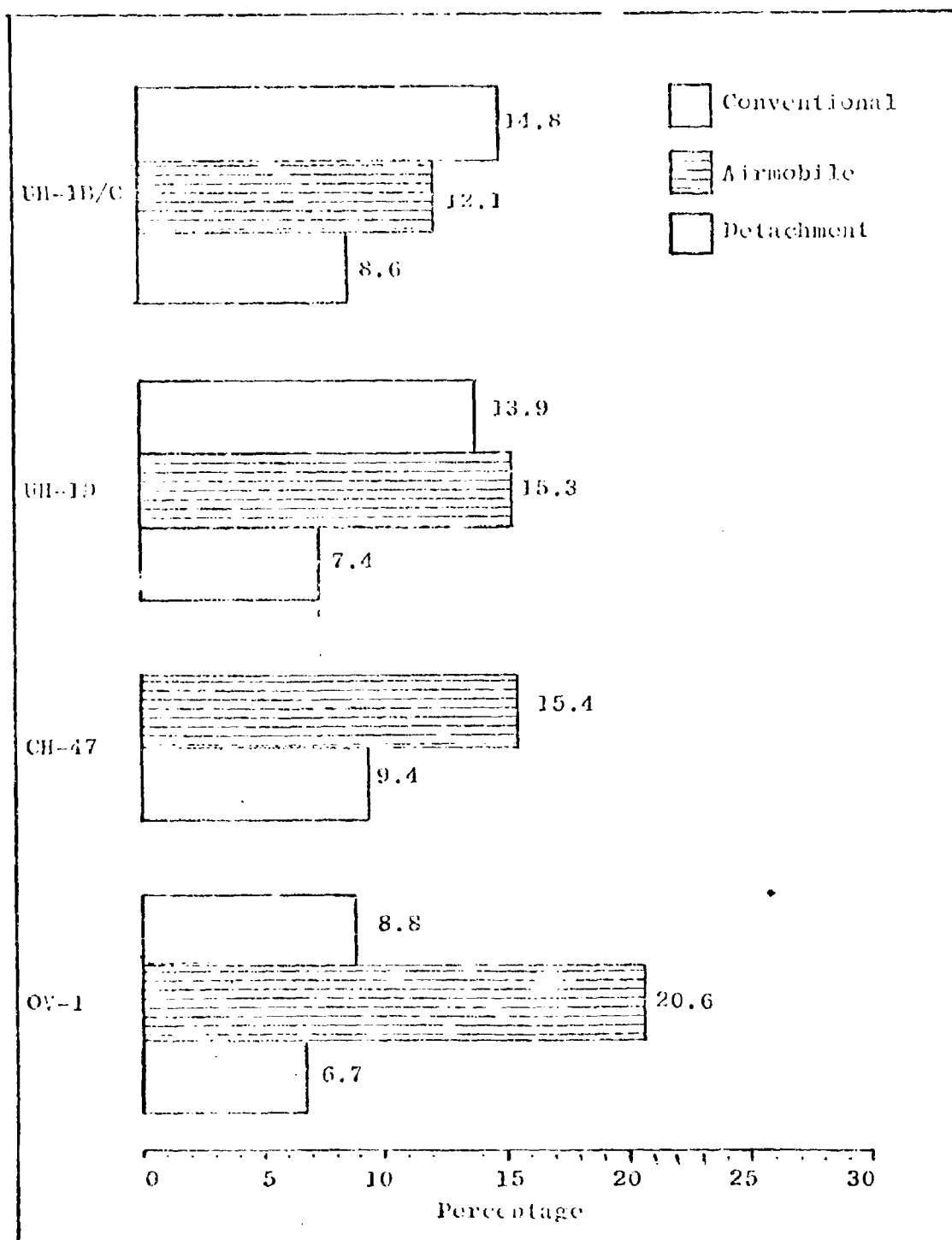


Figure 5-22. Comparison of Average NORM Rates
(Field Maintenance Only)
April 1966 Through May 1967

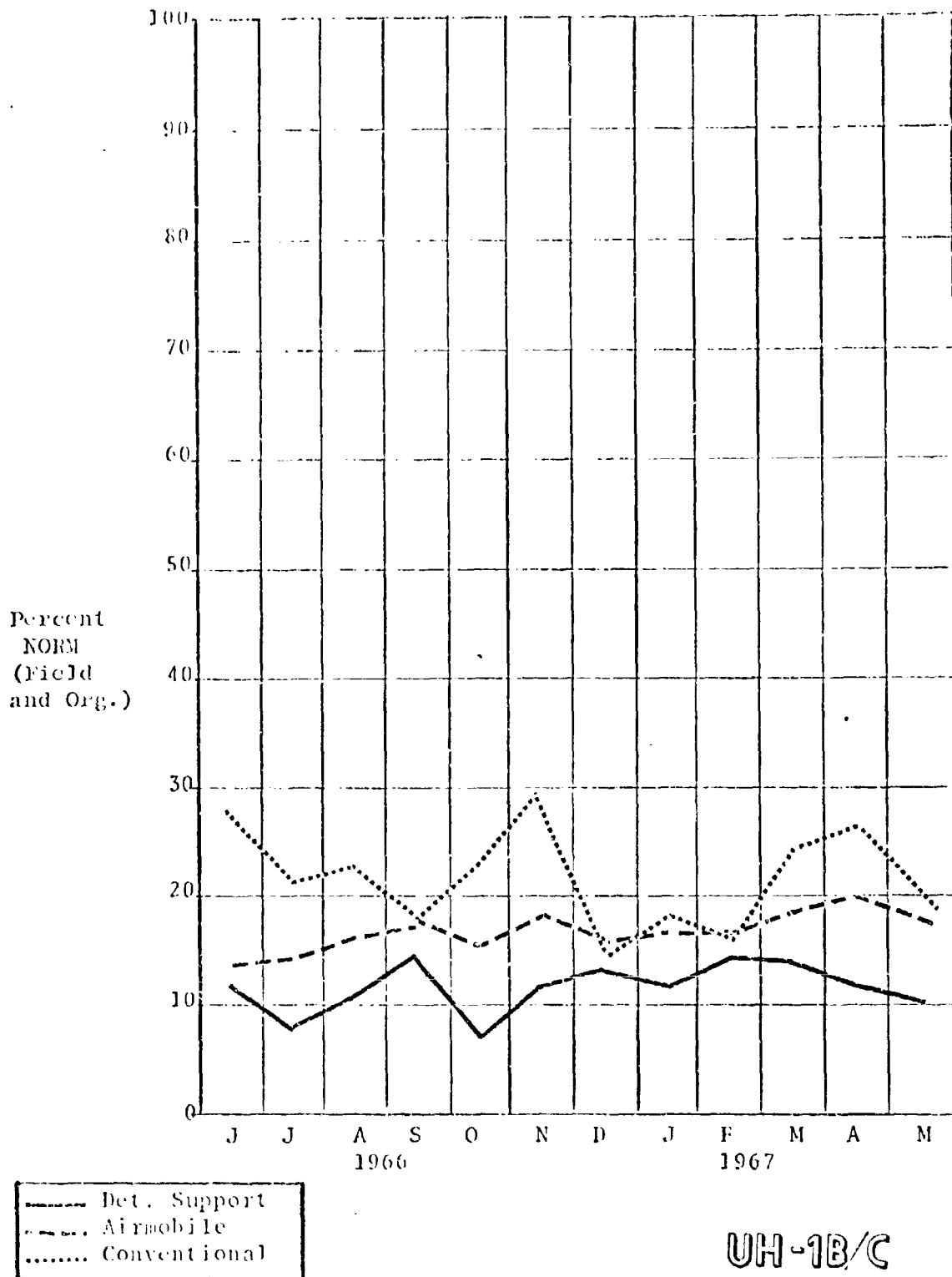


Figure 5-23. Comparison of Monthly Not Operationally Ready Organizational and Field Maintenance (NORM) Rates

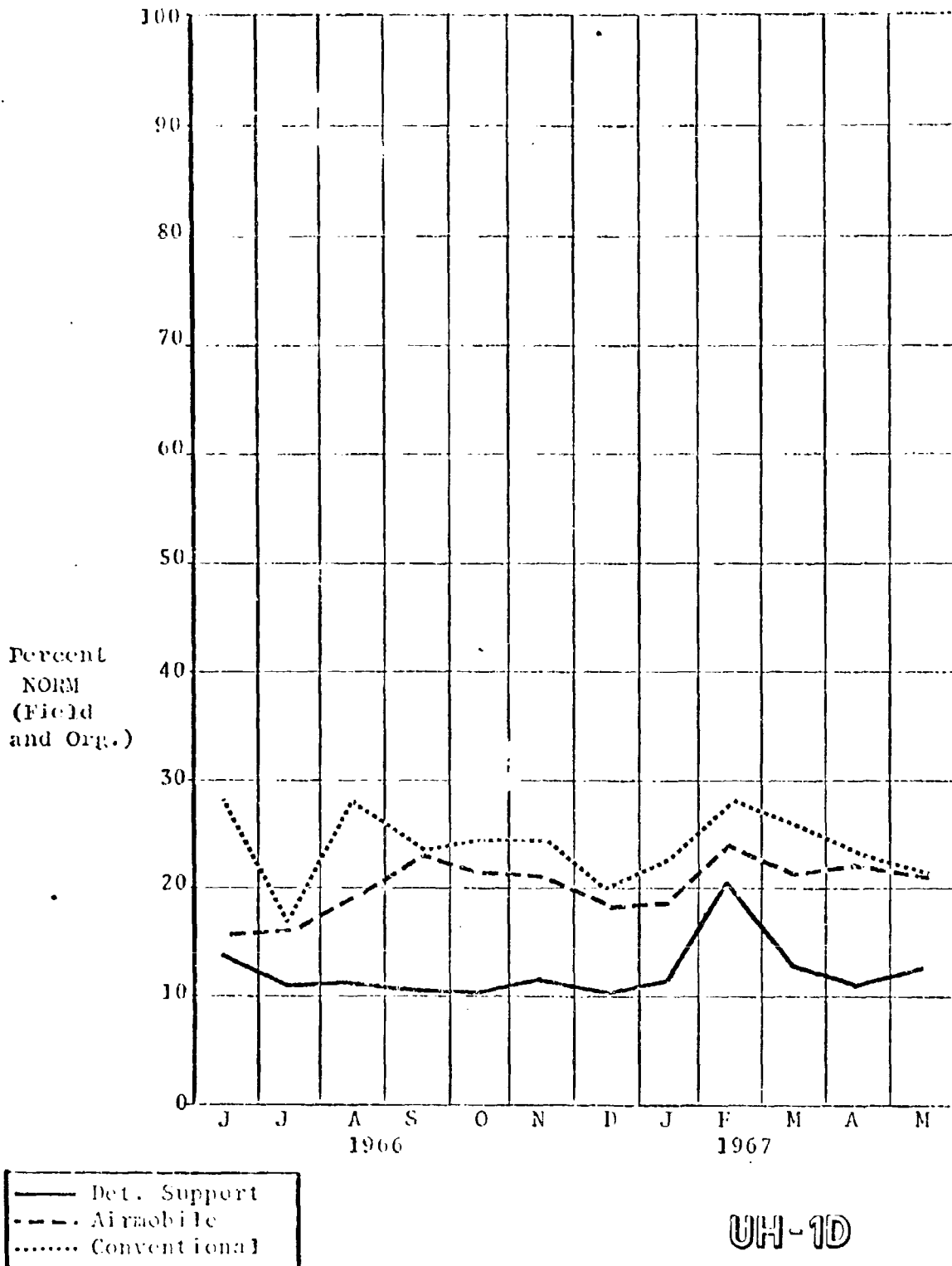


Figure 5-24. Comparison of Monthly Not Operationally Ready Organizational and Field Maintenance (NORM) Rates

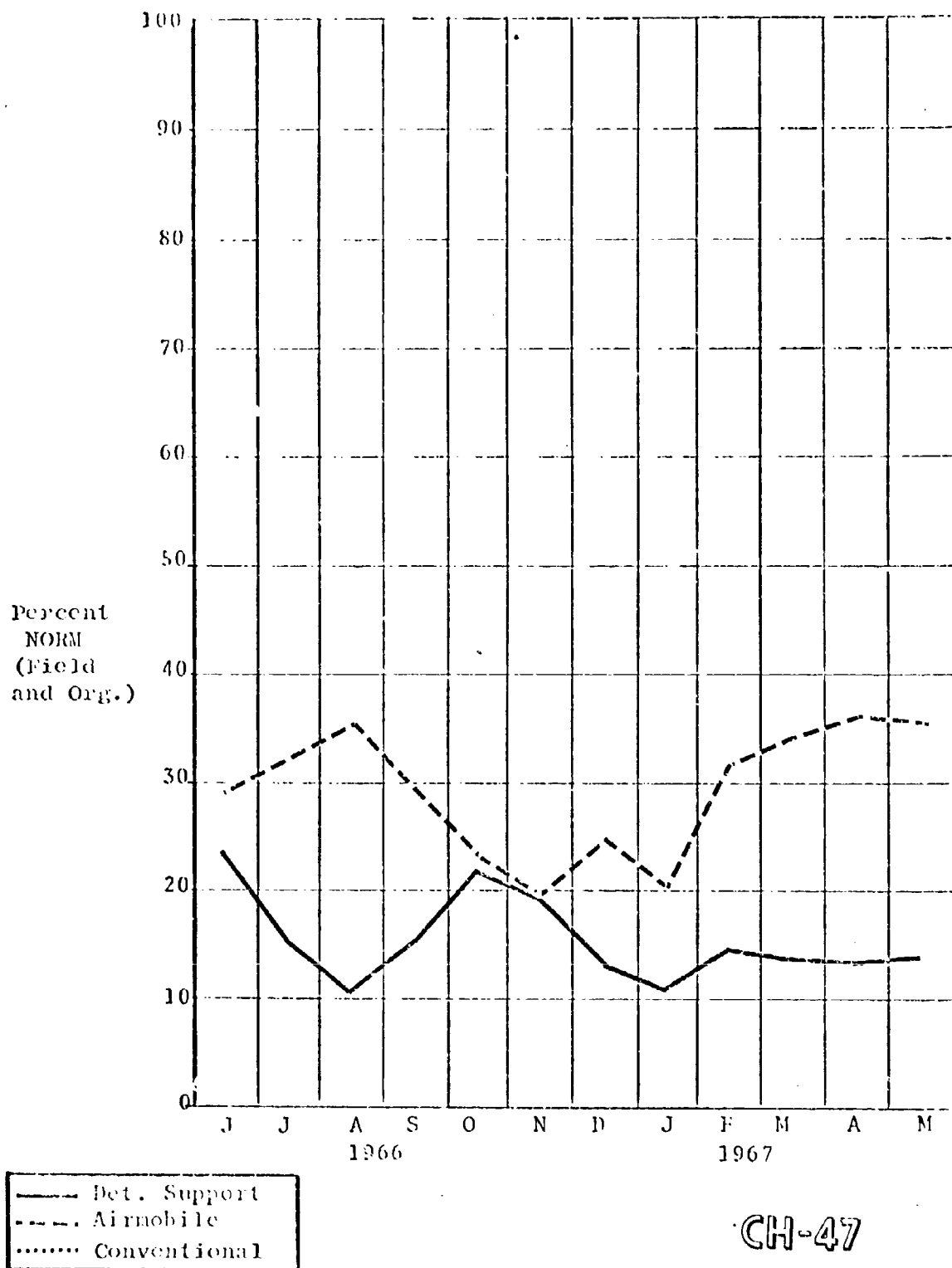


Figure 5-25. Comparison of Monthly Not Operationally Ready Organizational and Field Maintenance (NORM) Rates

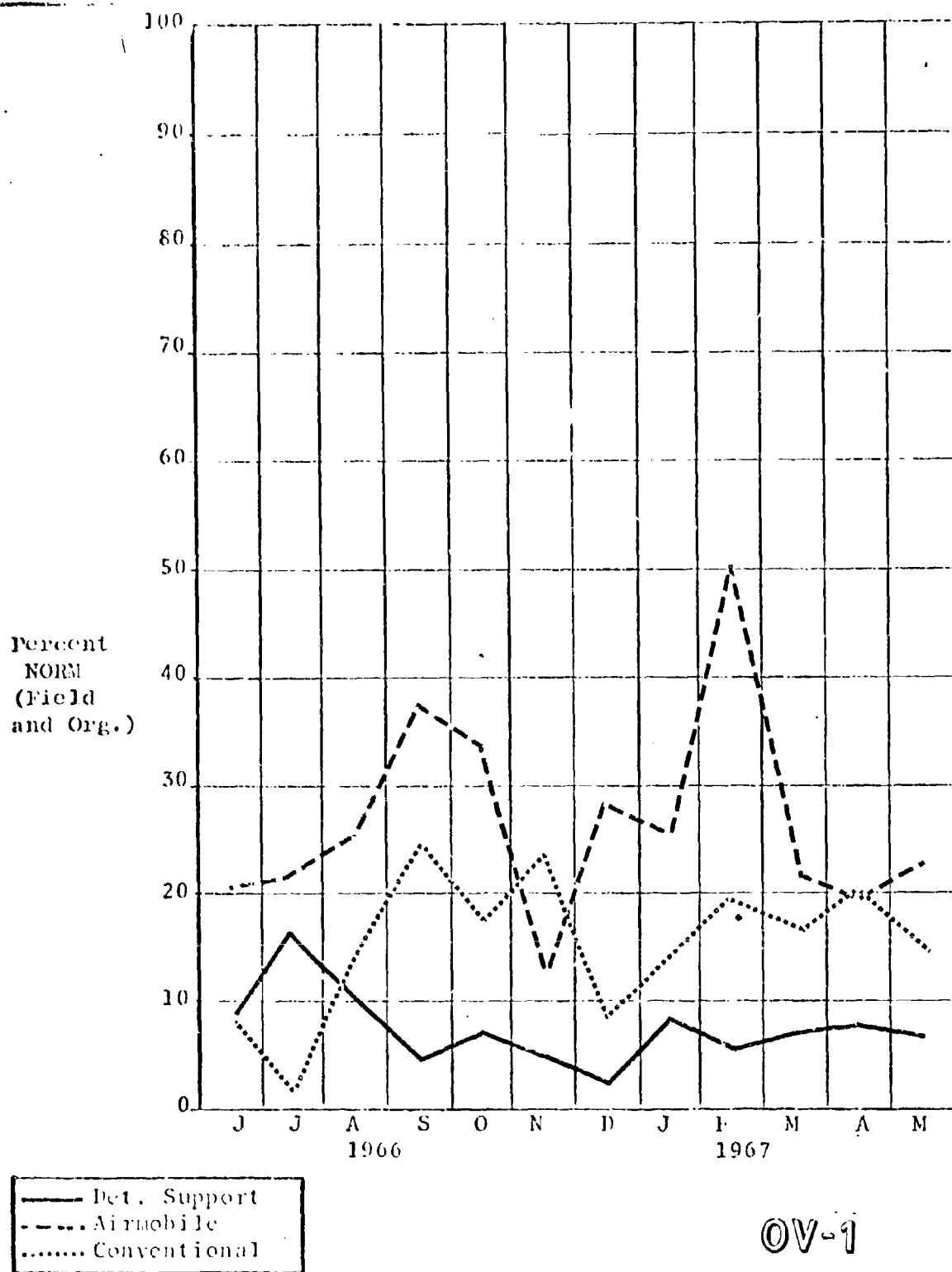


Figure 5-26. Comparison of Monthly Not Operationally Ready Organizational and Field Maintenance (NORM) Rates

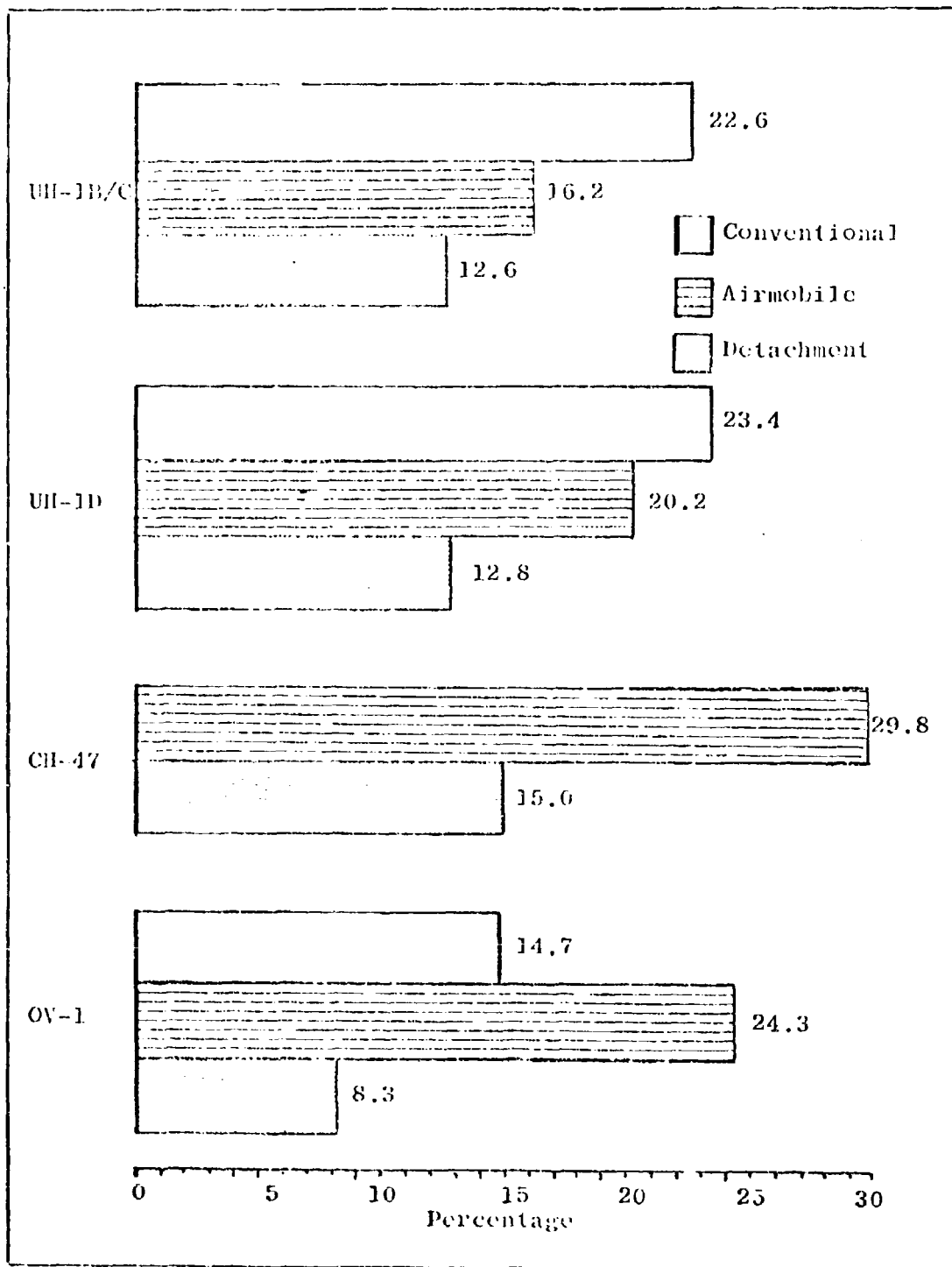


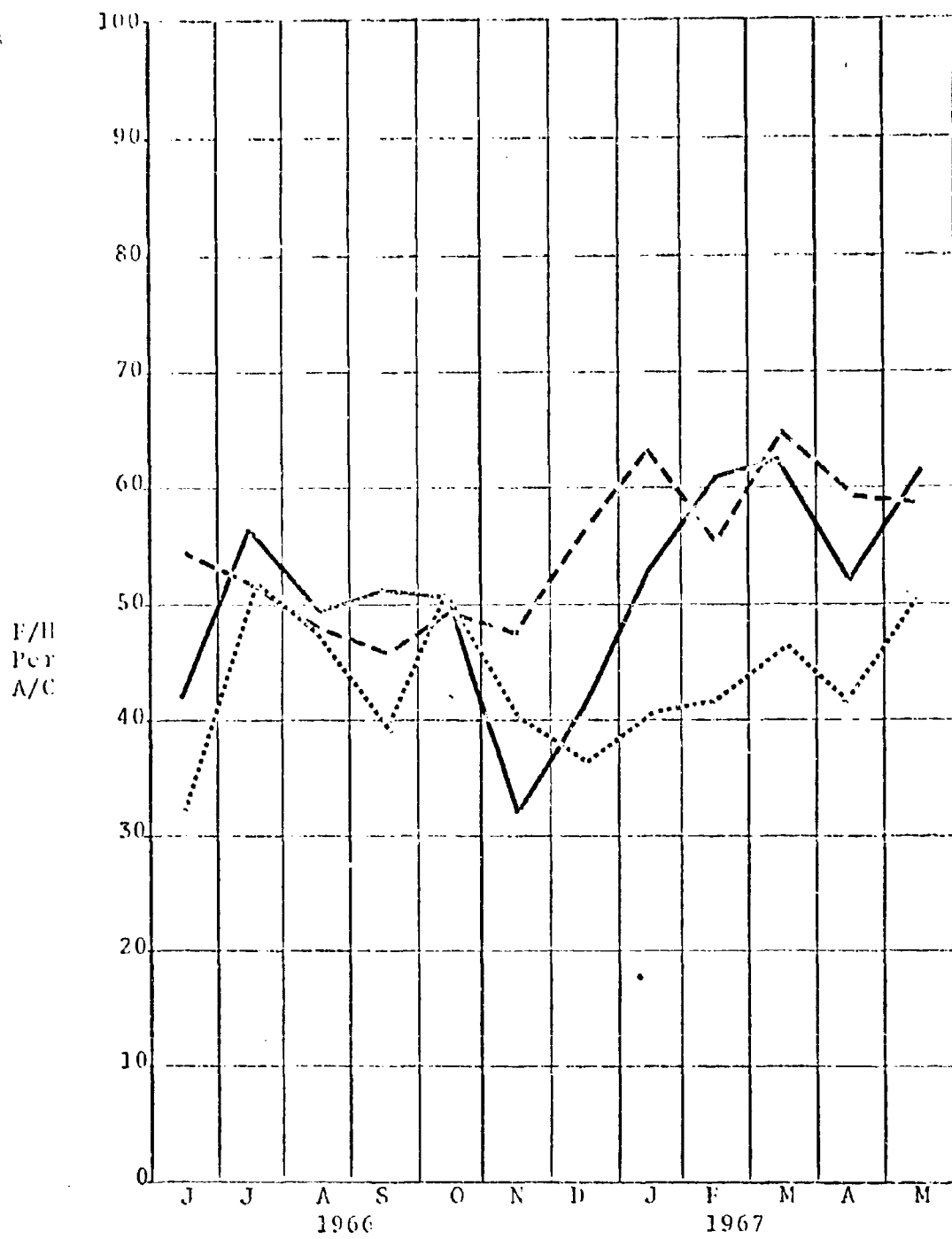
Figure 5-27. Comparison of Average NORM Rates
(Organizational and Field Maintenance Combined)
April 1966 Through May 1967

under the Conventional concept. Throughout these comparisons, the OV-1 rates for the detachments were based on an average of about 32 aircraft but, on the other hand, the OV-1 data for the Airmobile and Conventional concepts were based on an average of only five or six aircraft supported under each. These comprise the total aircraft available at the Divisional level, and random variations due to a non-average situation affecting one or two aircraft are mirrored in the averages because of the small number in the total population.

UTILIZATION

A further analyses was made of aircraft utilization rates under the three concepts. Maintenance workload, at the flying hour rates attained in Vietnam was found to be almost directly related to utilization rates, i.e., an increase in utilization of ten percent will normally increase maintenance workload by about ten percent. Therefore, it was necessary to verify that the higher readiness rate did not result from lower utilization with a correspondingly lower maintenance demand.

A comparison of monthly utilization rates for the period of one year is presented in Figures 5-28 through 5-31, and summarized in Figure 5-32, setting forth average rates by concept for a 14-month period. From these data, it can be seen that the detachments have the highest flying hour rates for three types of aircraft and the second highest for the fourth type. To more clearly relate the utilization rates among the three concepts, a weighted average of all types of aircraft evaluated is also shown in



——— Det. Support
 - - - Airmobile
 Conventional

UH-1B/C

Figure 5-28. Comparison of Monthly Utilization Rates

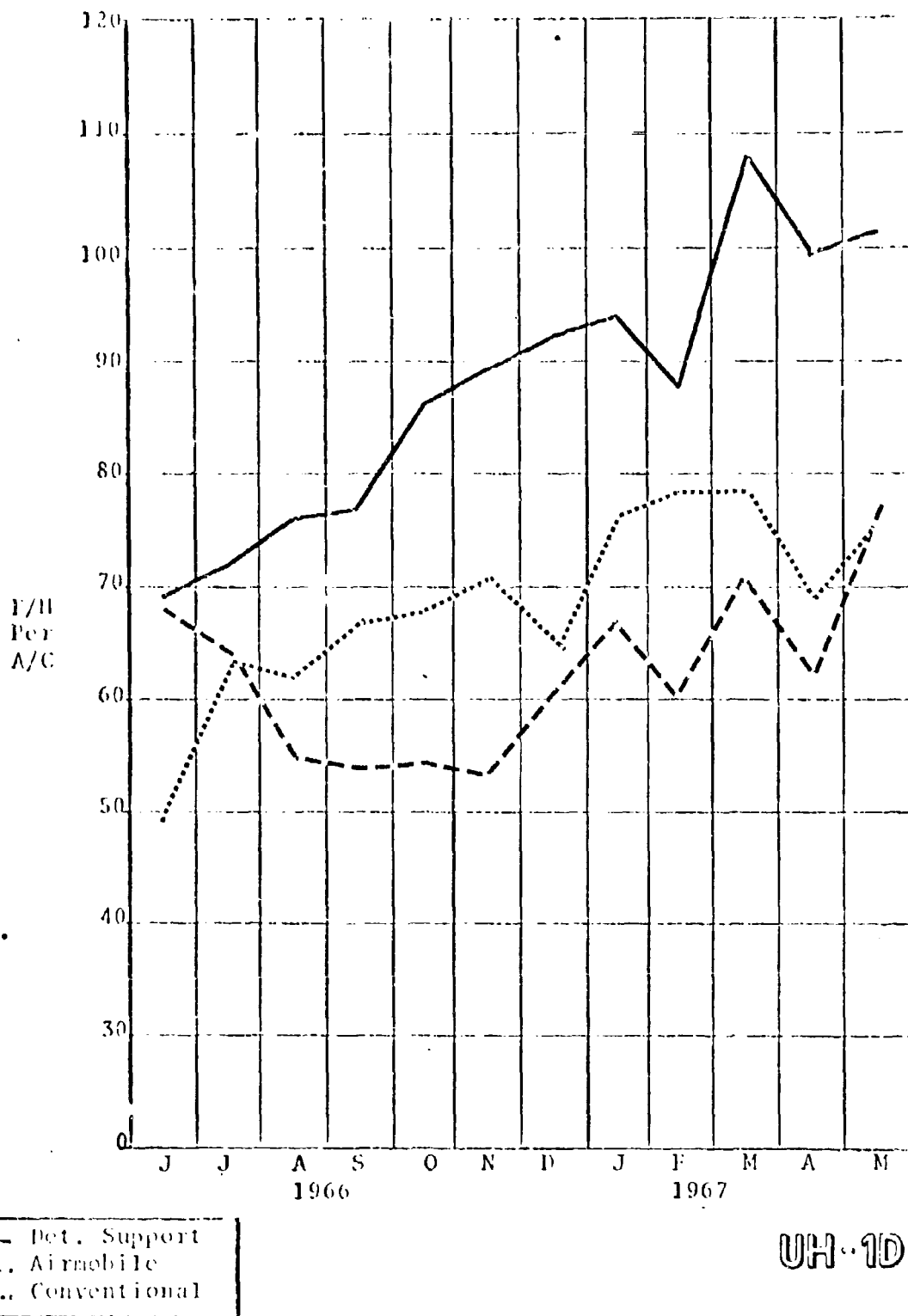
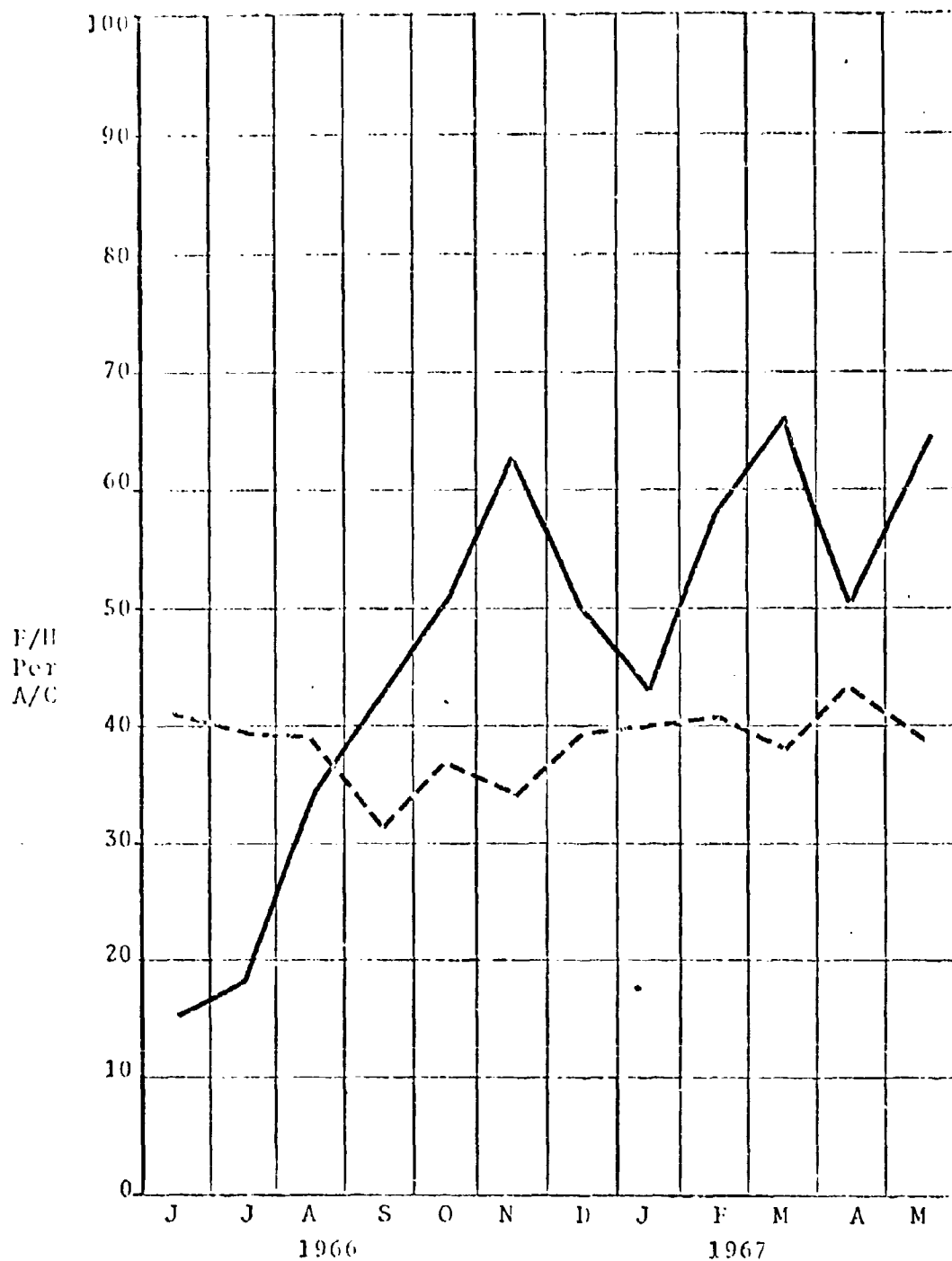


Figure 5-29. Comparison of Monthly Utilization Rates



— Det. Support
 - - - Airmobile
 Conventional

CH-47

Figure 5-30. Comparison of Monthly Utilization Rates

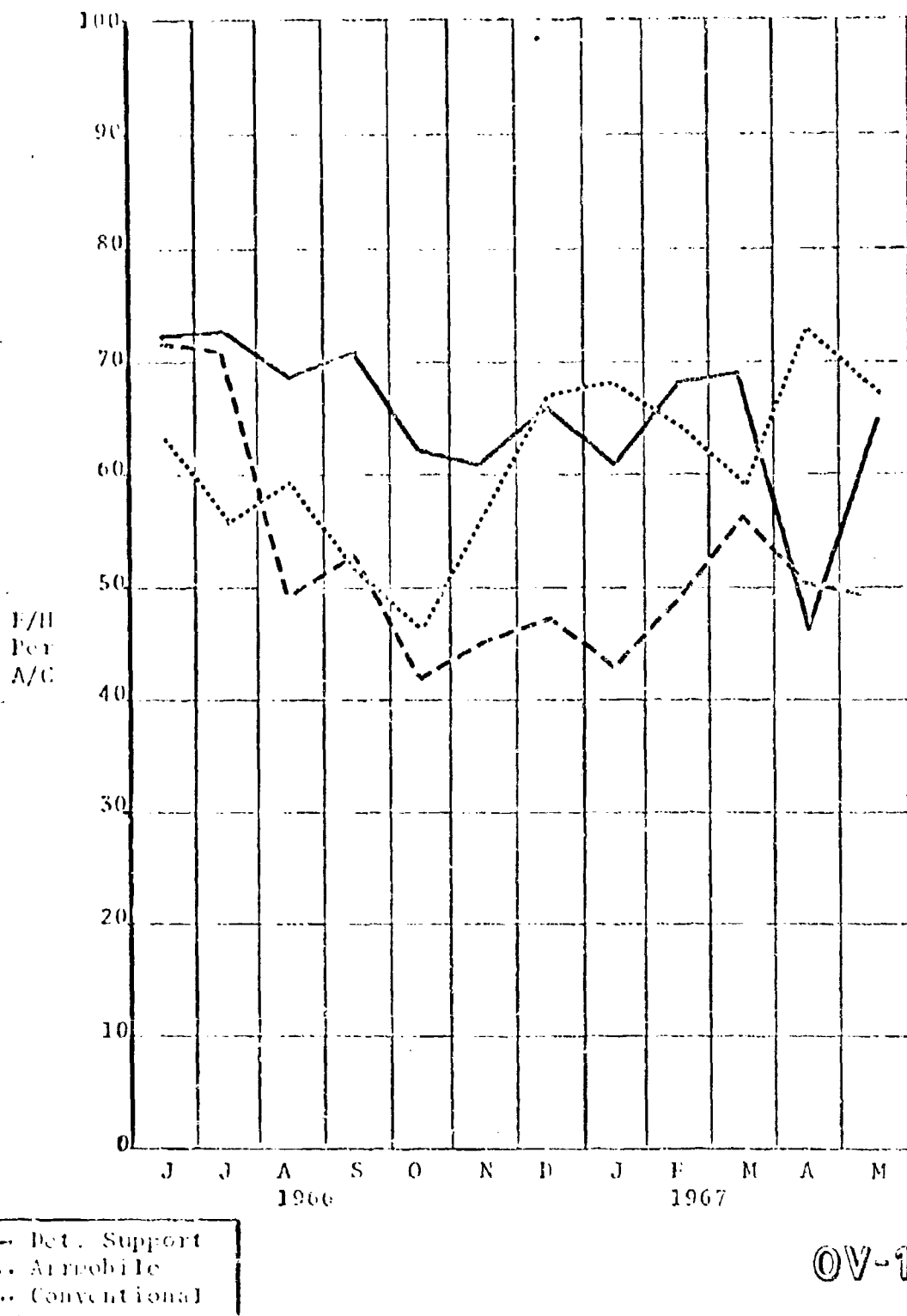


Figure 5-31. Comparison of Monthly Utilization Rates

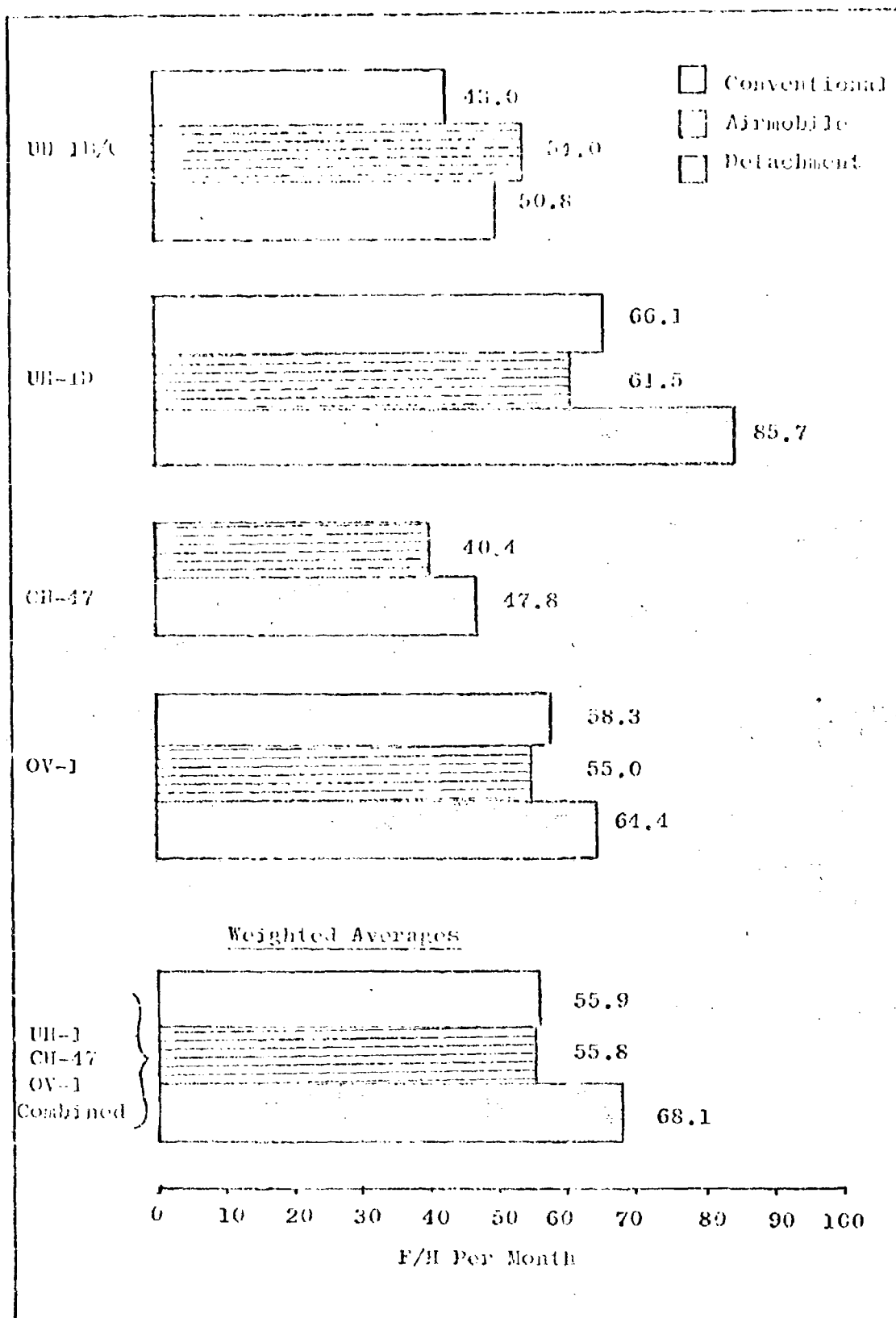


Figure 5 32. Comparison of Average Monthly Utilization Rates - April 1966 Through May 1967

Figure 5-32. This clearly shows a 12 per-cent higher flying rate supported by the Detachments, as compared with the almost identical flying hour rates experienced in the Conventional and Airmobile Organizations.

EFFECTIVENESS SUMMARY

The results of the analysis of aircraft support concept effectiveness measured by readiness, NORM, and utilization are set forth in Figure 3-33. Each of the three concepts is given a Figure of Merit reflecting its ranking in the respective areas. Thus a ranking of ++ is better than a ranking of +, and + is, in turn, better than ○.

Concept	Readiness	NORM	Utilization	Figure of Merit
Conventional	○	○	⊕	○
Airmobile	+	+	⊕	+
Detachment	++	++	++	++

○ = Norm + = Better ++ = Best

Figure 5-33. Comparative Figures of Merit of Maintenance Effectiveness Concepts by Prime Indicators

The Detachment concept is clearly superior in each area, followed by the Airmobile. The Conventional concept attains the same utilization as Airmobile, but with lower readiness and higher NORM. This relative ranking is consistent across the different types of aircraft, and the relationship is apparent from data covering a year of operations. Moreover, the supply factor is irrelevant for the comparison because there was no marked superiority of NORS, across the units studied, under each of the concepts.

CHAPTER 6

CHAPTER 6

RESPONSIVENESS OF SUPPORT

The effectiveness of maintenance performance is reflected in the responsiveness with which maintenance support is rendered, i.e., the length of time that ensues between the recognition of the requirement for maintenance and the return to the user of the aircraft in serviceable condition. The action is, of course, triggered by a maintenance request, and the time that elapses between the maintenance request and the return of the aircraft in serviceable condition is composed both of administrative and technical processes. Thus, the analysis of responsiveness includes:

1. Time from submission of the maintenance request to formal receipt and entry in the maintenance register in the DS unit.
2. Time from receipt of maintenance request to the start of work on the aircraft.
3. Time from start of work to final inspection.
4. Time from final inspection to acceptance of aircraft by the unit.

The fourth factor was found to be widely fluctuating. It appeared strongly dependent on command emphasis, i.e., units whose commanders insisted on the prompt inspection and return of aircraft showed acceptance times lower than the average.^{1/} For this reason, the analysis covers only the first three factors above.

^{1/} The importance of command emphasis is shown, the fact that excessive periods of time frequently occurred, even though the finished aircraft might be on the same ramp or airfield of using unit.

The evaluation covers the UH-1 and CH-47. Support of the OV-1 aircraft, particularly in the two Aerial Surveillance Companies, was highly integrated into the organizational structure, and DS maintenance is not readily defined as a separate function. Moreover, back-up support is provided by contract.

Figure 6-1 presents the results of this analysis, showing the percentage of UH-1 job orders that fell into groupings of time intervals (days) for each of the echelons of maintenance and each of the concepts. Figure 6-2 shows similar information for the CH-47 helicopters in the Assault Support Helicopter Companies of the 1st Aviation Brigade and the 1st Cavalry Division. To facilitate comparison of maintenance responsiveness to operational requirements, these results were further stratified in Figures 6-3, 6-4 and 6-5.

The first two time intervals studied (date submitted to received and date received to work started) were actually the administrative processing of the maintenance request and initiation of maintenance work on the aircraft. Sameday action was considered a desirable and achievable standard to be obtained. Therefore, the percentage of maintenance requests submitted and received the same day were compared for the three maintenance concepts in Item 1 of Figure 6-3. Similarly, under Item 2 of Figure 6-3, a comparison was made of the percentage of instances where the work was started the same day the maintenance request was received. Additionally, Item 3 shows the percentage of instances where work was started the same day or the next day after the maintenance request was received.

Concept	Number of Events	Percent of Job Orders											
		A				B				C			
		Days				Days				Days			
		0	1	2(or more)		0	1	2	3-5	6-10	11-30	31(or more)	
Conventional Infantry Division													
ROAD Div DS Co	139	76	20	4		73	14	13		58	18	16	4
Backup DS Co	1001	83	7	10		87	10	3		28	14	28	16
CS Co	55	73	18	9		69	13	18		26	18	20	22
Airmobile													
Airmobile DS Co	180	87	12	1		82	14	4		36	14	20	12
GS Co	213	67	20	13		52	29	19		18	12	20	9
Detachment													
DS Detachment	1538	94	4	2		81	11	8		63	15	14	4
Backup DS Co	967	84	6	10		87	10	3		28	14	28	16
GS Co	32	72	28	0		84	9	7		0	16	25	34

A- Days from submission of maintenance request (DA Form 2407) by Unit to receipt by DS Maint. Org.
 B- Days from receipt of maintenance request to start of work
 C- Days in work (inclusive)

Figure 6-1. Comparative Distribution (Percent) of Time Intervals in Maintenance Cycle for UH-1 Helicopter Under Alternative Maintenance Concepts

Concept	Number of Events	Percent of Job Orders											
		A		B		C							
		Days		Days		Days							
		0	1 2(or more)	0	1 2(or more)	1	2	3-5	6-10	11-30	31(or more)		
Airmobile													
DS Co	1019	91	7	2	81	11	3	32	23	25	9	8	3
GS Co	59	81	12	7	36	23	36	56	14	10	4	8	8
Detachment													
DS Det	210	98	5	0	87	11	2	78	8	8	4	2	0
Backup DS Co	17	94	6	0	71	23	6	40	6	18	12	12	12
GS Co	59	86	5	9	59	9	32	63	10	15	7	1	4

A- Days from submission of maintenance request (DA Form 2407) by Unit to receipt by DS Maint. Org.
 B- Days from receipt of maintenance request to start of work
 C- Days in work (inclusive)

Figure 6-2. Comparative Distribution (Percent) of Time Intervals in Maintenance Cycle for CH-47 Helicopter Under Alternative Maintenance Concepts

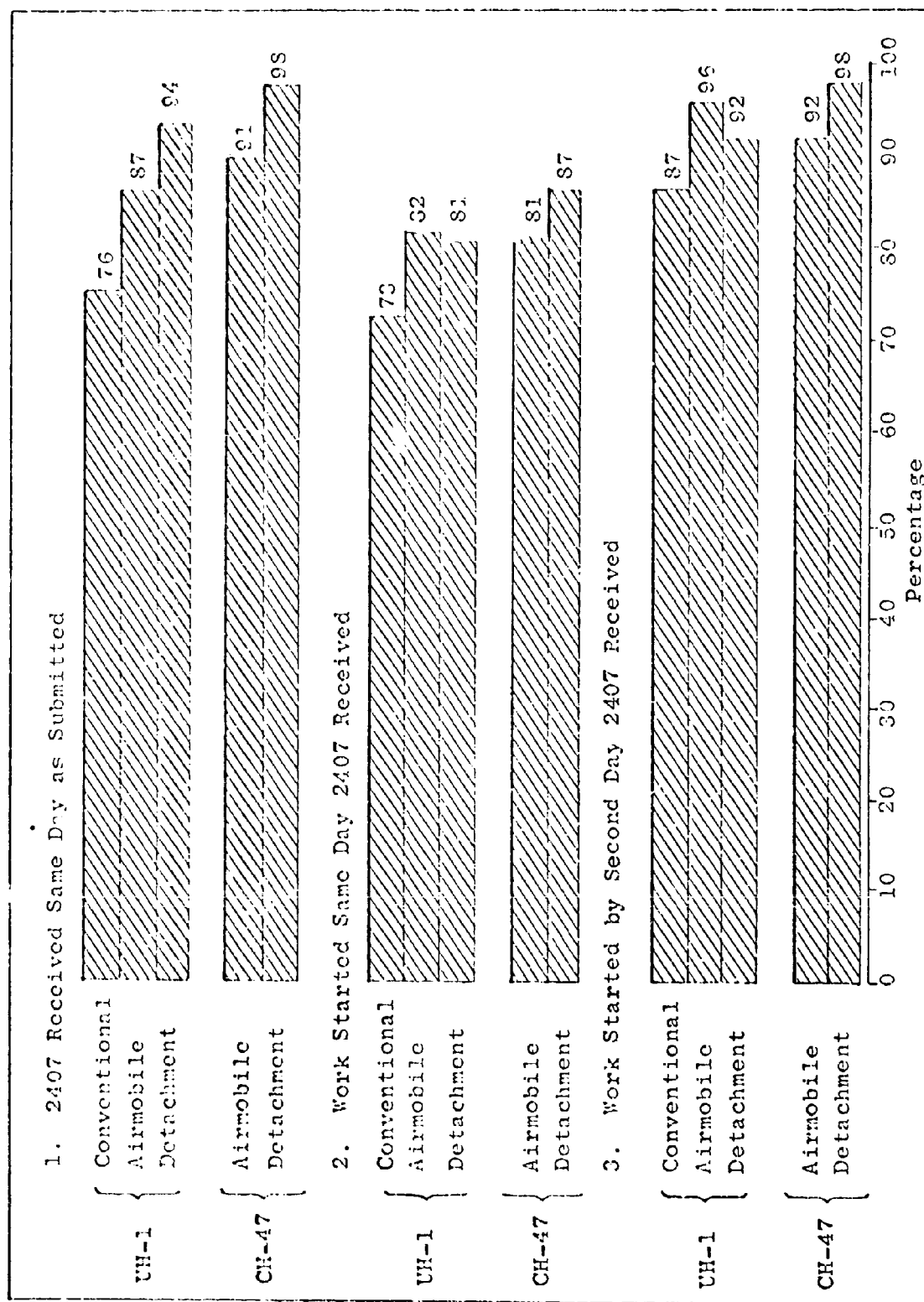


Figure 6-3. Comparative Distribution of Time Intervals in Maintenance Cycle for Inbound Processing of Maintenance Requests

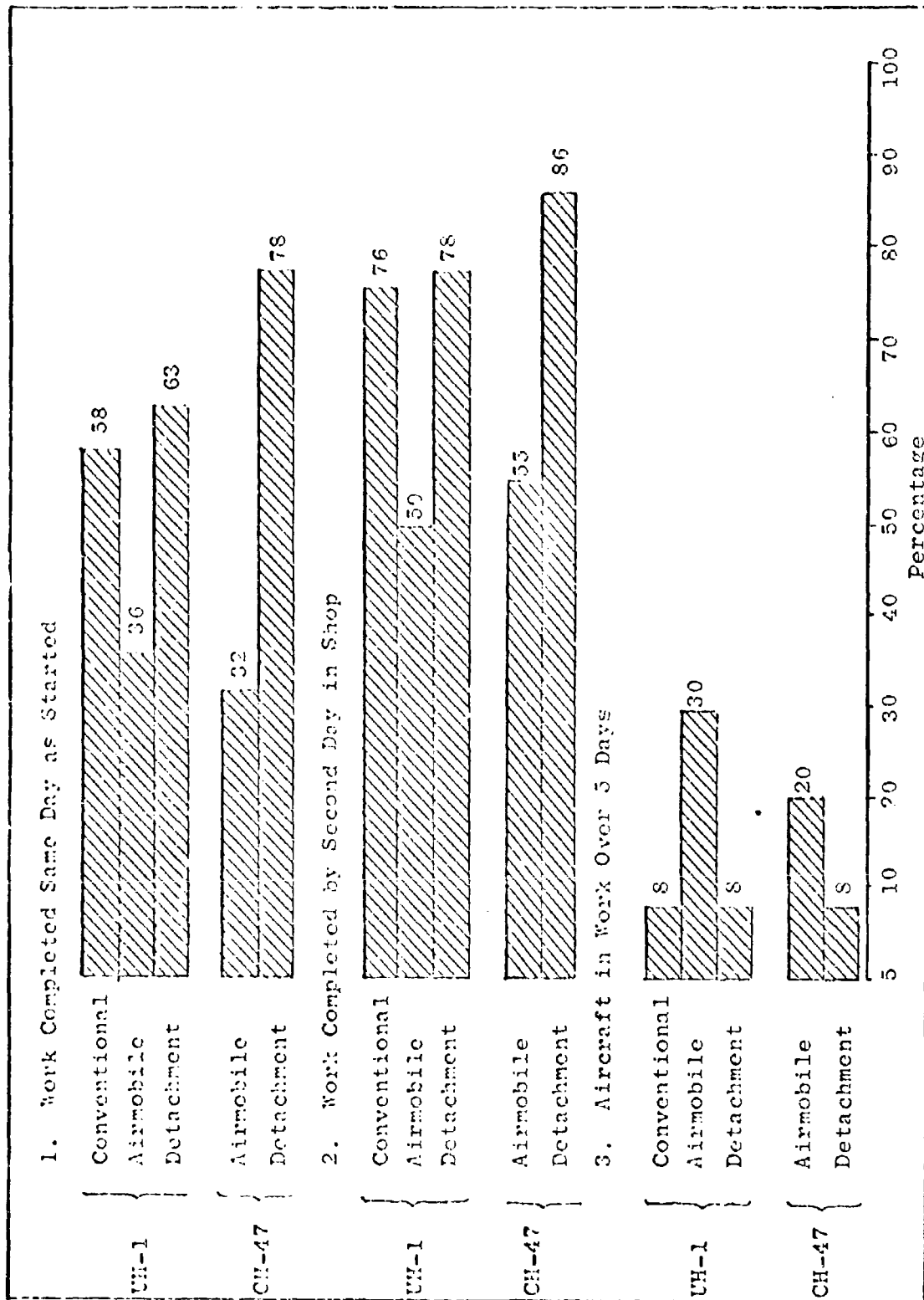


Figure 6-4. Comparative Distribution of Days Aircraft are in Work at DS Maintenance

Cumulative Indicators of Relative DS Responsiveness

- ☒ % of Maintenance Requests Received Same Day as Submitted
- ☐ % of Aircraft Work Started Same Day as Received
- ☒ % Aircraft Job Orders Completed Next Day After Work Started

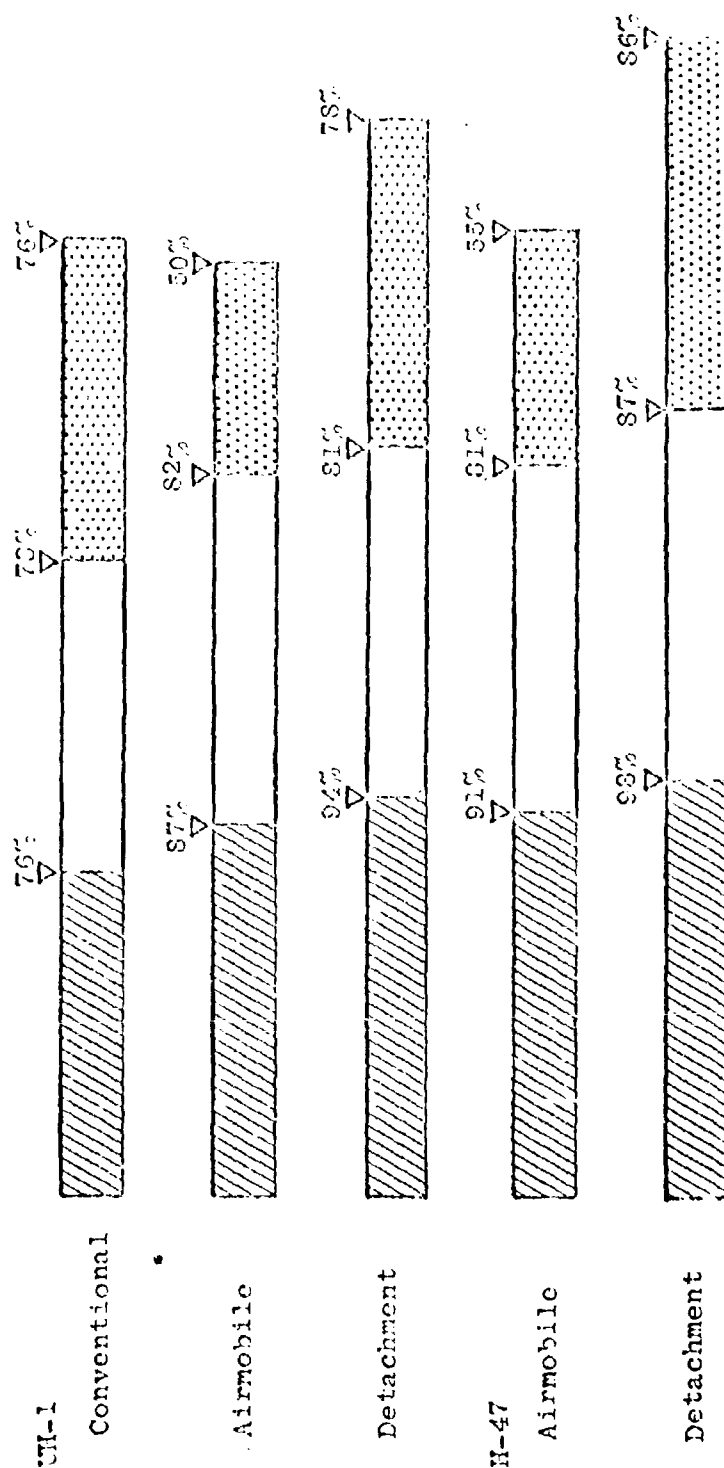


Figure 6-5. Prime Indicators of DS Maintenance Responsiveness Grouped for Simultaneous Presentations

These results show (Figure 6-3) that the Detachment concept had the highest percentage of same-day processing of maintenance requests submitted (Item 1). It was closely followed by the Airmobile concept, but was substantially better than the Conventional Concept.

The Airmobile and the Detachment concepts' rates for same-day induction into work (Item 2) of the UH-1 were essentially the same, and both were significantly higher than the Conventional concept rate. For the CH-47, the Detachment had a higher percentage than the Airmobile Concept.

For work started on the second day (Item 3), the rate for the UH-1 supported by the Detachment concept was slightly lower than the Airmobile concept, but higher than the Conventional concept. However, for the CH-47, the Detachment rate was better than the Airmobile rate.

Figure 6-4 shows the comparative distribution of the days that aircraft are in work at a DS Maintenance element. For the UH-1, for work completed the same day as started (Item 1), or work completed by the second day (Item 2), the Conventional and Detachment concepts had similar rates. These were appreciably higher than that experienced in the Airmobile Division for the same categories. For the CH-47, the Detachment reaction rate was substantially better than that for the Airmobile concept. In Item 3, (the percentage of aircraft in work over five days), a low percentage is, of course, desirable. The Conventional and Detachment concepts showed considerably lower rates than the Airmobile concept.

Figure 6-5 portrays cumulative indicators of relative DS responsiveness. This figure clearly shows a better overall reaction time for the Detachments on both types of aircraft, with the Conventional concept showing a slightly better indication than the Airmobile concept on the UH-1. The differentials in these cumulative indicators are considered sufficient to conclude that the Detachment concept is more responsive in this regard than the other two concepts.

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CHAPTER 7

DISTRIBUTION OF DS AND GS WORKLOAD

GENERAL

To assess the effectiveness of each of the field maintenance concepts, detailed analyses must be made of the workload structure of each concept. The interaction among the various support maintenance levels within each concept (workload at each level) must be carefully dissected to establish the interrelationship between the personnel skills and equipment at each level of support maintenance and the aircraft maintenance requirements filled by those same levels of maintenance.

Two parameters were studied to evaluate the maintenance workloads of the three concepts considered. The first parameter analyzed was the distribution of workload among levels of maintenance for each of the three concepts.

Under the Detachment concept, three maintenance levels were studied. The first was the DS Detachment; the second was the Corps Backup DS Company, and the third, the GS Company.

For the Conventional concept (ROAD Division), three maintenance levels also were studied. The first was the DS Company within the ROAD Division. The second level was the Corps Backup DS Company which supports the ROAD Division, and finally, the GS Company.

In the Airmobile concept, only two maintenance levels were studied. The first was the DS Company within the Airmobile Division. The second was the GS Company in support of the Airmobile Division. No Corps Backup DS Company was studied for the Airmobile concept because it does not use any in actual operation in Vietnam. The four DS Companies within the Airmobile Division provided all Direct Support field maintenance requirements. Discussion of General Support maintenance (GS) includes any maintenance performed at that level by contracted civilian personnel.

The second parameter studied in evaluating maintenance workloads was the distribution of workload by maintenance category. For this study, the workload was stratified into nine separate categories:

1. Airframe repairs which include sheet metal, welding, spot painting and repair or replacement of airframe structural components, parts, bracketry, etc.
2. Component removal and replacement, other than armament, avionics, and airframe structural components.
3. Inspection and inspection assistance to Organizational units.
4. Avionics repair and component replacement.
5. Armament repair and component replacement.
6. Back shop component repair, not related to a serial numbered aircraft.
7. MWO installations.
8. Processing aircraft in and out of the theater.
9. Other maintenance on aircraft.

Because of the special circumstances concerning the maintenance of OV-1 aircraft in Vietnam (as discussed elsewhere in this Report), only the UH-1 and the CH-47 aircraft were studied in this analysis.

UH-1 WORKLOAD REQUIREMENTS

Echelonment
of
Maintenance

A comparison of the percentage of total support maintenance performed by the DS Detachment with that performed by the DS Companies within the respective Divisions under those two maintenance concepts is as follows:

	Percent Field Maintenance
DS Detachment	90.0
DS Co Airmobile Division	83.6
DS Co ROAD Division	82.0

The Detachment fills 90 percent of the maintenance requirements, leaving only 10 percent to be filled by the Corps Backup DS and GS Companies which support it. The Conventional ROAD Division and the Airmobile Division DS Companies fill 82.0 percent and 83.6 percent of the field maintenance requirements respectively. The DS Detachments perform six to eight percent more of the maintenance requirements than either of the two Divisions. Thus, a higher percentage of maintenance is performed in the immediate vicinity of the operating unit under the Detachment maintenance concept than under the two Divisional maintenance concepts. However, the total impact of this differential will be even more significant when considered in relationship to the personnel, supply, and equipment investment costs (discussed in Chapter 9).

The following table presents the distribution of the residual field maintenance performed by the Backup DS and GS Companies under each of the three concepts.

	Percent Residual Maintenance		
	Detachment	Airmobile Division	ROAD Division
Backup DS Co.	99%	0%	95%
GS Co	1%	100%	5%

In the case of the Detachment, 99 percent of the residual support maintenance, or 9.9 percent of the total maintenance requirements, is performed by the DS Company, while only one tenth of a percent is performed by the GS Company.

For the ROAD Division, 95 percent of the residual maintenance is performed by the Backup DS Company, but since the residual maintenance for the ROAD Division represents a total of 18 percent of the total support maintenance, the result is that 17.1 percent of the total field maintenance requirement is performed by the Backup DS Company for the Conventional maintenance concept. Nine-tenths of one percent of the total maintenance requirement for the Conventional ROAD Division is performed by the GS Company. In the case of the Airmobile Division, 100 percent of the residual maintenance is performed by the GS Company. This is obviously the result of the GS Company being physically closer to the Divisional DS Companies than they ordinarily are under the other two concepts. Because of this proximity of the GS Company

to the Airmobile Division, no use is made of its Backup DS Company.

A summary of the distribution of the total maintenance workload is presented in Figure 7-1. These data emphasize the differences in the level at which work is actually accomplished under each of the three concepts. During the time period studied, only 18 percent of the total aircraft assets in the theater were being provided field maintenance by non-divisional companies. The remaining 82 percent of the aircraft were being supported by Divisional DS Companies or DS Detachments. Thus, the relationships shown in Figure 7-1 represent the support distribution for the majority of the UH-1 aircraft since they represent the largest population of any type in the theater.

The most important finding to be made from these data for the UH-1 aircraft is that the Detachment concept is superior to the others since a greater portion of field maintenance is performed in the forward area. That is, 90 percent in the case of the Detachment concept and approximately 83 percent in the case of the two Divisional concepts.

	Percent Detachment Concept	Percent Conventional Maintenance Concept	Percent Airmobile Div Concept
DS Detachment	90.0	-	-
Divisional DS Co	-	82.0	83.6
Backup DS Co.	9.9	17.1	-
GS Co	0.1	0.9	16.4

Figure 7-1. Total Workload Distributions by Level
of Field Maintenance - UH-1

Maintenance
Work
Categories

Figure 7-2 presents the distribution of workload by category of maintenance at each level for the three concepts. The DS Detachment and the DS Company within the Airmobile Division distributions are very similar, but in the levels of supporting maintenance, the differences become quite apparent. In the case of the Detachment concept, the Backup DS Company performs the majority of maintenance on separate components, apparently the primary purpose for which it is used. At GS level, the Conventional maintenance concept and the Airmobile Division concept are approximately equivalent, with one major exception. There was no work recorded on separate components under the Airmobile Division concept. In this case, most component maintenance apparently was identified to a serial numbered aircraft.

The Conventional maintenance concept employs the Backup DS Company and the GS Company differently from either the Detachment or the Airmobile Division. For the ROAD Division, the Backup DS Company provides a relatively well-rounded support, with no one category of maintenance outstanding. The GS Company, in this case, plays a role similar to that of the Backup DS Company of the Detachment; that is, the GS Company primarily provides component repair support for the Detachment. The 63.8 percent separate component maintenance rate for the ROAD Division.

Work Category	Percent Conventional				Percent Detachment				Percent Airmobile			
	Backup		GS Co		Backup		GS Co		Backup		GS Co	
	DS Co	DS Co	DS Co	DS Co	DS Det	DS Co	DS Det	DS Co	DS Co	DS Co	DS Co	GS Co
Components (Replaced)	27.5	23.8	*	*	18.1	*	12.1	16.6	-	-	-	7.2
Work on Sep. Comp.	*	*	63.8	*	0.5	71.1	2.6	*	-	-	*	*
Airframe	44.5	31.8	*	*	28.1	*	74.0	20.4	-	-	-	71.3
Inspection	10.6	12.7	0.4	*	33.3	*	2.7	29.2	-	-	-	4.0
Avionics	0.4	0.1	*	*	0.2	*	*	1.0	-	-	-	*
Other Work on Acft	10.1	29.9	35.8	*	17.5	28.9	6.3	30.2	-	-	-	14.3
MWO	5.5	1.7	*	*	2.3	*	*	2.6	-	-	-	2.3
Armament	1.4	*	-	*	*	*	2.3	*	-	-	-	-
Prepare for CONUS Ship	-	-	*	*	-	-	*	-	-	-	-	0.9

*Insignificant

Figure 7-2. Workload Distribution by Category of Work, UH-1

GS Company compares well with the 71.1 percent rate for the Detachment Backup DS Company. At the DS Company level, the ROAD Division accomplishes a greater amount of its component replacements and airframe repair work. From Figure 7-2, it can be seen that the higher level of performance of the Detachment can be attributed to the fact that component repair and extensive airframe work are performed outside the Detachment. While the Conventional maintenance concept performs its separate component maintenance at GS, it does perform a high percentage of its airframe work at its DS Company. The Airmobile Division performs a large percentage of its airframe repair work at GS maintenance and a higher percent of its component work at the DS Company level.

It should be noted that armament maintenance on division aircraft is accomplished within the division. This can be compared in Figure 7-2 with the Detachment Concept in which a significant percent (2.3) of maintenance of the General Support company is armament.

CH-47 WORKLOAD REQUIREMENTS

The following chart presents the distribution of field maintenance for the CH-47 in both the Detachment concept and the Airmobile Division concept.

	Percent Field Maintenance	
	Detachment	Airmobile Division
DS Detachment or Company	96.1	96.0
Backup DS Co	3.1	0
GS Co	0.8	4.0

96 percent of the support maintenance requirements was filled by the DS Detachment and a DS Company respectively. The remaining

four percent falls primarily to the Backup DS Company under the Detachment concept, and totally to the GS Company in the Airmobile Division concept.

Though the percent of field maintenance performed at the lowest level of maintenance is approximately the same for both concepts, the capability of the Airmobile Division DS Company is far superior to that of the DS Detachments. These greater capabilities of the Airmobile Division are further demonstrated in Chapter 9, in which equipment, supply, and personnel investments are analyzed. The conclusion might be that the Detachment is performing its field maintenance mission more effectively and economically than is the DS Company of the Airmobile Division. In both cases, however, it must be remembered that this aircraft has been receiving special support in the way of supply, technicians, etc., which probably accounts for the same workload distribution for the Detachment and the Airmobile DS Company. The distribution of the residual maintenance follows the pattern of the UH-1.

Maintenance
Work
Categories

Figure 7-3 presents the results of the work category analysis for the CH-47 aircraft. The largest percent of workload occurs for the airframe category in both the DS Detachment and its Backup DS Company. This level of airframe repair work in the forward echelon is an important factor in the support of these aircraft.

Work Category	Percent Detachment			Percent Airmobile		
	DS Det	Backup DS Co	GS Co	DS Co	Backup DS Co	GS Co
Components (Replaced)	19.9	12.4	15.6	24.2	-	*
Work on Sep. Comp.	0.7	1.2	11.0	*	-	73.4
Airframe	55.2	60.2	15.6	38.4	-	*
Inspection	3.3	5.0	11.3	13.0	-	0.8
Avionics	4.1	2.8	1.2	0.9	-	*
Other work on acft	16.8	18.3	4.7	21.1	-	4.1
MWO	*	0.1	2.0	2.4	-	21.7
Prepare to Evac. to CONUS	-	-	38.6	-	-	*

*Insignificant

Figure 7-3. Workload Distribution by Category of Work. CH-47

The GS Company of the Airmobile Division provides primarily component repair maintenance support (73.4 percent of the residual maintenance) and MWO installation support. In the case of the Detachment, the GS Company provides a well-rounded maintenance support. Long term jobs in nearly every category of maintenance are evacuated back to the Backup DS Company, and to the GS Company, leaving the Detachment free to perform the smaller, quick turnaround maintenance tasks.

CHAPTER 8

CHAPTER 8

SUPPLY PERFORMANCE

The evaluation of operational effectiveness parameters in Chapter 5 of this Report indicated no significant difference in NORS performance among the various concepts being studied. It is of interest to determine how this highly comparable NORS performance was accomplished under each concept.

NORS Rates

Starting from the base point developed in Chapter 5, Figure 8-1 is a time trend analysis of NORS rates experienced by specific units operating with the Conventional maintenance concept and compared to the other two concepts. Although in Chapter 5 it was noted that average NORS rates in the three concepts, were similar, it is obvious from Figure 8-1, that there is a real difference in the NORS rates among specifically identified units. Field investigations indicate that the primary difference in NORS rates can be attributed, not to the particular maintenance concept itself, but to the distances between the maintenance units and the main supply activity, and the total time required to deliver aviation spare parts from the central supply to the maintenance units. The delivery time of aviation spare parts to units which have additional intermediate supply sources (e.g., UH-1 detachments) are also primarily determined by their distance from the AMMC, since it is the ultimate supply source for all units in Vietnam.

It will be noted from Figure 8-1 that the Airmobile Division DS Companies have had a high NORS rate over the entire time period covered. Field investigations indicate that the order-ship-time for requisitions from the Central Supply Agency (AMMC) to the Airmobile Division is from three to

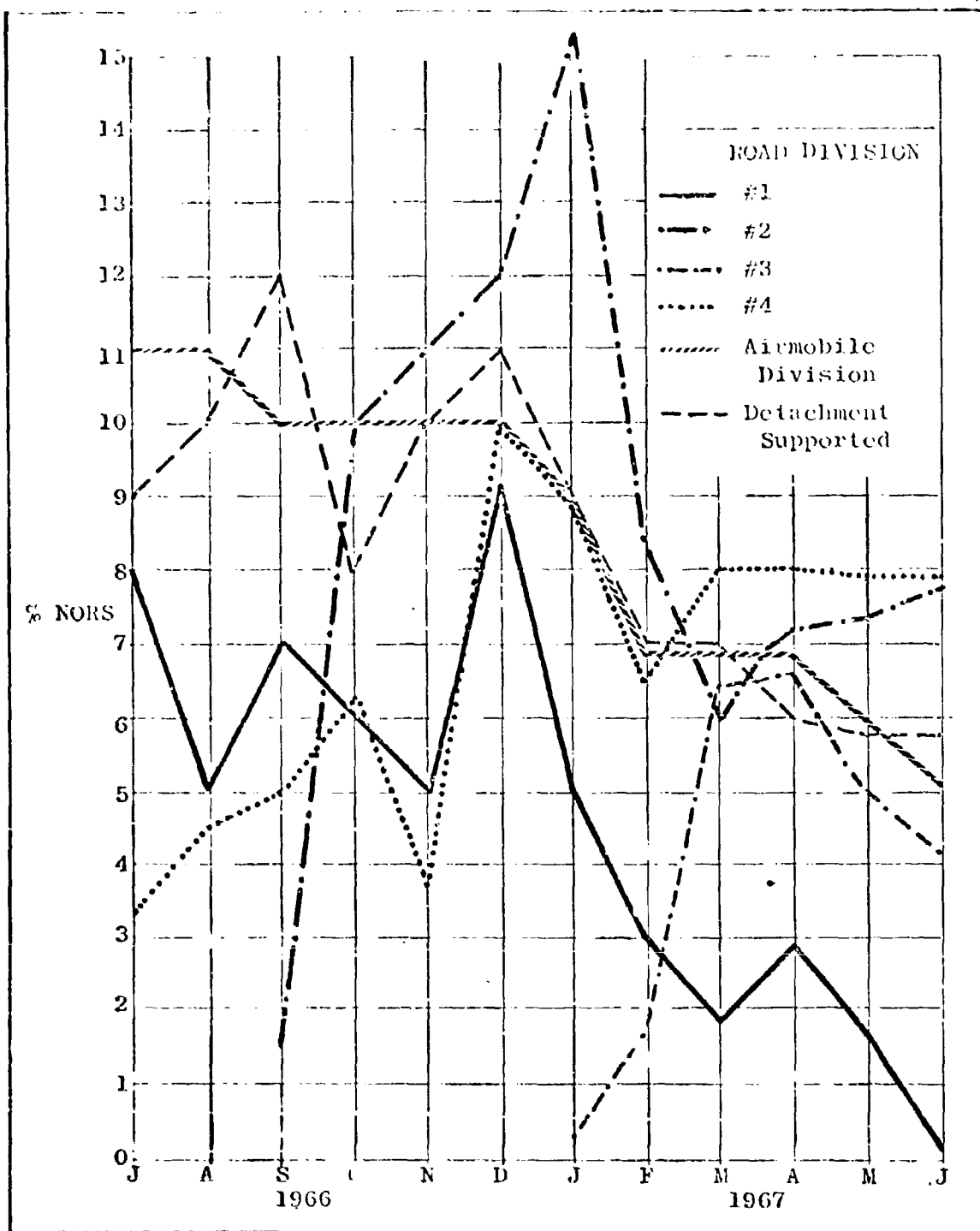


Figure 8-1. UH-1 Helicopter Not Operationally Ready: Supply (NORS)

five days, usually closer to the five-day mark.

The NORS rates for the various ROAD Divisions (Conventional concept) are also a function of distance. ROAD Division No.1, located a distance of 20 miles from the AMMC, has a maximum requisition delivery time of 24 hours. ROAD Division No.2, at a considerably greater distance has a delivery time of three days. Although this division had an exceptionally high NORS rate for October 1966 through January 1967, the initial months of operations in the theater, its NORS rate has now stabilized at a point equivalent to those units, a similar distance from the central supply point. ROAD Division No.3, has a delivery time of one to two days, and is lower in NORS than the average. ROAD Division No.4 has an average delivery time of two days.

Reviewing the trends in Figure 8-1, it is noted that ROAD Division No.1 is extremely low with ROAD Division No.3 next, which reflects the short order-ship-time of requisitions, regardless of whether they are EDP or routine. On this basis, it might be concluded that the time required to fill EDPs is not a function of the particular maintenance concept employed by the activities, but is a direct function of distance from the point of supply.

Demand
Accommodation
and Demand
Satisfaction

The next area of research consisted of an evaluation of the Demand Accommodation and Demand Satisfaction rates of the activities supporting the various units operating

under the three maintenance concepts. Figure 8-2 presents the averages of the supply performance for these DS units for an eight to ten month period up to December 1966. For this study, 24 UH-1 Detachments, 3 CH-47 DS Detachments, 2 OV-1 DS Detachments, 1 ROAD Division DS Company, 4 Airmobile DS Companies, 7 Corps DS Companies and 1 General Support Company were evaluated.

Figure 8-3, the supply performance report of the 58th Battalion, AMMC, is included for comparative purposes only.

It will be noted that the comparison of the number of lines on the ASLs among the various units (and maintenance concepts) is not really suggestive of any correlation with type and/or number of aircraft being supported. This, of course, has been verified by many other studies in this same area which indicates a requirement for further investigation into the basis for the development of ASLs. However, the supply performance of these units may be measured on the basis of the degree to which the ASL actually satisfied their requirements.

The Demand Accommodation rates of the UH-1 DS Detachment, the Airmobile DS Companies, and the independent (Corps) DS Companies were approximately the same at 75 to 80 percent. The ROAD Division DS Company had a Demand Accommodation of 60 percent. The CH-47 and OV-1 DS Detachments had the lowest Demand Accommodation rate of all the DS activities, 52 percent for the OV-1 and 60 percent for the CH-47. Of course, these

Sample Size	UH 1 DS Det (24)	CH 47 DS Det (3)	OV-1 DS Det (2)	ROAD DIV DS Co (1)	Vermobile DS Co (4)	Corps DS Co (7)	GS Co (1)
Lines on ASL							
Acft	1374	795	852	2811	2158	6549	653
Arm	243	95	-	580	310	1248	-
Avnc	429	2913	1489	743	234	3557	-
Mission Ess							
Acft	978	435	525	480	-	3925	189
Arm	231	95	-	346	-	964	-
Avnc	414	2963	239	648	-	2336	-
Zero Bal							
Acft	309	159	151	1097	520	2245	209
Arm	127	19	-	216	256	589	-
Avnc	150	364	974	257	62	798	-
Req Received							
Acft	722	857	346	2175	2378	6531	924
Arm	89	-	-	370	165	527	-
Avnc	25	233	284	103	126	742	-
Match ASL							
Acft	543	513	148	1314	1790	5140	200
Arm	78	-	-	170	104	465	-
Avnc	25	14	252	13	60	479	-
Filled ASL							
Acft	309	334	109	947	944	2844	100
Arm	39	-	-	109	60	220	-
Avnc	16	12	58	8	32	432	-
PERCENTAGES							
Dem. Acc							
Acft	75.2	59.9	42.8	60.4	75.3	78.7	21.6
Arm	87.6	-	-	45.9	63.0	88.2	-
Avnc	100.0	6.0	88.7	12.6	47.6	64.6	-
Dem. Sat.							
Acft	59.9	65.1	73.6	72.1	52.7	55.3	50.0
Arm	50.0	-	-	64.1	57.7	47.3	-
Avnc	64.0	85.7	23.0	61.5	53.3	90.2	-
Zero Bal							
Acft	22.49	20.00	17.72	39.03	24.08	34.28	32.01
Arm	52.26	20.00	-	37.24	20.65	47.20	-
Avnc	34.97	12.50	65.41	34.59	26.50	22.43	-
No EDP	117	155	40	511	467	906	223

*Based on 8 to 10 month period ending December 1966

Figure 8-2. Average Direct Support Supply Performance*

	Acft	Arm	Avnc	Total	Order- Ship-Time
Lines on ASL	20,420	1,740	8,084	30,244	-
No. Dem. Supp.	20,420	1,740	8,084	30,244	-
No. Comb. Miss. Iss.	-	-	-	-	-
No. at Zero Bal.	4,449	588	1,665	6,672	-
Total No. Fringe OH	14,261	462	1,306	16,029	-
Total No. Req. Rec.	46,073	4,140	4,554	54,767	-
No. Match ASL	37,214	3,673	3,708	44,600	-
No. Filled ASL	28,078	2,811	3,252	34,141	-
No. Fringe Reqn.	8,859	462	846	10,167	-
No. Filled Fringe	6,918	167	629	7,714	-
No. Reqn. Subm.	11,598	-	-	11,598	-
No. EDPs	4,746	-	-	4,746	19
02 (Non EDP)	4,379	-	-	4,379	51
05	2,052	-	-	2,052	69
12	421	-	-	421	81
17	-	-	-	-	121
Percent Zero Bal.	21.8	33.8	20.6	22.1	-
Dem. Acc.	80.8	88.8	81.4	81.4	-
Dem. Sat.	75.5	76.4	87.7	76.5	-
Fringe % OH	47.2	28.6	16.9	40.5	-

Figure 8-3. AMEC Supply Performance, Dec 1966

two aircraft types are the most complex of all in the Army inventory. However, they have also had the support of specialized teams, tech reps, special supply procedures, etc., which have the problems of complexity to a degree. This is particularly apparent in the Demand Satisfaction rates for these aircraft.

Demand Satisfaction, a measure of the degree to which the supply activity can satisfy demands that are placed against its Authorized Stockage Lists (ASL), reveals a somewhat different picture from that of Demand Accommodation. The CH-47 and OV-1 DS Detachments had the highest percent Demand Satisfaction, 65 percent and 74 percent respectively. This was accounted for by the relatively low zero balances for these units which probably resulted from the special supply support given these aircraft. The ROAD Division DS Company also enjoyed 72 percent Demand Satisfaction. All other activities varied from a low of 50 percent to a high of 59.9 percent Demand Satisfaction, a very small differential. In each of these instances, the percent zero balance had a smoothing effect on the Demand Satisfaction which resulted in approximately the same level results.

From Figure 8-3, it is noted that the Demand Accommodation and Demand Satisfaction was somewhat higher for the 58th Battalion than for the DS units being supported. The percent zero balance was approximately equal to the supported units.

Supply Study
in Depth

From the above, it is evident that no conclusive decision could be made as to the relative merits of any of the maintenance

concepts with regard to their supply performance. Therefore, the evaluations were carried to a greater depth of detail in the evaluation of the UII-1 DS Detachment supply performance to determine whether there were any distinguishable trends which might be used. Figure 8-4 shows the results of an analysis on the correlation of number of requisitions filled from the ASL and the number of items on the ASL. Needless to say, the scattering of these data indicates that there is no definite pattern which can be distinguished.

The NORS rates were then correlated with the number of requisitions filled from the ASL in Figure 8-5. Here again, it will be noted that a wide scattering of the data permits no definite correlation without an extremely large degree of error.

The NORS rates were correlated with Demand Accommodation (Figure 8-6) and Demand Satisfaction (Figure 8-7). No distinguishable correlation factors could be developed in either of these instances.

The final evaluation in this area was to correlate the percent NORS rates with the number of ASL lines carried. These results shown in Figures 8-8 through 8-11 for aircraft, armament and avionics indicate that no positive correlation can be developed in any of the areas. The sample in the case of avionics is much too small to develop any conclusion with the data from aircraft items and armament indicating that an expansion of the avionics will probably result in a scattering of data with no positive correlation.

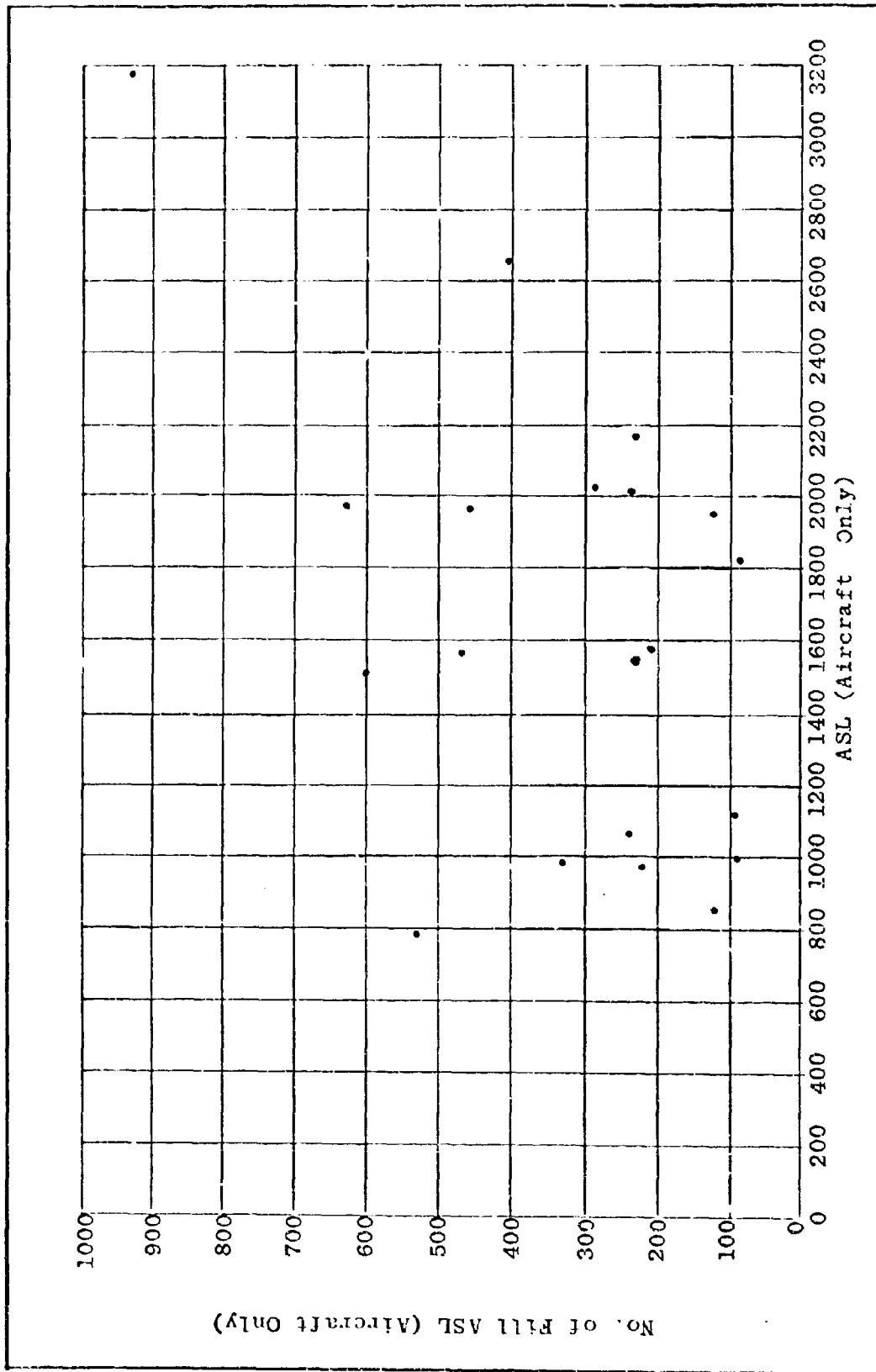


Figure 8-4. UH-1 Direct Support Detachment Supply Performance - ASL vs Number of Requisitions Filled from ASL (Aircraft Only)

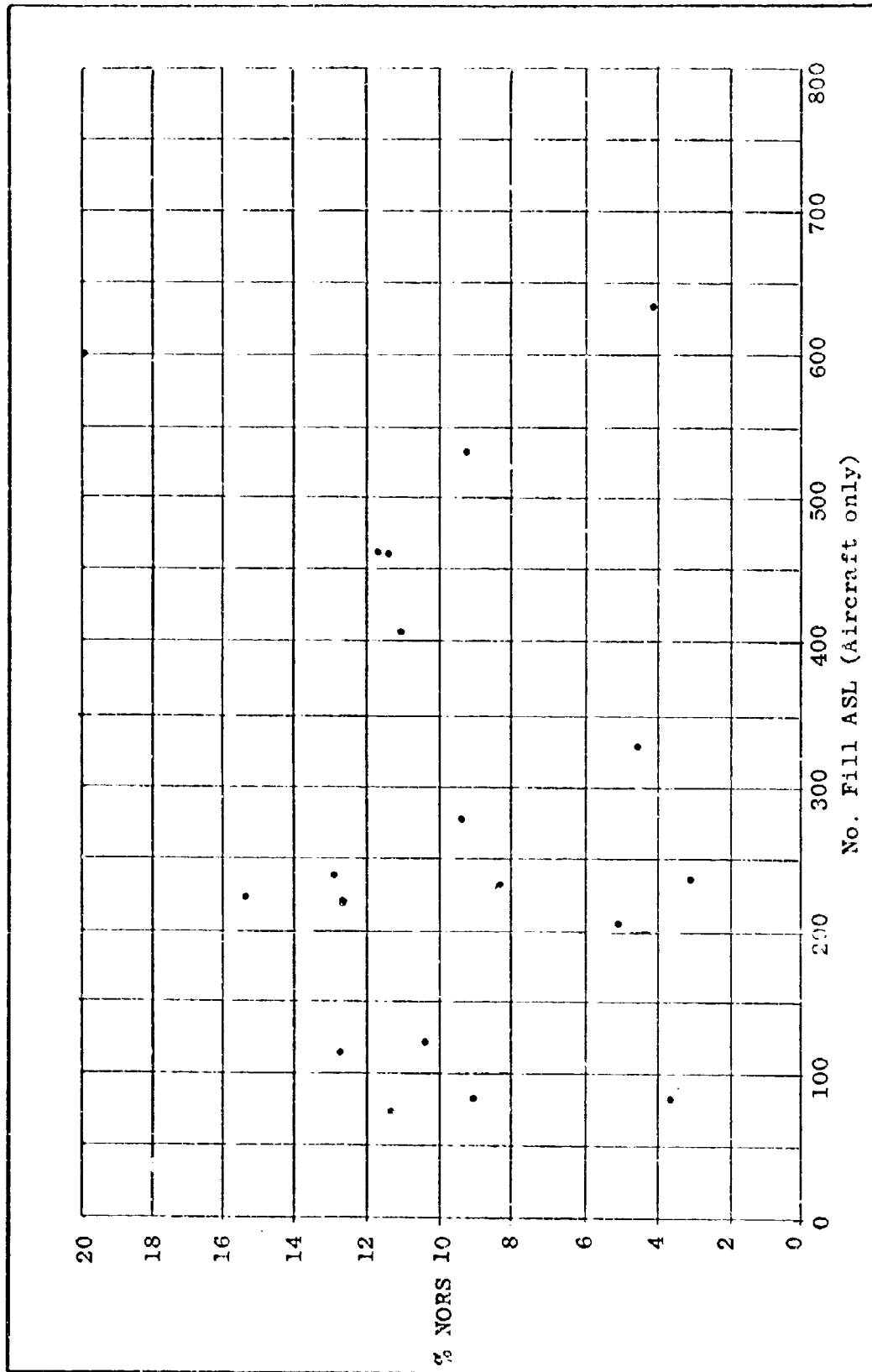


Figure 8-5. UH-1 Direct Support Detachment Supply Performance - Number of Requisitions Filled From ASL vs % NORS (Aircraft Only)

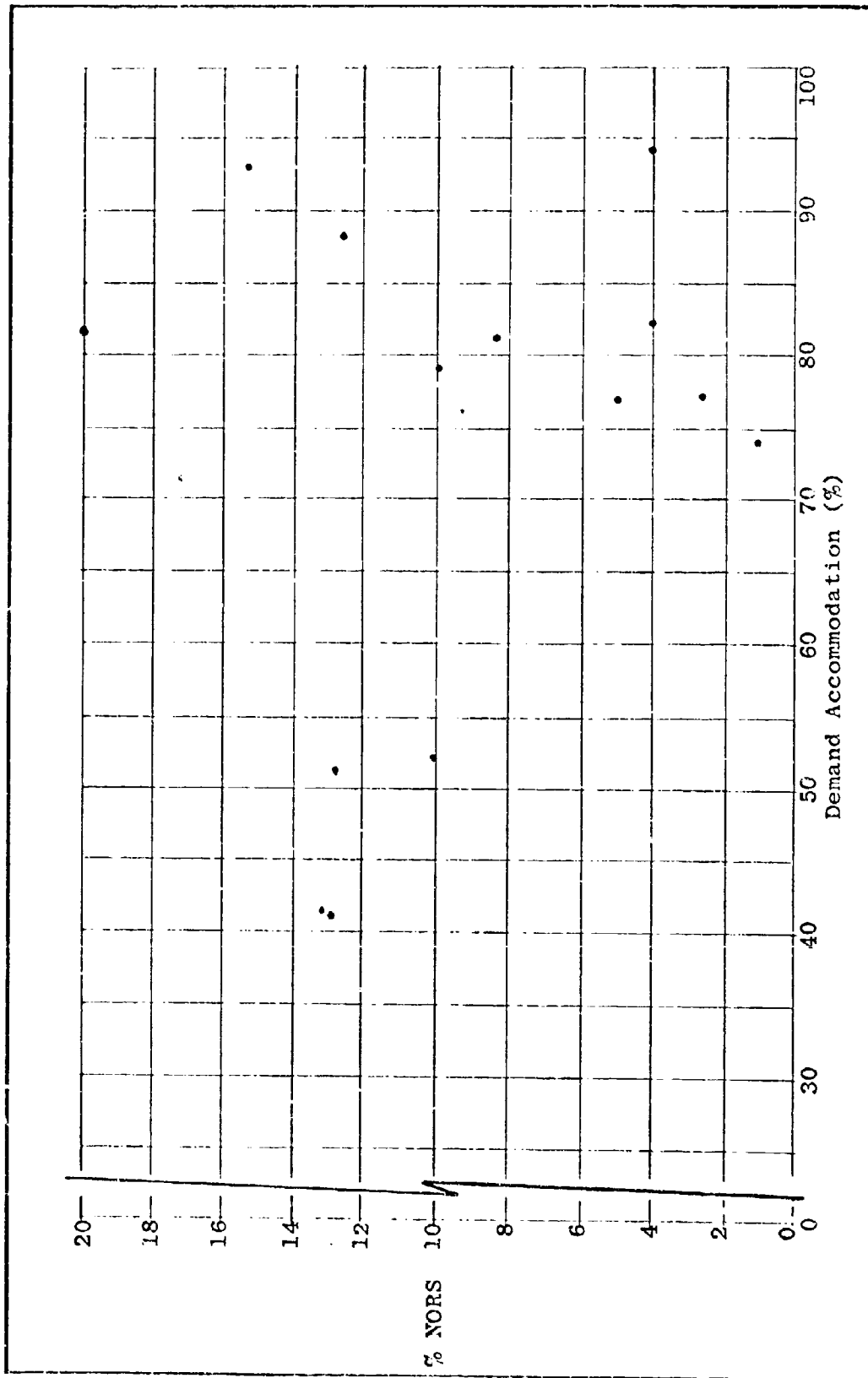


Figure 8-6. UH-1 Direct Support Detachment Supply Performance - Demand Accommodation vs % NORS

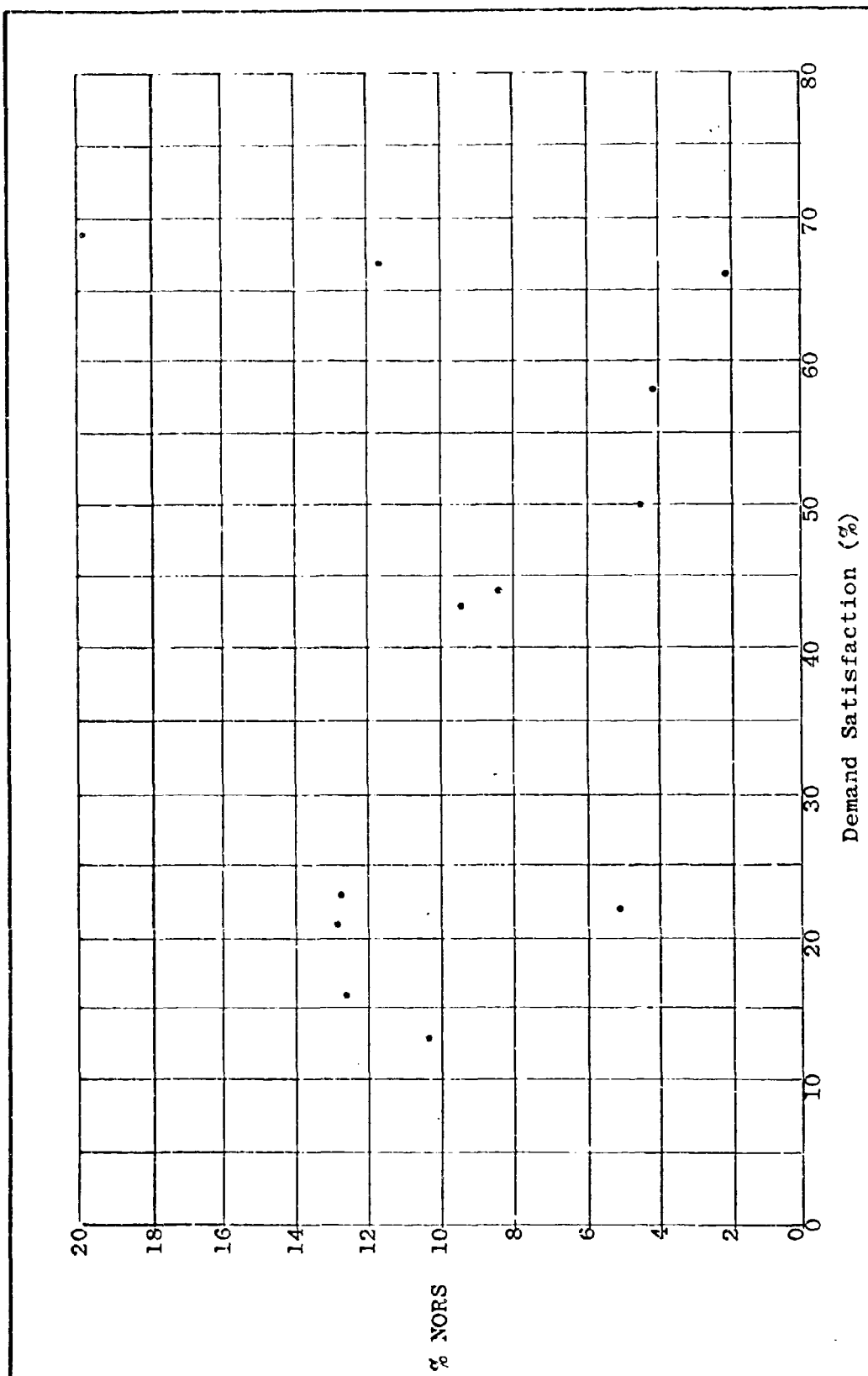


Figure 8-7. UH-1 Direct Support Detachment Supply Performance - Demand Satisfaction vs % NORS

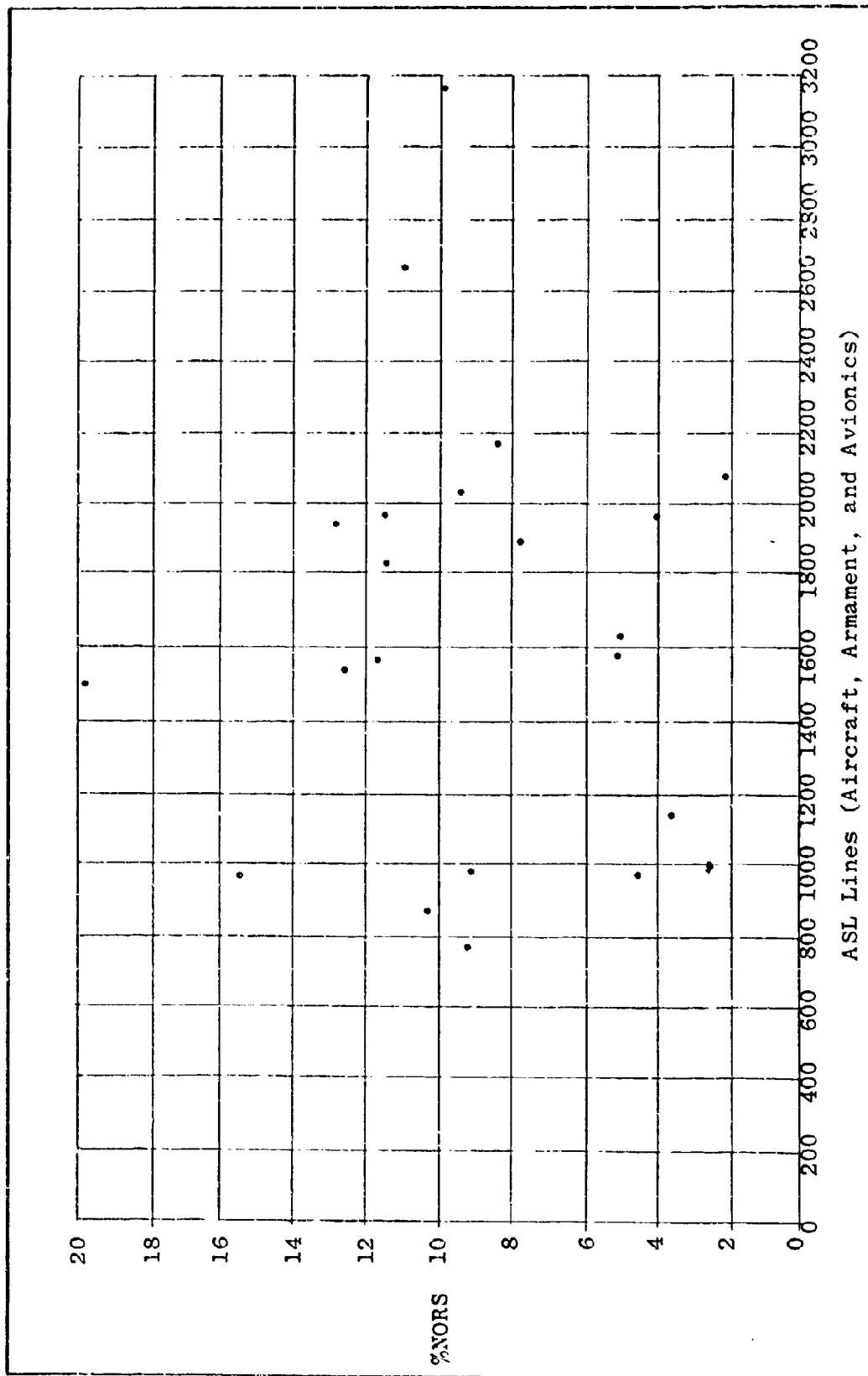


Figure 8-8. UH-1 Direct Support Detachment Supply Performance -
ASL Lines vs % NORS

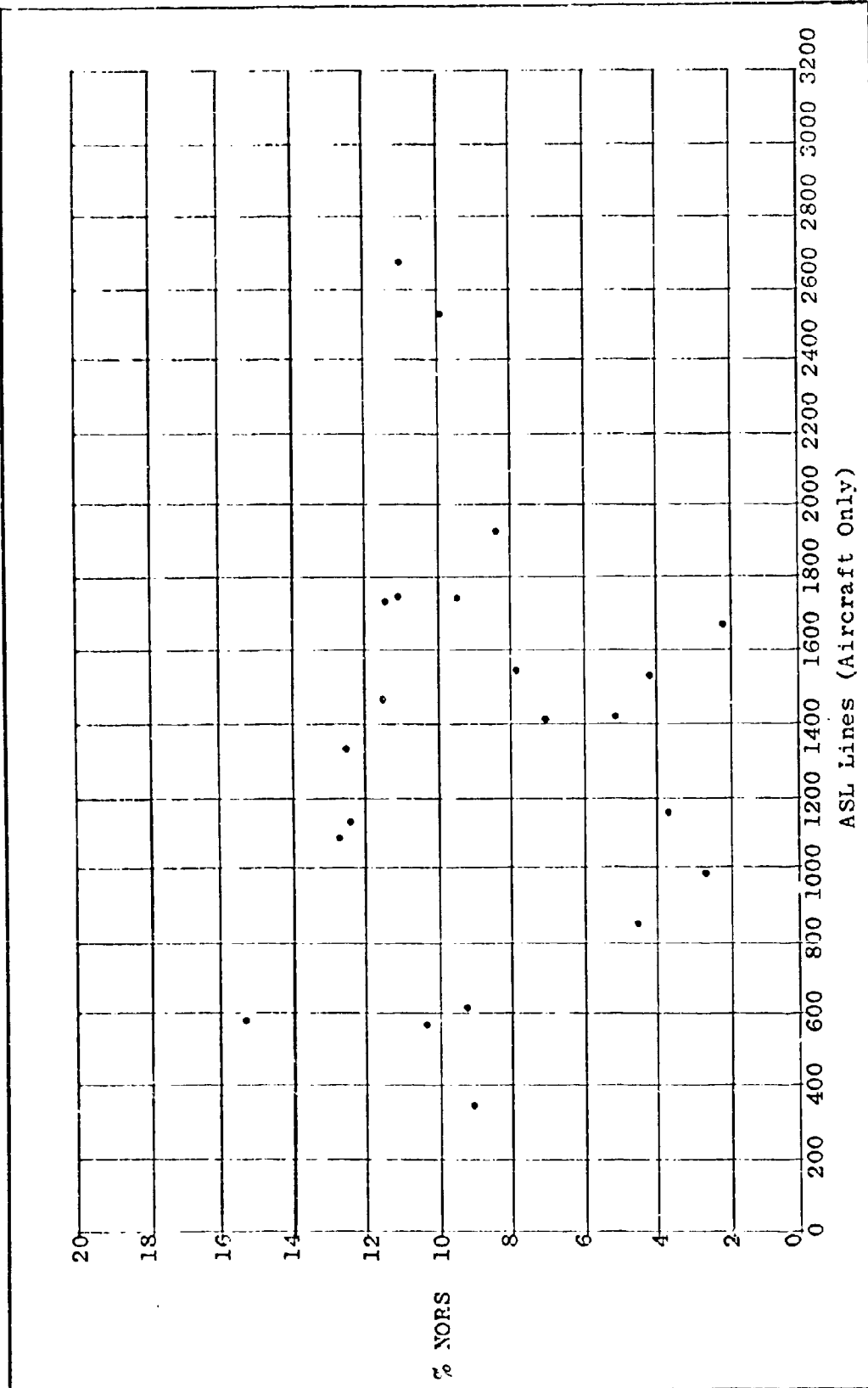


Figure 8-9. UH-1 Direct Support Detachment Supply Performance -
ASL Lines vs % NORS (Aircraft Only)

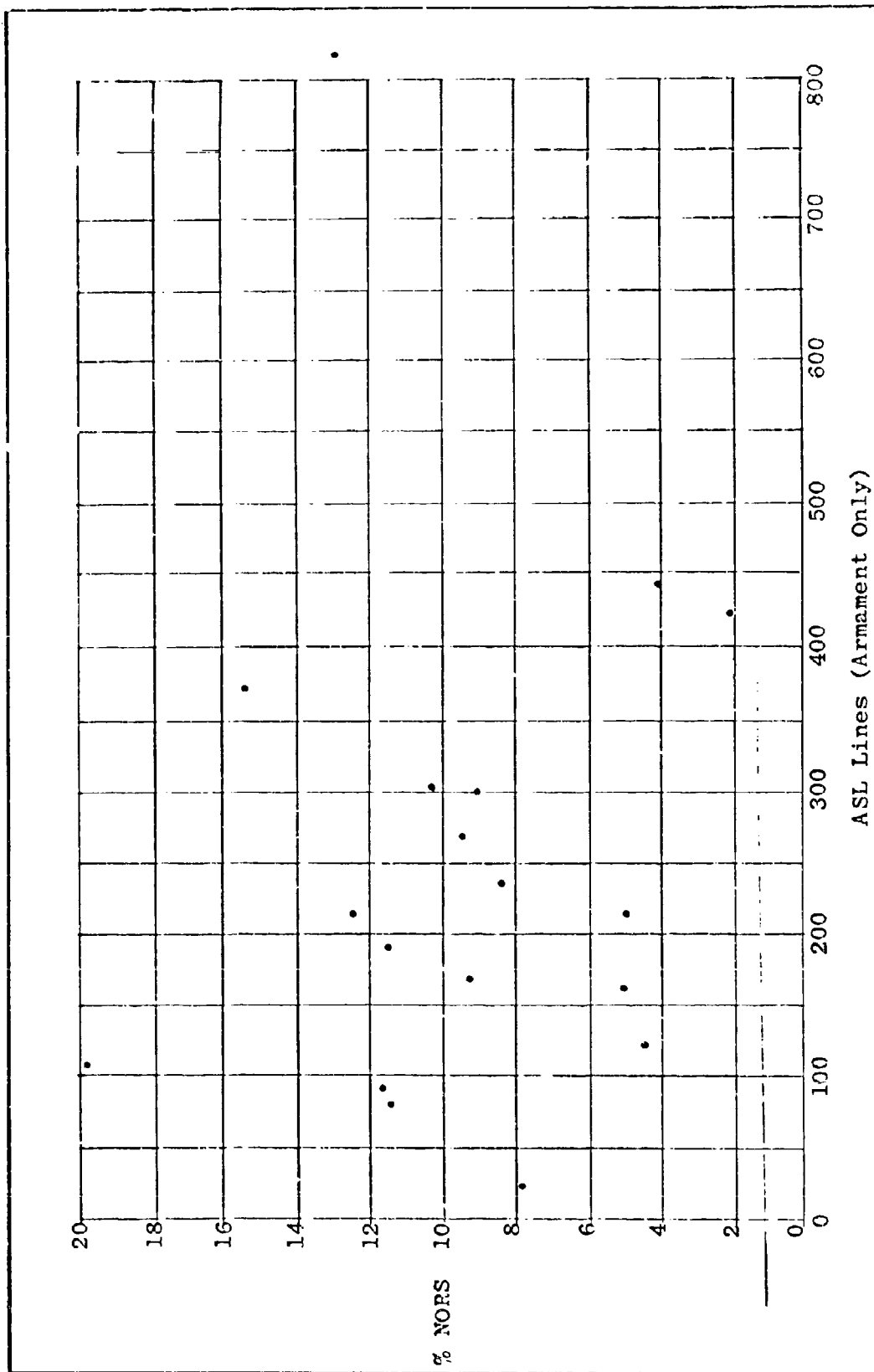


Figure 8-10. UH-1 Direct Support Detachment Supply Performance -
ASL Lines vs % NORS (Armament Only)

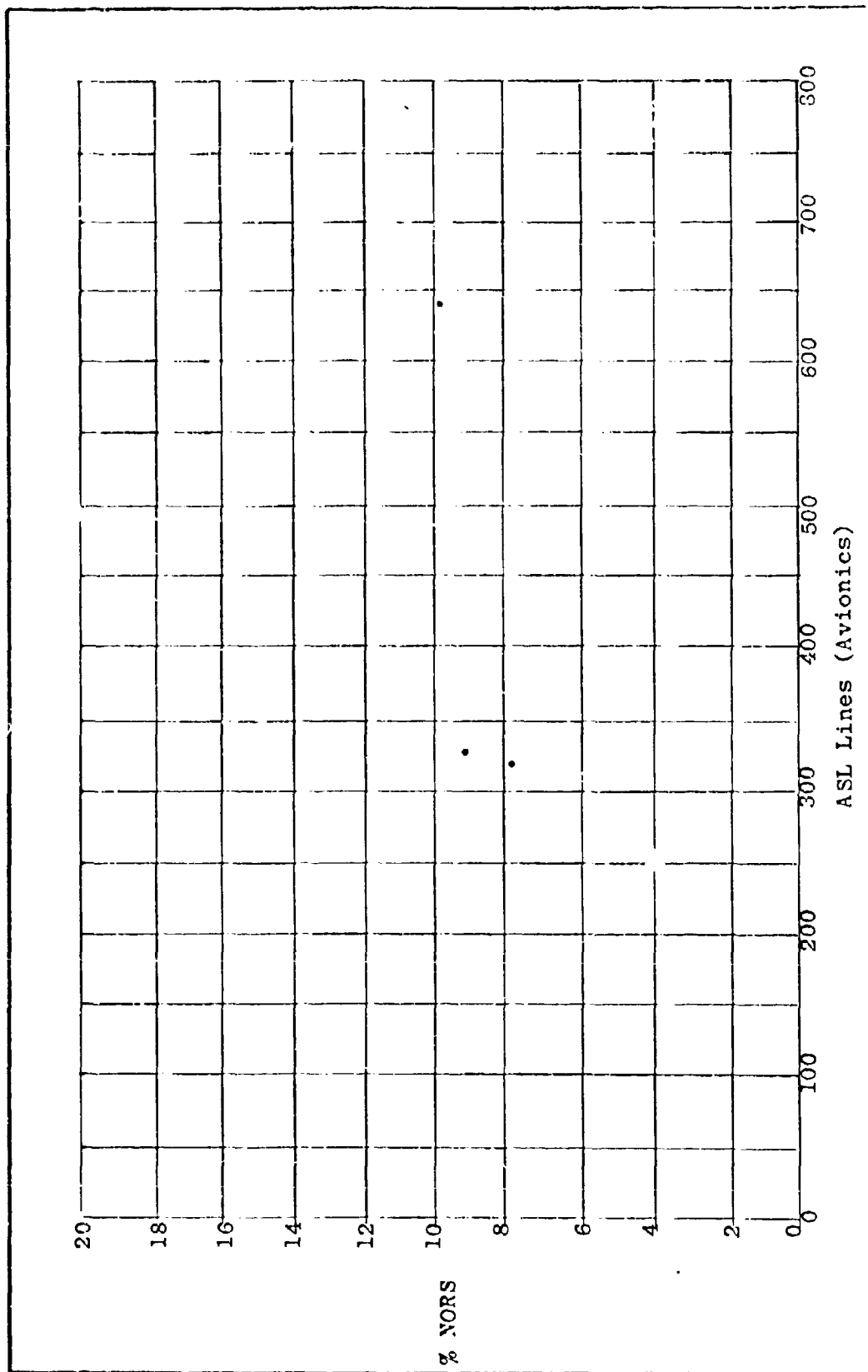


Figure 8-11. UH-1 Direct Support Detachment Supply Performance -
ASL Lines vs % NORS (Avionics Only)

Results
of
Analysis

The results of these analyses indicate that there is a definite requirement to reassess the present procedures used in establishing ASLs for DS Detachments, since it has been shown that there is no definite relationship between the supply performance of a unit and the size of its ASL. The very recent supply capability appraisal of the 15th TC Bn. (AM&S) 1st Cavalry Division and of other units under "Project Counter" should provide the needed guidance of such an assessment.

The primary measure of supply capabilities appears to be the time required for the Central Supply Agency to react to a requisition (although this has only been shown on a rather limited basis in an environment which is peculiar to Vietnam). The CH-47 and OV-1 DS Detachments are chronically less responsive in the area of Demand Accommodation, because of the complexity of the aircraft. At the same time, they have a much higher Demand Satisfaction rate and lower zero balance rates because of the specialized supply and support given these aircraft. The UH-1 DS Detachment, on the other hand, enjoyed a higher Demand Accommodation rate, but consistently had a lower Demand Satisfaction rate with a higher zero balance level. This was particularly true in the armament area and to a lesser degree for avionics. These factors were also reflected in the supply performance of the 58th Battalion, AMMC.

The supply performance achieved by the DS Detachments and the DS Companies under both the ROAD and Airmobile Divisions had indicated no significant differences for the same type of aircraft. However, it must be pointed out that this supply performance

has been achieved, in most cases, by the units with a very limited supply management capability.

The Airmobile Division does have an adequately staffed supply activity assigned to the DS Battalion. However, the DS Detachments and the Divisional DS maintenance Activities have been inadequately staffed (in accordance with their present MTOE) to accomplish the supply function efficiently. In at least one instance, a completely separate aviation supply platoon has been established within a ROAD Division support battalion, using aviation maintenance personnel for the supply activity spaces (reducing their wrench turning maintenance capability).

It has also been reported that the procedures presently being used in the maintenance of the ASLs is far from adequate to perform the tasks at hand.

In spite of all of these problems, the supply performance of these DS units have more or less stabilized at an acceptable level with regard to the influence that they have on aircraft readiness. The potential increased capability of these units, with an adequately organized and staffed supply activity, is a matter of conjecture and should be made a subject of further analytical study.

CHAPTER 9

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CHAPTER 9

RELATIVE INVESTMENT AND PERSONNEL REQUIREMENTS

GENERAL

Equipment costs, manpower and supply are the three investment areas considered in this portion of the analysis. Maintenance equivalents have been developed from the evaluation in Chapter 3, based on Vietnam experience, to provide a common basis for the comparison of relative investment and personnel requirements among the various types of organizations, (Figure 9-1).

Unit	TOE	Maint. Equiv.
DS Co, 34th GS Gp	55-457E	33.3
DS Bn, 1st Cav Div	55-405T	164.8
DS Co, Inf. Div	55-89E	23.1
DS Det, CH-47	AB Team, 55-510T	10.3
DS Det, UH-1	KD Team, 55-500R	9.3
GS Co, 34th GS Gp	55-458E	42.4

Figure 9-1. Average Maintenance
Equivalents Supported
by Types of Field Main-
tenance Units in Vietnam
(as of 1 May 1967)

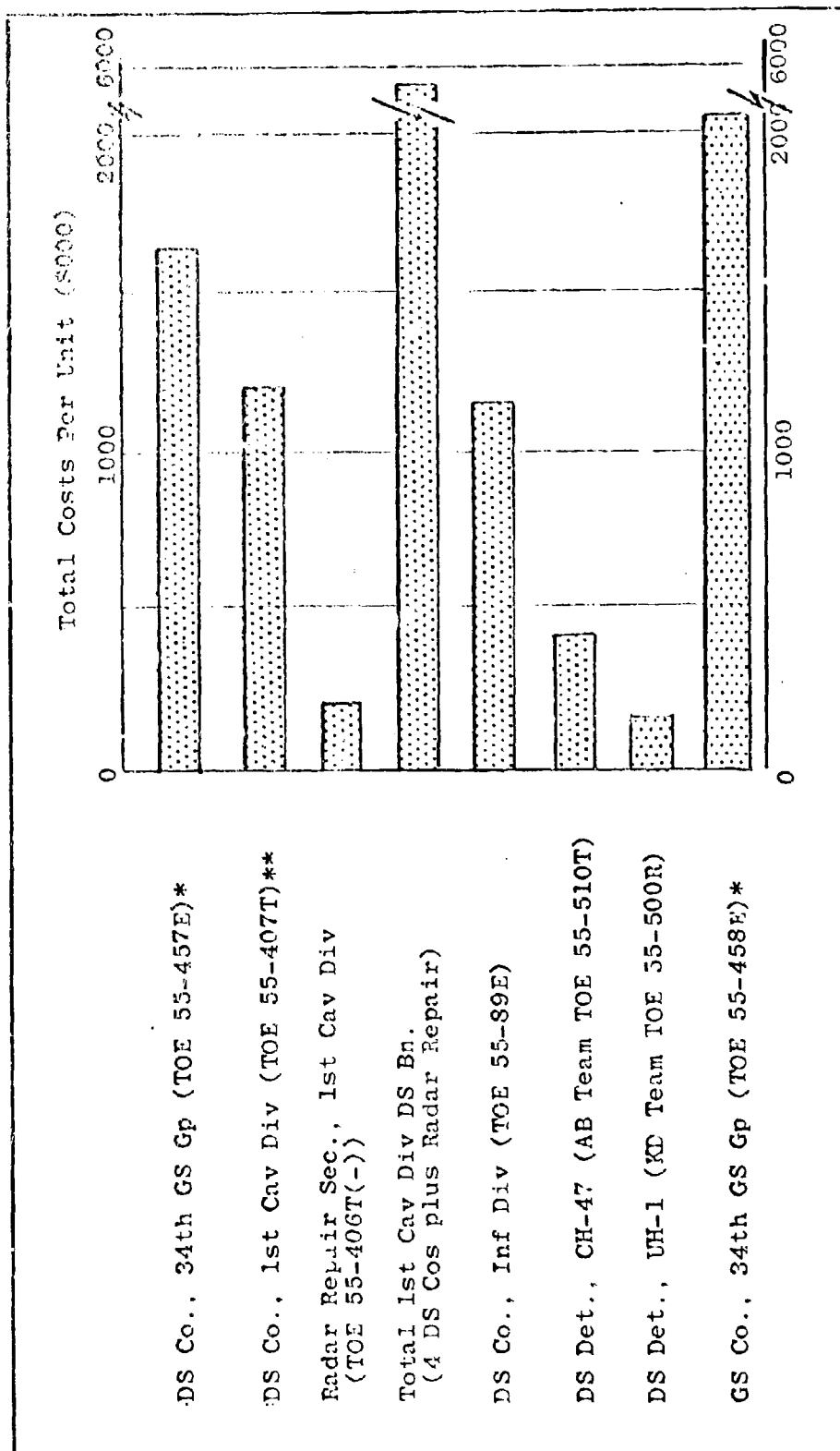
As previously noted, the concept of the maintenance equivalents in this analysis, has an application somewhat different from the ordinary. Instead of developing

the equivalents for items of equipment within a single maintenance echelon, this study applied equivalents to the total support required across all echelons, and assigned a value of unity to the UH-1 (largest population) total requirements. These total equivalent requirements were then redistributed among the various maintenance echelons. In this manner, the workload requirements for any one aircraft can be compared on the same basis, regardless of workload distribution among echelons. The development of these factors were set forth in Chapter 3.

TOE EQUIPMENT INVESTMENT COSTS

The equipment authorized under TOEs applicable to the field maintenance units in Vietnam were costed to produce total investment costs for each type unit as shown in Figure 9-2.

In Figure 9-3, these investment costs were normalized by maintenance equivalent supported for the various field maintenance organizations. These data illustrate that the cost per maintenance equivalent supported is closely related to the complexity of maintenance performed. As might be expected, the Detachment supporting the CH-47 has a considerably higher investment cost than that supporting the UH-1 because of the more sophisticated



*Includes 2 UH-1D Helicopters at \$239,921

**Includes 1 UH-1D Helicopter at \$239,921

Figure 9-2. Comparative Costs of Equipment in Field Maintenance Units

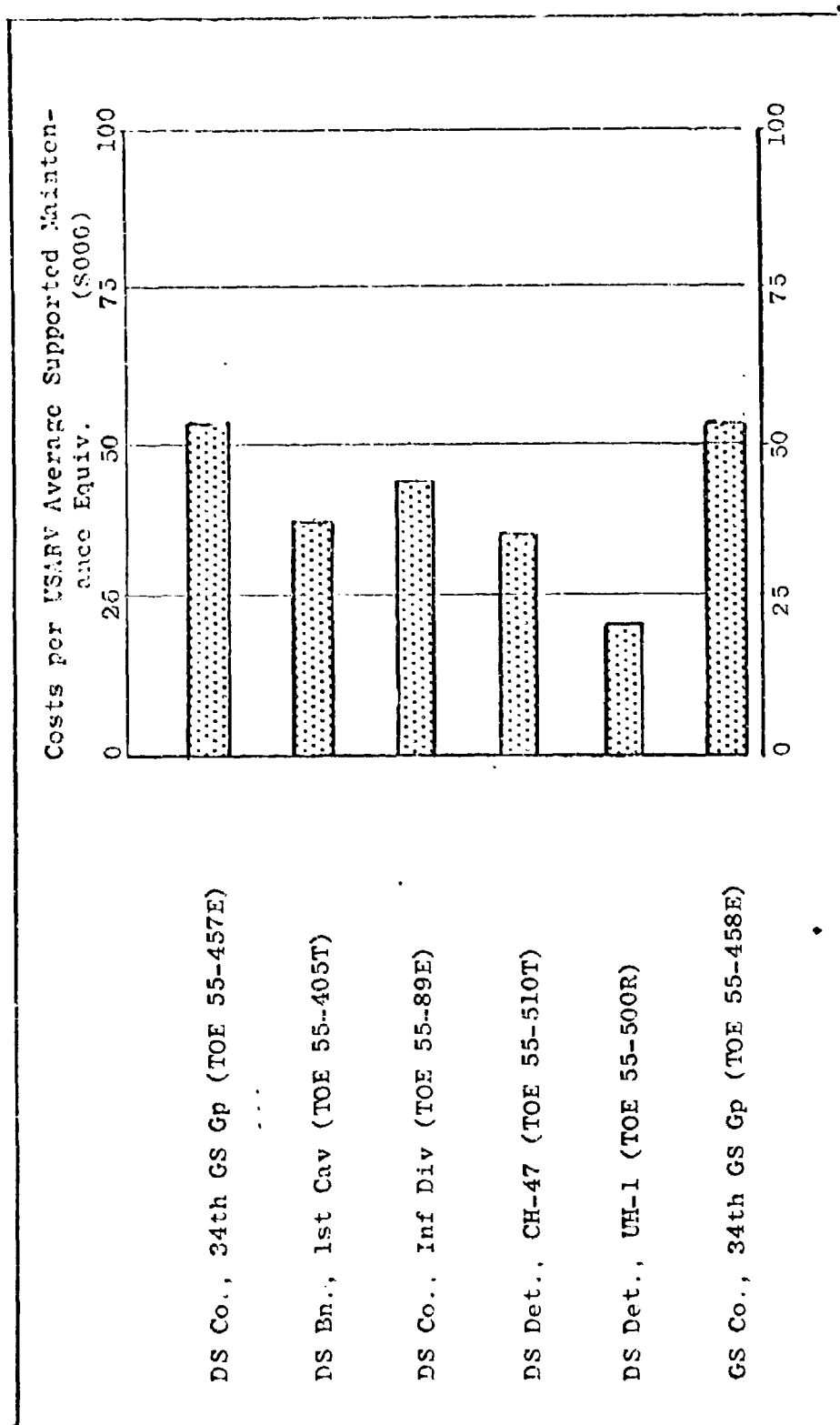


Figure 9-3. Comparative Costs of Equipment Related to Supported Maintenance Equivalents

equipment required for test and calibration of the complex stabilization and control systems in the CH-47 helicopter. Similar investment costs for the Airmobile Division and the Conventional ROAD Division might be expected since the savings which might be anticipated by the much higher density of aircraft in the Airmobile Divisions are more than offset by the mission profile of the ROAD Division with its normal requirement to operate highly dispersed. The separate maintenance companies must maintain a high degree of air mobility to accomplish their mission wherever required. Furthermore, the TOE of the Airmobile Division provides for a higher level of maintenance than that of the ROAD Division maintenance company which depends upon both the Division's DS Company and its backup.

The principal difficulty in evaluating the cost of equipment in a unit, or prorating these to their maintenance workloads (as indicated by maintenance equivalents), is the need to determine the extent to which the units rely on their own equipment or use equipment available to other elements of the same major organization or support elements. Particularly significant in this area is the use of helicopters for the maintenance mission. To normalize the prorata equipment costs to a greater degree, the cost of any authorized helicopters was deducted from the total and prorata costs. As indicated in Figures 9-4 and 9-5, the relative favorable position of the CH-47 Detachment resulted in a higher prorata cost than the DS Companies of the Division. However, the DS Detachments with UH-1 were not too different.

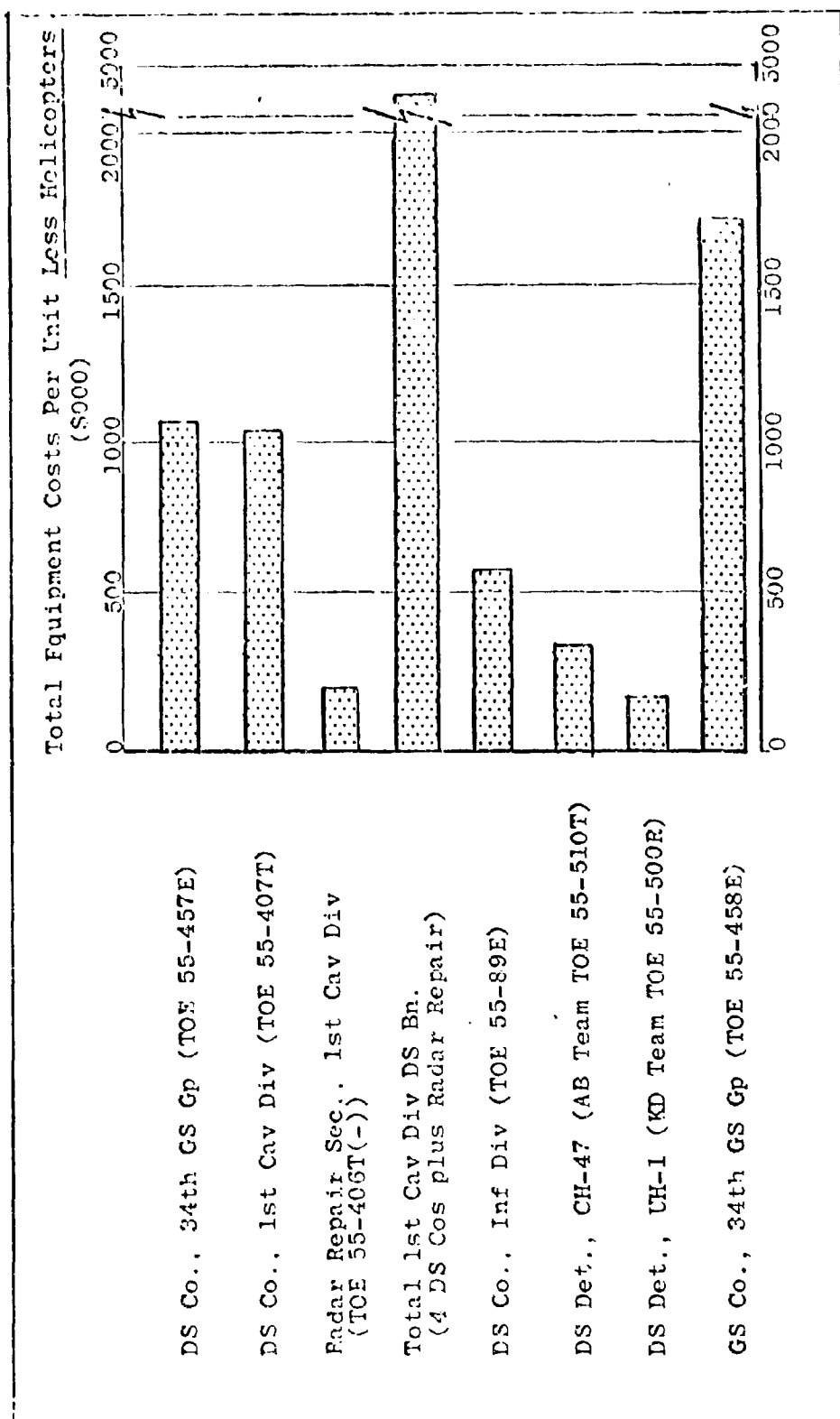


Figure 9-4. Comparative Costs of Equipment, Less Helicopters, in Field Maintenance Units

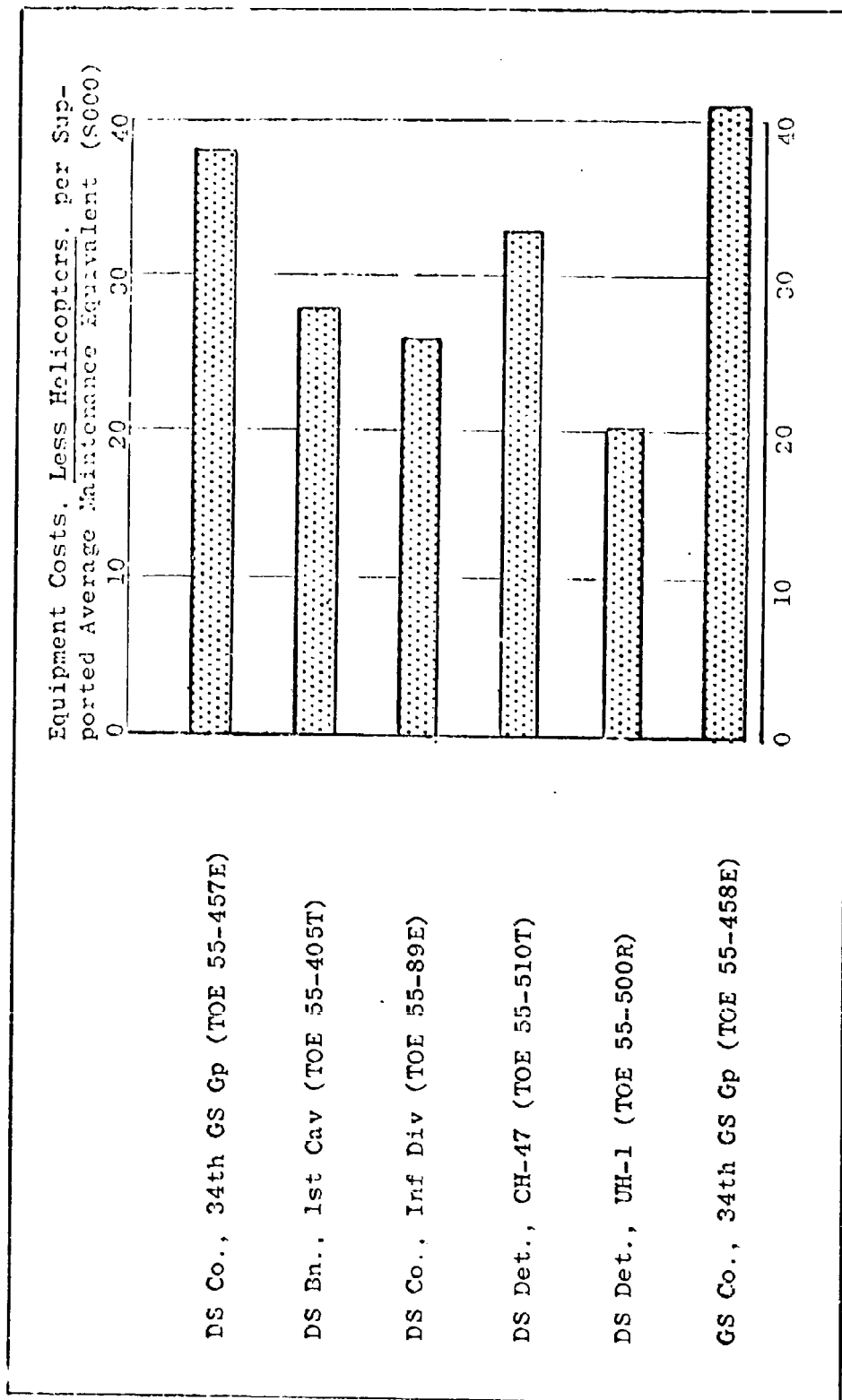


Figure 9-5. Comparative Costs of Equipment, Less Helicopters, in Field Maintenance Units Related to Support Maintenance Equivalents

It would appear (as might be expected) that the relative costs of equipment are proportionate to the complexity of the aircraft supported or to the level of work accomplished. These costs were a prime consideration in developing the recommended organizational structure to insure that particularly high cost low utilization items were not assigned to a maintenance level when it would not have seriously affected aircraft readiness by sending the aircraft to a backup support. Equipment costs must be kept in perspective, recognizing that the total equipment for a Divisional DS Company approximates the cost of a single, fully equipped CH-47 or OV-1. Any savings contemplated in onetime investment costs or equipment must consider the potential degradation of support capability across the entire service history of the unit.

PERSONNEL INVESTMENT COSTS

The personnel authorizations of six types of field maintenance units are compared in Figure 9-6.* The three categories of personnel considered are defined below:

<u>Maintenance Direct</u>	<u>Maintenance Indirect</u>	<u>Overhead</u>
Repairmen	Production Control	Company Officers
Mechanics	Quality Control	Platoon Leaders
Helpers	Inspectors	First Sergeants
	Supervisory	Cooks
	Clerical	Mess
	Service & Equipment	Radio & Telephone
	Toolroom keepers	Company Drivers
	Truck Drivers	Company Clerks
	MHE	

Of the six types of units, the Detachments have the lowest number of direct personnel, ranging between 37 and 55 direct mechanics per unit. The DS Companies of the 34th Group and the DS Company of the Conventional ROAD Division are next in size with 114 and 129 direct personnel respectively. These are more than twice as large as the Detachments. The last unit is the DS Company of the Airmobile Division. Taken together, the Division has a total of over 700 direct labor personnel in four DS Companies and a radar repair section, an average of 182 personnel per DS Company.

It is noted that the ratio of direct to overhead personnel is highest in the Detachments, i.e., the UH-1 Detachments have 13.3

*OV-1 Detachment maintenance equivalent excludes avionics.

	Direct Support Det (CH-47) Team AB 55-510T	Direct Support Det (UH-1) Team XD 55-500R	OV-1** & Team JEM 55-500E	Infantry Division "E" Company 55-89E	Avg. Automobile DS 55-407TX4 + Radar Repair 55-405T	Direct Support Company 55-407E
TOE						
Direct	55	54	37	129	182	114
Indirect	14	9	8	28	89	78
Overhead	5	4	4	20	47	24
Total	74	67	49	177	318	216
Ratio						
Direct:Overhead	11.0:1	13.3:1	9.3:1	6.1:1	3.8:1	4.8:1
Direct:(Overhead Plus Indirect)	2.9:1	4.2:1	3.1:1	2.6:1	1.3:1	1.1:1
Maint.Equiv.Reqd*	10.3	9.3	5.8**	23.1	41.2	33.3
Direct: Maint. Equiv.	5.3:1	5.8:1	6.4:1	5.5:1	4.4:1	3.4:1
Total Pers: Maint. Equiv.	7.2:1	7.2:1	8.4:1	7.7:1	7.7:1	6.5:1

*Averaged over DS Units in Vietnam on 1 May 1967

** Excludes avionics

Figure 9-6. Manpower Breakdown of DS Field Maintenance Elements, Less DS Supply Activity, with Relationships Between Direct, Indirect and Overhead Related to Maintenance Equivalents

direct labor personnel assigned for each overhead person. The DS Companies have 3.8 to 6.1 direct labor personnel to each overhead personnel, less than half the ratio of the Detachments.

When the indirect labor personnel are included with the overhead, the differences between the Detachment and DS Companies decrease. However, there is still a somewhat higher ratio in the case of the Detachments. The direct labor to overhead and indirect personnel ratio for the Detachments range between 2.9 to 4.2:1; the ratio for DS Companies is 1.1 to 2.6:1.

Figure 9-7 presents the ratio of manpower to maintenance equivalents supported by a Direct Support maintenance unit. Considering all personnel, the UH-1 and CH-47 DS Detachments had ratios of 7.2:1, while the ratio for the ROAD and Airmobile Divisions was 7.7:1. This indicates that the Divisions require one half a man more than the Detachments require to support one aircraft maintenance equivalent. This added personnel authorization is in the non-direct productive personnel category. A comparison of the differences between the total personnel and direct personnel ratios shows that the Detachments have the lowest ratio of non-direct personnel per maintenance equivalent. These ratios are 1.4:1 and 1.9:1 respectively for the UH-1 and CH-47 Detachments, while for the ROAD and Airmobile Divisions they are 2.2:1 and 3.3:1 respectively. Thus, the Detachment concept is able to apply a greater number of personnel to "wrench turning" supported by fewer "non-wrench turning" personnel than either of the other two concepts.

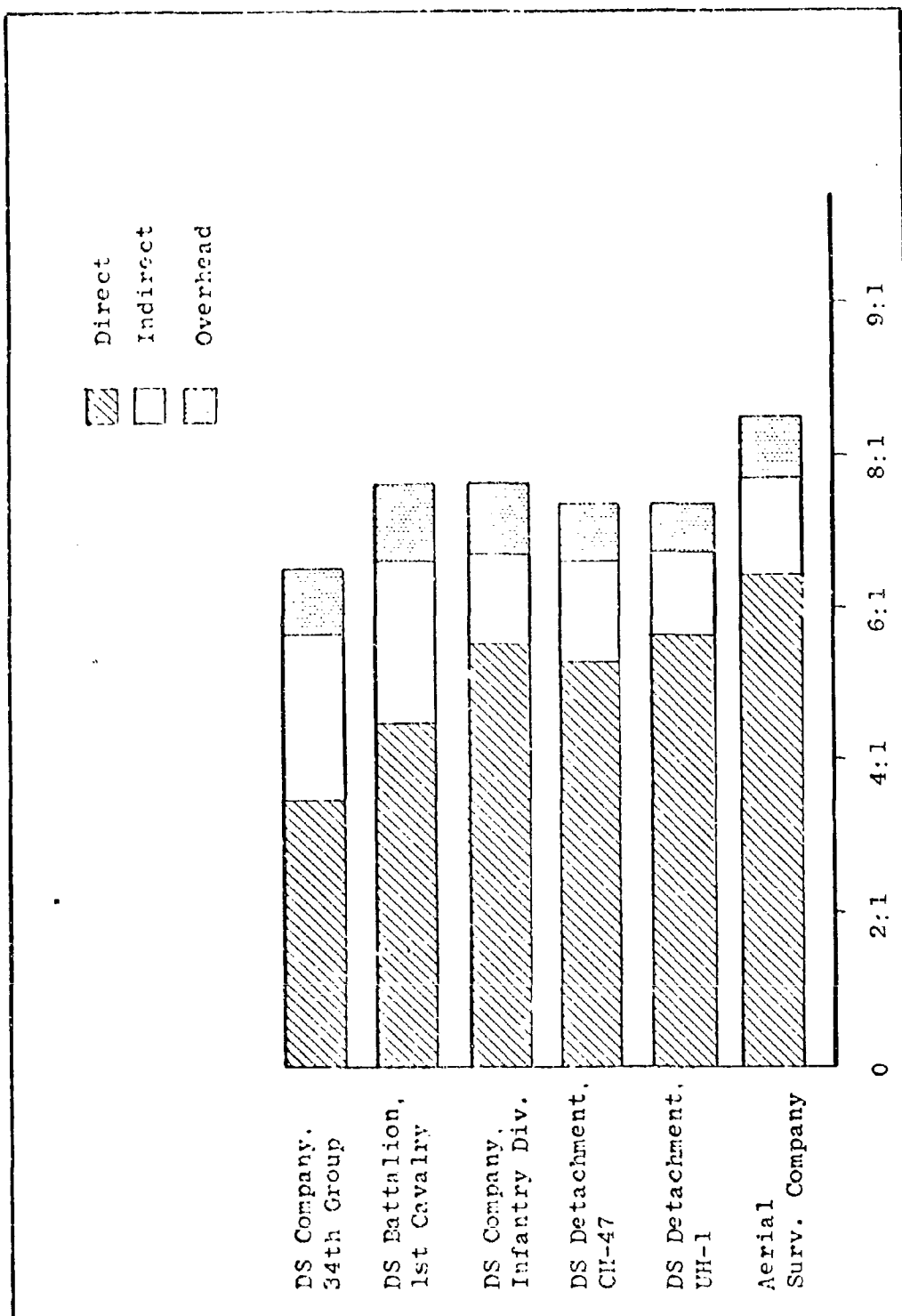


Figure 9-7. Ratio of Manpower (Overhead, Indirect and Direct Productive) to Maintenance Equivalents Supported by Field Maintenance Organizations

To establish a base from which to develop recommended organizations in the next Chapter, each TOE was further reviewed to identify the administrative support by rank and/or grade provided in each maintenance concept. These data are presented in Figure 9-8, together with the total maintenance and supply support personnel.

Figure 9-9 illustrates the percentage distribution in each TOE. It is noted that the Divisional DS Companies have a considerably higher percentage of administrative support personnel than all others (25-30 percent of the total TOE strength). The non-Divisional TOE provides about 20 percent of the staff for administrative support, while the Detachments have from 11 to 15 percent of the total staff in administrative roles. Except for the Corps Backup DS Company, supply function personnel comprise 5-10 percent of the total personnel for the Detachment and 11-13 percent for the DS Companies. The Corps Backup DS Company, as constituted in the TOE, provides only 2.21 percent of the staff in the supply function since it depends on the consolidated Battalion supply unit for support. As noted, the 1st Infantry Division, under MTOE 55-89G provides for 18 supply spaces in the DS Company, which makes it comparable to the DS Companies.

SUPPLY INVESTMENT COSTS

The Supply investment costs, for the purpose of this study, were analyzed in terms of the number of ASL Lines. The average number of aircraft, armament and avionics ASL Lines per maintenance equivalent for each type of field maintenance unit are

	OV-1		UH-1		CH-47		ROAD		Airmobile			Corps		GS Co	Totals	
	DS Det	11-500D	DS Det	55-500R	DS Det	55-510T	DS Co	55-89E	DS Co	55-407T	Hq & Hq		DS Co			55-457E
											Co	Bn*				
Administrative Support																
Officers - Lt Col	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	
Maj	-	-	-	-	-	-	-	-	2	1	-	-	-	4	4	
Capt	-	-	1	1	1	1	1	1	8	5	1	1	4	20	20	
Lt	1	-	-	-	-	-	1	1	-	2	-	5	-	10	10	
Total	1	1	1	1	1	1	2	2	11	8	6	5	35	35	35	
Warrant Officers																
Non-Commissioned Officers	2	1	1	1	1	1	4	4	4	12	4	4	8	36	36	
E9	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	
E8	-	-	-	-	1	1	1	1	2	1	1	1	1	7	7	
E7	-	-	-	-	-	-	1	1	7	1	1	1	1	11	11	
E6	-	-	-	-	-	-	3	3	5	1	4	4	3	16	16	
E5	-	-	-	-	-	-	4	4	2	2	1	1	-	9	9	
Total	-	-	-	-	-	-	9	9	17	5	7	5	44	44	44	
Other Enlisted	6	7	7	7	7	7	20	20	37	52	58	54	239	239	239	
Total Administrative Support	9	9	9	9	12	12	35	35	69	77	75	72	354	354	354	
Total Maintenance (Figure 4-1)	63	59	59	59	62	62	142	142	18*	215	141	200	888	888	888	
Total Supply (Figure 4-3)	7	4	4	4	8	8	4	4	17	39	28	14	121	121	121	
Grand Total	79	72	72	72	82	82	181	181	104	331	244	286	1363	1363	1363	

*Direct, productive maintenance space in Avionics Repair Section, Hq, Hq Co, AM&S Bn

Figure 9-8. Administrative Support Spaces and Ranks - Alternative DS Concepts

	OV-1 DS Det 11-500D 11-500E	UH-1 DS Det 55-500R	CH-47 DS Det 55-510T	ROAD DS Co 55-89E	Airmobile (4)55-407T (1)55-406T	Corps DS Co 55-457E	GS Co 55-458E
Administrative Support Personnel	11.39	12.50	14.63	19.34	23.40	30.74	25.17
Maintenance Personnel	79.75	81.94	75.61	78.45	61.48	57.79	69.93
Supply Personnel	8.86	5.56	9.76	2.21	12.12	11.47	4.90

Figure 9-9. Percentage Distribution of Personnel Resources -
Alternative DS Concepts

presented in Figure 9-10. For armament and avionics, the ASL Lines were averaged over those units which had an armament and avionics ASL. If a unit did not have an armament or avionics authorization, it was not included in the analyses.

Aircraft ASL

The ranking of the units in terms of aircraft ASL Lines per maintenance equivalent results in four groupings; the first and lowest is that of the 58th Battalion with eight ASL Lines per maintenance equivalent. This rate is low since it is developed from a broad maintenance equivalent basis. The 58th Battalion supports all aircraft in Vietnam and, in calculating the maintenance equivalent, the total aircraft population in Vietnam was considered.

The CH-47 Direct Support Detachment, the most complex aircraft considered in this study, has the next lowest ASL Lines per maintenance equivalents, approximately 80. This ratio is low since:

1. These complex aircraft would have complex components requiring special capabilities for installation and thus would be installed by the Backup Direct Support Company or General Support Company.
2. This aircraft has a high ASL per maintenance equivalent in the Avionics area. When all types of lines are considered in calculating this ratio the total CH-47 ASL Lines per maintenance equivalent are approximately equal to all other maintenance units.

The next group includes the UH-1 and OV-10 DS Detachments, the ROAD Division DS Company and the Airmobile Division DS Company. These four units group closely together between approximately 120 and 150 ASL Lines

	Aircraft	Armament*	Avionics*	Total
DS Det. UH-1	137	26	43	206
DS Det, CH-47	78	4	126	208
DS Det, OV-1	148	-	**	148
DS Co, ROAD Div	122	25	31	178
DS Co, Airmobile Div	131	19	14	164
DS Co, Corps	195	37	107	339
58th Bn (AMMC)	8	1	3	12

*Average for units having Armament or Avionics in ASL

**No data available at time of study

Figure 9-10. Average Number of ASL Lines by Type
Field Maintenance Unit per Maintenance
Equivalent

per maintenance equivalent. The ratios of these four units are influenced by the high concentration of UH-1 aircraft which they both support. In the case of the UH-1 DS Detachment, the population is pure. In the Conventional ROAD Division and the Airmobile Division, the population is mixed with a large number of small observation type aircraft and, in the case of the Airmobile Division, the more complex CH-47 aircraft. Because of the simplicity of the observation aircraft, a lower ASL Line per maintenance equivalent would be expected. Therefore, due to the influence of the type of aircraft supported, these units can be considered on equal par in this ratio.

The last group includes the non-divisional DS Companies (backup DS units) with 195 ASLs per maintenance equivalent. This factor is very high because this group supports the Detachment and DS Companies of the Divisions, and consequently, will stock many items that are not normally required by the supported units because of the workload (by type) distributions.

Armament ASL

Similar patterns occur for the Armament ASL Lines per maintenance equivalent with the 58th Battalion being very low since it supports the entire theater. The 34th Group is very high as it provides close support for the DS Detachments and the DS Companies of the Division. The DS Detachments and the DS Companies fall in a low or medium range. The DS of the Airmobile and Conventional ROAD Division can again be considered as being on an equal par with the UH-1 DS Detachment.

Avionics ASL

In the Avionics area, the variation is between field maintenance units, which is seen to be more directly related to the type of aircraft supported. The CH-47 DS Detachment has very high values of ASLs per maintenance equivalent, approximately 125 lines per maintenance equivalent.

The next highest ratio is that of the DS Companies of the 34th GS Group at 107 ASL Lines per maintenance equivalent. This represents a broad mixture of aircraft, including the complex CH-47 and OV-1, as well as many items of avionics which simply are not included in the ASL of the units that the 34th Group supports. For the same reason that this ratio was higher under aircraft and armament ASLs, the avionics ratio is also high.

The lowest group is the same as that found to be grouped in the two previous types of ASL lines. They include the DS Companies of the Conventional ROAD, Airmobile Divisions and the UH-1 DS Detachment. The wide range is a result of the type of aircraft supported. In the case of the Airmobile Division, there is a large mixture of aircraft other than the UH-1. This is also true, but to a lesser degree, for the Conventional ROAD Division. In the case of the UH-1 DS Detachment, the population is pure, that is, it includes only UH-1 aircraft which frequently use numerous items of avionics. The lowest ASL Line per maintenance equivalent ratio is that of the 58th Battalion, as cited previously.

Total ASL

Because of the relative distribution of ASL lines for aircraft, armament and avionics items among the various types of units, the comparisons can be drawn by type of aircraft supported, but not related to the entire workload. The summation of total ASL lines, also shown on Figure 9-10 presented a much better correlation. The Detachments range from 206-208 lines per ASL, the Divisional DS Companies from 164 to 178, and the Corps Backup DS Company with 339 lines per ASL. However, the degree of correlation which should be expected among the various units leave much to be desired. The CH-47 Detachment ASL should be much higher than the UH-1 because of the additional complexity in both airframe and avionics. The Airmobile Division, because of the higher population of aircraft, should have a larger ASL than the ROAD Division. Therefore, a further detailed evaluation was initiated to determine the total number of supply lines assigned in the theater to support each maintenance equivalent.

It was considered possible that the variations of workload distributions between the various maintenance levels might manifest itself in changes in ASLs at the DS level. This would require the summation of the PLLs of the operation units with the ASLs of the supporting units. Figure 9-11 presents the average PLL lines per maintenance equivalent for each of the units concerned. It will be noted that the UH-1, CH-47 and OV-1 Aviation Companies are cited because they represent the units to which the DS Detachments will be satellited for support. In the case of the OV-1, no field data were available at the time of the evaluation on the number of PLL lines authorized the two

OV-1 Companies in Vietnam. The ROAD and Airmobile Division PLL lines constitute a summation of the total number of PLL lines authorized to the individual units assigned to the Divisions. Since the relationship of lines per maintenance equivalent normalizes the data base to individual aircraft, there was no requirement to further assess the distribution of lines by the DS Companies within the Divisions.

	PLL Lines	Maintenance Equivalents	PLL Lines per Maintenance Equivalent
UH-1 Avn Co.	935	9.3	101
CH-47 Avn Co.	355	10.3	34
OV-1 Avn Co.	Not Avail	-	-
ROAD Division	2479	23.1	105
Airmobile Division	8195	164.8	49

Figure 9-11. Average PLL Lines per Maintenance Equivalent

The relationships of the number of PLL lines per maintenance equivalent between the Detachments and the Divisional concepts appear to have no correlation. However, when these data are summed with the average number of ASL lines per type field maintenance unit, per maintenance equivalent, a very significant result is obtained. The following

constitutes the complete summation of all ASL and PLL lines per maintenance equivalent by the maintenance concept:

Maintenance Concept	Total Lines per Maintenance Equivalent
UH-1 DS Detachment	307
CH-47 DS Detachment	242
Airmobile DS Company	213
Conventional Divisional DS	283

The Airmobile DS concept now has the lowest total lines per maintenance equivalent, a fact which would be expected in the case where support is being provided to a relatively large population of aircraft. It might be expected that as the population of aircraft being supported decreases, the total number of lines would decrease, but the number of lines per maintenance equivalent would increase. Thus, the ROAD Division, supporting approximately 100 aircraft as opposed to 400 in the Airmobile Division, has an average of 283 lines per maintenance equivalent. The UH-1 DS Detachment concept, supporting only one company of UH-1s, has an average of 307 lines per maintenance equivalent. The differences between the UH-1 Detachment and ROAD Division are not as significant since the ROAD DS units are supporting a multiplicity of aircraft type, model and series, whereas the Detachment is supporting a single type aircraft.

In the case of the CH-47, an average of 242 lines per maintenance equivalent is relatively low in comparison to the UH-1,

particularly since this Detachment supports a single type of aircraft in company size units. However, it must be remembered that the CH-47 has been provided a specialized supply support procedure, and although the actual volume of stocks is not reflected in this, the total number of lines of support have apparently been reduced by the supply system.

On the basis of the evaluation of total lines required to support a maintenance equivalent, there were apparently no significant differences in supply requirements between any of the maintenance concepts over what might normally be expected of routine procedures. In other words, the adoption of the Detachment concept did not significantly reduce the total number of lines required in the support of the aircraft from what might be expected for the normal reduction in the actual size of the aircraft population. However, the very important fact that the distribution of these supplies might be changed among the various levels in accordance with local procedures rather than a concept itself is validated. As an example, the UH-1B is supported at the Organizational level with 101 PLL lines per maintenance equivalent and 206 ASL lines at Direct Support. Alternatively, the CH-47 is supported with only 34 PLL lines per maintenance equivalent at the Organizational level and 208 lines ASL for maintenance equivalent at the DS level. This infers that in the case of the UH-1, the PLLs at the Organizational level contain many similar types of lines that are now being provided at the Direct Support level. Insofar as the principal technical assistance is provided the Chinook at DS

level, it is quite obvious that the workload distribution in these areas have been shifted from Organizational level to the DS Detachment.

SUMMARY

On the basis of this analysis, it appears that there is no significant difference in the supply posture, or requirements among the Detachment concept, the Conventional Maintenance concept, or the Airmobile concept. Of course, no attempt has been made to evaluate the quantity of each line item which is authorized the various maintenance units. However, since the normal procedures are followed with regard to establishing an authorized stockage item on the basis of demand, it must be assumed that the total quantity and dollar investment will be approximately equivalent. To go beyond this point into the actual dollar value of the stockages would require a depth of investigation which is beyond the scope and intent of this analysis. However, it is conceivable that a narrow penetration into this investigation might reveal the considerable impact on total dollars required for the support of the concept and is recommended as the subject of future studies.

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CHAPTER 10

RECOMMENDED CONCEPTS

CONCEPT SUMMARY

The results of this study have displayed the superiority of the Detachment DS maintenance concept over the Conventional and Airmobile DS concepts. Based on these results, the following concept is proposed:

1. The procedure of assigning Detachments to non-Divisional "company-strength" aviation units for the DS maintenance be continued as a general policy rather than as an exception to the general rule
2. The administrative support and supervision of the Detachment be provided for by the parent organization (augmented as required) upon which it is satellited. Since the DS Detachment would not be re-assigned to another parent unit, its capability should, in fact, be integrated into the basic company thus eliminating all Detachment overhead.
3. The current DS maintenance provided the Airmobile and Conventional Division maintenance concepts be reviewed to provide the Detachment type support to company size aviation units within the Division.
4. Where number of aircraft assigned to an organization is insufficient to warrant a Detachment, the organizational structure of that element of the tactical arm be provided Direct Support capability in a Detachment assigned to the next higher command level, i.e., a Battalion Level Detachment rather than a Company Level Detachment. In this case, the Detachment would be satellited on the Battalion Headquarters with adequate augmentation to provide administrative support to the Detachment.

5. A DS Aviation Maintenance Support Unit be assigned to each Airmobile or Conventional ROAD Division to provide back-up support to the Direct Support Detachment and to support aircraft not supported by a DS Detachment. The organization and strength of such a unit should be related to the total anticipated DS workload for aircraft assigned to units in less than company-strength numbers and overflow Detachment work.
6. The assignment of a DS Aviation Maintenance Support Unit to the Corps area to provide maintenance support for non-Divisional aircraft assigned to units in less than company-strength levels and to provide for the accomplishment of residual backlog work from the Detachments. The strength and organization of this company should depend on the anticipated workload in both areas.
7. No consideration be given to the assignment of a DS Aviation Maintenance Company to handle any residual backlog or overflow from the Divisional DS maintenance function. Experience indicates that the types of work being sent to the Backup DS Company are extensive repair requirements, or repair and test, where equipment may not be available within the Divisional unit. This same type of maintenance could be performed by a Corps level GS Maintenance Company.
8. General Support capability be provided in accordance with present procedures. This unit will also provide Backup DS maintenance to the Divisional and non-Divisional DS units, as required.
9. To provide for potential deficiencies in skill level availability or in special problem areas, tech assistance teams be organized by the Divisional maintenance units to periodically review the accom-

plishments of each DS Detachment through field visits. The primary purpose of the tech assistance teams will be to provide on-site assistance in problem areas where the Detachment may not have the technical capability. They are not to provide additional DS capability in the routine workload of the units.

10. The direct exchange program presently being operated by the DS Companies within Vietnam be maintained under the same procedures by the Divisional DS Companies, to the extent feasible, considering their overall workload and potential capabilities. No attempt should be made to introduce the DX program into the Detachment concept due to the limited workload capabilities of the Detachments and the relative dispersion of these units in comparison to the DS Companies at the Divisional level.

In general, the concept of the organization recommended above is to take advantage of the superiority of the DS maintenance Detachment where aircraft are assigned in adequate numbers to warrant the adoption of the principle. Provision is also made for the support of those aircraft that are dispersed, i.e., assigned in very few numbers to each unit.

The next step in the development of this concept is to demonstrate its possible application to maintenance units presently in existence in Vietnam. The staffing requirements of the Detachments required for the support of the Divisional aircraft will be compared to the present maintenance units. Additions or deletions of personnel required as a result of the application of this concept over the present force structure will be noted. The results of this analysis

will portray the actual advantages of the Detachment concept over the Conventional and Airmobile concepts as applied in operational conditions. The units to be used as examples in this development will be the 1st Cavalry (Airmobile) Division and the 1st Infantry Division operating in Vietnam in July 1967.

DEVELOPMENT OF DS DETACHMENT CONCEPT

Organization

The first steps taken in the development of the concept were the detailed review of the organization of the 1st Cavalry (Airmobile) Division and the 1st Infantry Division; the identification of the aircraft owning units to which each provide support; and the total number of aircraft by type, model and series assigned to each of the supported units in July 1967. In the case of the 1st Infantry Division, the Divisional aircraft were distributed among seven organizations, in addition to two aircraft that were authorized E Company of the 701st as float and/or for their own use. These units owned 99 aircraft of which three were OV-1, 44 OH-13s, 28 UH-1Bs and 24 UH-1Ds as shown in Figure 10-1.

The 1st Cavalry Division support was identified by the particular Maintenance Company of the 15 TC Battalion. Company A of the 15th Battalion, as shown in Figure 10-2, supported a total of 65 aircraft assigned to six units. However, it is noteworthy that this unit was supporting 57 CH-47s out of the total of 65; of the remainder, four were O-1s, one U-6, and three OV-1s.

	Aircraft Type				Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	OV-1	OH-13	UH-1B	UH-1D	Total	
1st Brigade						
No. of A/C	-	6	-	-	6	7.5
ME Req'd	-	1.56	-	-	1.56	
M/H Req'd	-	349	-	-	349	
2nd Brigade						
No. of A/C	-	6	-	-	6	7.5
ME Req'd	-	1.56	-	-	1.56	
M/H Req'd	-	349	-	-	349	
3rd Brigade						
No. of A/C	-	5	-	-	5	6.2
ME Req'd	-	1.30	-	-	1.30	
M/H Req'd	-	291	-	-	291	
A Co. 1st Avn. Bn.						
No. of A/C	-	-	9	16	25	34.1
ME Req'd	-	-	2.34	4.80	7.14	
M/H Req'd	-	-	523	1073	1596	
B Co. 1st Avn. Bn.						
No. of A/C	3	8	-	8	19	26.4
ME Req'd	1.05**	2.08	-	2.40	5.53	
M/H Req'd	235**	465	-	536	1236	

*Aircraft assignments in July 1967

**Excludes Avionics

Figure 10-1. Aircraft Assignments* and Related Maintenance Equivalents,
Manhours and Number of Maintenance Personnel - 1st Infantry
Division - E Company - 701st Battalion (Continued)

	Aircraft Type				Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	OV-1	OH-13	UH-1B	UH-1D	Total	
D Co. 4th Cav.						
No. of A/C	-	9	17	-	26	32.3
ME Req'd	-	2.34	4.42	-	6.76	
M/H Req'd	-	523	988	-	1511	
Div. Artillery						
No. of A/C	-	10	-	-	10	12.4
ME Req'd	-	2.60	-	-	2.60	
M/H Req'd	-	581	-	-	581	
E Co. 701st						
No. of A/C	-	-	2	-	2	2.6
ME Req'd	-	-	.52	-	.52	
M/H Req'd	-	-	116	-	116	
TOTAL A/C	3	44	28	24	99	(129.0)
TOTAL ME Req'd	1.05*	11.44	7.28	7.20	26.97	
TOTAL M/H Req'd	235*	2558	1627	1609	6029	

*Aircraft Assignments in July 1967

**Excludes Avionics

Figure 10-1. Aircraft Assignments* and Related Maintenance Equivalents,
Manhours and Number of Maintenance Personnel - 1st Infantry
Division - E Company - 701st Battalion (Concluded)

	Aircraft Type					Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	O-1	U-6	OV-1	CH-47	Total		
11th Gen. Sup. No. of A/C	-	1	3	-	4	6.5	5.5
ME Req'd	-	.20	1.05**	-	1.25		
M/H Req'd	-	45	235**	-	280		
Co. A 228th No. of A/C	-	-	-	18	18	58.6	49.6
ME Req'd	-	-	-	11.34	11.34		
M/H Req'd	-	-	-	2534	2534		
Co. B 228th No. of A/C	-	-	-	16	16	52.1	44.1
ME Req'd	-	-	-	10.08	10.08		
M/H Req'd	-	-	-	2253	2253		
Co. C 228th No. of A/C	-	-	-	16	16	52.1	44.1
ME Req'd	-	-	-	10.08	10.08		
M/H Req'd	-	-	-	2253	2253		
Btry. E 82nd No. of A/C	4	-	-	-	4	4.3	3.5
ME Req'd	.80	-	-	-	.80		
M/H Req'd	179	-	-	-	179		

*Aircraft Assignments in July 1967

**Excludes Avionics

Figure 10-2. Aircraft Assignments* and Related Maintenance Equivalents,
Manhours and Number of Maintenance Personnel - 1st Cavalry
Division - A Company - 15th Battalion (Continued)

	Aircraft Type				Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	O-1	U-6	OV-1	CH-47	Total	
1st Aviation Det.						5.5
No. of A/C	-	-	-	2	2	
ME Req'd	-	-	-	1.26	1.26	
M/H Req'd	-	-	-	282	282	
Co A 15th TC						13.9
No. of A/C	-	-	-	5	5	
ME Req'd	-	-	-	3.15	3.15	
M/H Req'd	-	-	-	704	704	
TOTAL A/C	4	1	3	57	65	(166.2)
TOTAL ME Req'd	.80	.20	1.05**	35.91	37.96	
TOTAL M/H Req'd	179	45	235**	8026	8485	

*Aircraft Assignments in July 1967

**Excludes Avionics

Figure 10-2. Aircraft Assignments* and Related Maintenance Equivalents,
Manhours and Number of Maintenance Personnel - 1st Cavalry
Division - A Company - 15th Battalion (Concluded)

Company B of the 15th Battalion (as shown in Figure 10-3) supported a total of 135 aircraft for nine owning units. These aircraft comprised 28 OH-13s, 10 UH-1Bs, 12 UH-1Cs, 73 UH-1Ds and 12 UH-1Hs.

Company C of the 15th Battalion (see Figure 10-4) supported a total of 127 aircraft for 15 owning units. These aircraft consisted of 12 OH-13s, 33 UH-1Bs, 20 UH-1Cs, 62 UH-1Ds.

Company D of the 15th TC Battalion (see Figure 10-5) supported a total of 127 aircraft for 10 owning units. These aircraft consisted of 52 OH-13s, 18 UH-1Bs, 18 UH-1Cs, 34 UH-1Ds and 5 UH-1Hs.

In total, the 1st Cavalry Division had a total of 454 aircraft. These aircraft were supported by four DS companies, each organized under the same TOE (TOE 55-107T).

The above figures demonstrate the relative density of aircraft assignments within the two types of Division. It will be noted that in many instances, full size company-strength units appear in the Divisional structure. However, there are many organizations which have very few aircraft, (from one to five aircraft per company). Therefore, to assess the Detachment configuration or organization necessary to support the larger unit, it was necessary to normalize the total support requirements on the basis of the number and type of aircraft being supported. In Chapter 3 of this Report, the concept of the "maintenance equivalent" was developed, and the normalized values presented for each type, model and series of aircraft, for each level of maintenance by the particular concept, indicating the

	Aircraft Type					UH-1H	Totals	Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	OH-13	UH-13	UH-1C	UH-1D	UH-1H				
11th Gen Sup									
No. of A/C	9	3	3	4	-	-	19	30.4	25.8
ME Req'd	2.52	.96	.96	1.44	-	-	5.88		
M/H Req'd	563	215	215	322	-	-	1315		
11th C 229th									
No. of A/C	3	1	-	-	-	-	4	6.0	5.1
ME Req'd	.84	.32	-	-	-	-	1.16		
M/H Req'd	188	72	-	-	-	-	260		
Co. A 229th									
No. of A/C	-	-	-	17	-	-	17	31.7	26.8
ME Req'd	-	-	-	6.12	-	-	6.12		
M/H Req'd	-	-	-	1368	-	-	1368		
Co. B 229th									
No. of A/C	-	-	-	19	-	-	19	35.4	30.0
ME Req'd	-	-	-	6.84	-	-	6.84		
M/H Req'd	-	-	-	1529	-	-	1529		
Co. C 229th									
No. of A/C	-	-	-	19	-	-	19	35.4	30.0
ME Req'd	-	-	-	6.84	-	-	6.84		
M/H Req'd	-	-	-	1529	-	-	1529		

*Aircraft Assignments in July 1967

Figure 10-3. Aircraft Assignments* and Related Maintenance Equivalents.
Manhours and Number of Maintenance Personnel - 1st Cavalry
Division - B Company - 15th Battalion (Continued)

	Aircraft Type					Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	OH-13	UH-1B	UH-1C	UH-1D	UH-1H	Totals	
Co. D 229th No. of A/C ME Req'd M/H Req'd	- - -	5 1.60 358	6 1.92 429	- - -	- - -	11 3.52 787	15.4
Co. B 15th TC Bn. No. of A/C ME Req'd M/H Req'd	- - -	- - -	1 .32 72	2 .72 161	- - -	3 1.04 233	4.6
Hq 15th Med. Bn. No. of A/C ME Req'd M/H Req'd	- - -	- - -	- - -	11 3.96 885	12 4.32 966	23 8.28 1851	36.3
Bty E 82nd No. of A/C ME Req'd M/H Req'd	16 4.48 1001	1 .32 72	2 .64 143	1 .36 80	- - -	20 5.80 1296	25.5
TOTAL A/C	28	10	12	73	12	135	(199.5)
TOTAL ME Req'd	7.84	3.20	3.84	26.28	4.32	45.48	
TOTAL M/H Req'd	1752	717	859	5874	966	10,168	

*Aircraft Assignments in July 1967

Figure 10-3. Aircraft Assignments* and Related Maintenance Equivalents
Manhours and Number of Maintenance Personnel - 1st Cavalry
Division - B Company - 15th Battalion (Concluded)

	Aircraft Type					Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	OH-13	UH-1B	UH-1C	UH-1D	CH-47	CH-54	Totals
HHC 3rd Bde.							17.7
No. of A/C	8	-	-	5	-	-	13
ME Req'd	2.24	-	-	1.80	-	-	4.04
M/H Req'd	501	-	-	402	-	-	903
HHC 227th							3.1
No. of A/C	3	1	-	-	-	-	4
ME Req'd	.84	.32	-	-	-	-	1.16
M/H Req'd	188	72	-	-	-	-	260
Co. A 227th							31.6
No. of A/C	-	-	-	17	-	-	17
ME Req'd	-	-	-	6.12	-	-	6.12
M/H Req'd	-	-	-	1368	-	-	1368
Co. B 227th							33.5
No. of A/C	-	-	-	18	-	-	18
ME Req'd	-	-	-	6.48	-	-	6.48
M/H Req'd	-	-	-	1448	-	-	1448
Co. C 227th							33.5
No. of A/C	-	-	-	18	-	-	18
ME Req'd	-	-	-	6.48	-	-	6.48
M/H Req'd	-	-	-	1448	-	-	1448
Co. D 227th							18.1
No. of A/C	-	3	8	-	-	-	11
ME Req'd	-	.96	2.56	-	-	-	3.52
M/H Req'd	-	215	572	-	-	-	787

*Aircraft Assignments in July 1967

Figure 10-4. Aircraft Assignments* and Related Maintenance Equivalents.
 Manhours and Number of Maintenance Personnel - 1st Cavalry
 Division - C Company - 15th Battalion - (Continued)

	Aircraft Type							Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	Aircraft Type								
	OH-13	UH-1B	UH-1C	UH-1D	CH-47	CH-54	Totals		
HH 2/20th								5.0	4.2
No. of A/C	-	-	3	-	-	-	3		
ME Req'd	-	-	.96	-	-	-	.96		
M/H Req'd	-	-	215	-	-	-	215		
A Btry. 2/20								19.9	16.8
No. of A/C	-	9	3	-	-	-	12		
ME Req'd	-	2.88	.96	-	-	-	3.84		
M/H Req'd	-	644	215	-	-	-	859		
B Btry 2/20								19.9	16.8
No. of A/C	-	8	4	-	-	-	12		
ME Req'd	-	2.56	1.28	-	-	-	3.84		
M/H Req'd	-	572	286	-	-	-	858		
C Btry. 2/20								19.9	16.8
No. of A/C	-	10	2	-	-	-	12		
ME Req'd	-	3.20	.64	-	-	-	3.84		
M/H Req'd	-	715	143	-	-	-	858		
HHC 15th TC								1.9	1.6
No. of A/C	-	-	-	1	-	-	1		
ME Req'd	-	-	-	.36	-	-	.36		
M/H Req'd	-	-	-	80	-	-	80		

*Aircraft Assignments in July 1967

Figure 10-4. Aircraft Assignments* and Related Maintenance Equivalents.
Manhours and Number of Maintenance Personnel - 1st Cavalry
Division - C Company - 15th Battalion - (Continued)

	Aircraft Type							Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	OH-13	UH-1B	UH-1C	UH-1D	CH-47	CH-54	Totals		
Co. A 15th TC								1.9	1.6
No. of A/C	-	-	-	1	-	-	1		
ME Req'd	-	-	-	.36	-	-	.36		
M/H Req'd	-	-	-	80	-	-	80		
Co. C 15th TC								6.6	3.5
No. of A/C	1	2	-	1	-	-	4		
ME Req'd	.28	.64	-	.36	-	-	1.28		
M/H Req'd	63	143	-	80	-	-	286		
Band Sup.								1.9	1.6
No. of A/C	-	-	-	1	-	-	1		
ME Req'd	-	-	-	.36	-	-	.36		
M/H Req'd	-	-	-	80	-	-	80		
TOTAL A/C	12	33	20	62	-	-	127	(220.5)	186.7
TOTAL ME Req'd	3.36	10.56	6.40	22.32	-	-	42.64		
TOTAL M/H Req'd	752	2361	1431	4986	-	-	9530		

*Aircraft Assignments in July 1967

Figure 10-4. Aircraft Assignments*and Related Maintenance Equivalents,
Manhours and Number of Maintenance Personnel - 1st Cavalry
Division - C Company - 15th Battalion - (Concluded)

	Aircraft Type						Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	OH-13	UH-1B	UH-1C	UH-1D	UH-1H	Totals		
HHC 1st Bde							20.9	17.7
No. of A/C	8	-	-	5	-	13		
ME Req'd	2.24	-	-	1.80	-	4.04		
M/H Req'd	501	-	-	402	-	903		
HHC 2nd Bde							19.0	16.1
No. of A/C	8	-	-	4	-	12		
ME Req'd	2.24	-	-	1.44	-	3.68		
M/H Req'd	501	-	-	322	-	823		
Co. A 228th							-	-
No. of A/C	-	-	-	-	-	-		
ME Req'd	-	-	-	-	-	-		
M/H Req'd	-	-	-	-	-	-		
Co. B 228th							-	-
No. of A/C	-	-	-	-	-	-		
ME Req'd	-	-	-	-	-	-		
M/H Req'd	-	-	-	-	-	-		
Co. C 228th							4.4	3.7
No. of A/C	3	-	-	-	-	3		
ME Req'd	.84	-	-	-	-	.84		
M/H Req'd	188	-	-	-	-	188		
Co. D 15th TC							9.7	8.2
No. of A/C	3	-	1	2	-	6		
ME Req'd	.84	-	.32	.72	-	1.88		
M/H Req'd	188	-	72	161	-	421		

*Aircraft Assignments in July 1967

Figure 10-5. Aircraft Assignments* and Related Maintenance Equivalents.
Manhours and Number of Maintenance Personnel - 1st Cavalry
Division - D Company - 15th Battalion (Continued)

	Aircraft Type						Share of Total Maint. Personnel	Share of Direct Labor Maintenance Personnel
	OH-13	UH-12	UH-1C	UH-1D	UH-1H	Totals		
UNIT/1st/9th							12.5	10.7
No. of A/C	-	1	1	5	-	7		
ME Req'd	-	.32	.32	1.80	-	2.44		
M/H Req'd	-	72	72	402	-	546		
Tr. A 9th							47.5	40.3
No. of A/C	10	7	4	6	2	29		
ME Req'd	2.80	2.24	1.28	2.16	.72	9.20		
M/H Req'd	626	501	287	483	161	2058		
Tr. B 9th							47.6	40.3
No. of A/C	10	5	6	6	2	29		
ME Req'd	2.80	1.60	1.92	2.16	.72	9.20		
M/H Req'd	626	358	429	483	161	2057		
Tr. C 9th							45.8	38.7
No. of A/C	10	5	6	6	1	28		
ME Req'd	2.80	1.60	1.92	2.16	.30	8.84		
M/H Req'd	626	358	429	483	80	1976		
TOTAL A/C	52	18	18	34	5	127	(207.6)	(175.7)
TOTAL ME Req'd	14.56	5.76	5.76	12.24	1.80	40.12		
TOTAL M/H Req'd	3256	1289	1289	2736	402	8972		

*Aircraft Assignments in July 1967

Figure 10-5. Aircraft Assignments* and Related Maintenance Equivalents.
Manhours and Number of Maintenance Personnel - 1st Cavalry
Division - D Company - 15th Battalion (Concluded)

degree of backup being provided each of the concepts. Using the maintenance equivalents cited in Chapter 3, the potential workload for the support of each individual company being supported was then established and related to the actual man-hours per month with these maintenance equivalents represented. These data also appear in Figures 10-1 through 10-5 for the two Divisional concepts.

Once the total potential man-hour support requirements were developed, it was then necessary to establish a basis for relative distribution of DS maintenance personnel in accordance with this distribution of maintenance requirements. A review of the TOEs indicated that the DS Company assigned to the 1st Cavalry Division had a total of 215 maintenance function personnel of which 182 were direct labor (aviation mechanics) and 33 were inspectors and supervisors within the maintenance function.

In E Company, the 701st Battalion (supporting the 1st Infantry Division), organized under MTOE 55-89G, 142 maintenance personnel were assigned, of which 129 were labor and 13 were inspectors and supervisors.

On the basis of these total personnel spaces authorized the Divisions, a distribution was made of the number of spaces, pro-rated to each of the companies being supported, based on the man-hours required for the support of the aircraft assigned to those units. These data, presented in Figures 10-1 through 10-5, reflect the total number of maintenance-function personnel and the total number of direct labor men in the maintenance function per unit. The difference between the two would represent the

number of inspectors and supervisors which could be likewise attributed to the support of the individual units.

1st Infantry Division Organization

The application of the Detachment concept to units within the 1st Infantry Division would be limited to only three of the total of seven aircraft owning units: A Company of the 1st Aviation Battalion, B Company of the 1st Aviation Battalion and Troop D of the 4th Cavalry, a total of 70 aircraft of the 99 authorized the entire 1st Infantry Division. (See Figure 10-6.) This break-out is unique in that the aircraft owned by the units, other than the three companies referred to above, constituted the equivalent of another full strength Aviation Company with its 29 aircraft, all of which were OH-13 helicopters except for two UH-1Bs assigned to E Company of the 701st. (See Figure 10-7.)

Applying the general concept above to this organization, a separate Detachment would be assigned to each of the three companies above and a fourth Detachment assigned to Battalion Headquarters of the consolidated maintenance battalion, the 701st Battalion. The primary purpose of this Detachment would be to provide support for those 29 aircraft assigned to the five units (four operational units plus the two float aircraft presently authorized E Company of the 701st). The total implication in number of spaces required in this concept will depend to an extent on the organization of the Detachments themselves. This will be dealt with later, after a complete review is made of the type of Detachments and number of aircraft that each would be required to support.

Organizational Unit	OV-1	OH-13	UH-1B	UH-1D	Total A/C	Recommended DS Detach. Assign
Co.A - 1st Avn. Bn.	-	-	9	16	25	UH-1 Team C
Co.B - 1st Avn. Bn	3	8	-	8	19	{ UH-1 Team A + OH-13 Team A + OV-1 Team A
D/4th Cav.	-	9	17	-	26	{ UH-1 Team B + OH-13 Team A
Total	3	17	26	24	70	

*Aircraft Assignments in July 1967

Figure 10-6. 1st Infantry Division Aircraft Assignments* - Company Size Aircraft Units

Organizational Unit	OV-1	OH-13	UH-1B	UH-1D	Total A/C
1st Brigade	-	6	-	-	6
2nd Brigade	-	6	-	-	6
3rd Brigade	-	5	-	-	5
Div. Artillery	-	10	-	-	10
E/701st	-	-	2	-	2
Total	-	27	2	-	29

*Aircraft Assignments in July 1967

Figure 10-7. 1st Infantry Division Aircraft
Assignments* Non-Company Size
Aircraft Units

1st Cavalry (Airmobile) Division Organization

Applying the Detachment concept to the 1st Cavalry (Airmobile) Division, the basic information in the organization of the Division was presented in Figures 10-2 through 10-5. However, to recap the application and its potential implication, Figures 10-8 and 10-9 present a consolidated listing of the units assigned to the Division, identified in Figure 10-8 for company size aircraft units and Figure 10-9 for companies with less than full company size aircraft units. It will be noted that there was a total of 17 different organizations which have sufficient aircraft to assign a Detachment under the current concept. The 17 units would contain 354 of the present 454 aircraft assigned to the 1st Cavalry Division as of July 1967. It will be noted in Figure 10-8 that some liberties were taken in the grouping of organizations for purposes of investigating the Detachment concepts.

The aircraft assigned to the Headquarters, Headquarters Company of the Assault Helicopter Battalion are assumed to be supported by the maintenance unit assigned to Company D of the Battalion since, in actual operations, the two are usually located in very close proximity. The troop carrying companies, Companies A through C, might well be dispersed. In the case of the 1st Squadron of the 9th Cavalry, the Headquarters unit was assumed to be attached to the same Detachment as Troop A for purposes of the analysis. This will be entirely dependent on the proximity of the Headquarters to the other two troops. Since each of the three troops of the 1st Squadron had roughly the same number in type of aircraft, the inclusion of the Headquarters unit with the Detachment from the troop

Organizational Unit											Total A/C	Recommended* DS Det. Assmt.	ME Req'd
	O-1	U-6	OV-1	OH-13	UH-1B	UH-1C	UH-1D	UH-1H	CH-47				
21st Gen Sup Co	-	1	3	9	3	3	4	-	-	23	{ UH-1 OH-13 OV-1	Team A + Team A + Team A +	7.12
	-	-	-	3	1	-	-	-	-	15	UH-1	Team B	4.68
	-	-	-	-	3	8	-	-	-	17	UH-1	Team B	6.12
	-	-	-	-	-	-	17	-	-	18	UH-1	Team B	6.48
HHC 227 ASH	-	-	-	-	-	-	18	-	-	18	UH-1	Team B	6.48
Co.D 227 ASH	-	-	-	-	-	-	-	-	18	18	CH-47	Team	11.34
Co.A 227 ASH	-	-	-	-	-	-	-	-	16	16	CH-47	Team	10.08
Co.B 227 ASH	-	-	-	-	-	-	-	-	16	19	CH-47	Team	10.92
Co.C 227 ASH	-	-	-	3	-	-	-	-	-	15	UH-1	Team B	4.68
HHC 229 ASH	-	-	-	3	1	6	-	-	-				
Co.D 229 ASH	-	-	-	-	5								

*See Figure 10-3 for Team Structure

**Aircraft Assignments in July 1967

Figure 10-8. 1st Cav (Airmobile) Division Aircraft Assignments**--Company Size Aircraft Units
(Continued)

Organizational Unit											Total A/C	Recommended* DS Det. Assnt.	MM Req'd
	O-1	U-6	OV-1	OH-13	UH-1B	UH-1C	UH-1D	UH-1E	CH-47				
Co.A 229 ASH	-	-	-	-	-	-	17	-	-	-	17	UH-1 Team B	6.12
Co.E 229 ASH	-	-	-	-	-	-	19	-	-	-	19	UH-1 Team B	6.84
Co.C 229 ASH	-	-	-	-	-	-	19	-	-	-	19	UH-1 Team B	6.84
HMT 1st Sq/ 9 Cav	-	-	-	-	1	1	5	-	}		36	UH-1 Team C OH-13 Team A	11.84
Trp A 1st Sq/ 9 Cav	-	-	-	10	7	4	6	2	-	-	29	UH-1 Team B OH-13 Team A	9.20
Trp B 1st Sq/ 9 Cav	-	-	-	10	5	6	6	1	-	-	28	UH-1B Team B OH-13 Team A	8.84
Trp C 1st Sq/ 9 Cav	-	-	-	16	1	2	1	-	-	-	24	OH-13 Team B UH-1 Team A	6.60
Btry E 82 Arty	4	-	-	-	-	-	11	12	-	-	23	UH-1 Team C	8.28
HSC Co.15 Med	-	-	-	-	-	-	-	-	-	-	-	-	-
Total 17 Units	4	1	3	64	32	36	147	17	50		354		132.27***

*See Figure 10-8 for Team Structure

**Aircraft Assignments in July 1967

***79.6 Percent of Total

Figure 10-8. 1st Cav (Airmobile) Division Aircraft Assignments** -Company Size Aircraft Units
(Concluded)

Organizational Unit	O-1	U-6	OV-1	OH-13	UH-1B	UH-1C	UH-1D	UH-1H	CH-47	CH-54	Total A/C	ME**
HHC 1st Brigade	-	-	-	8	-	-	5	-	-	-	13	4.04
HHC 2nd Brigade	-	-	-	8	-	-	4	-	-	-	12	3.68
HHC 3rd Brigade	-	-	-	8	-	-	5	-	-	-	13	4.04
HHC 2/20	-	-	-	-	-	3	-	-	-	-	3	0.96
A Battery 2/20	-	-	-	-	9	3	-	-	-	-	12	3.84
B Battery 2/20	-	-	-	-	8	4	-	-	-	-	12	3.84
C Battery 2/20	-	-	-	-	10	2	-	-	-	-	12	3.84
Band Supp. Co.	-	-	-	-	-	-	1	-	-	-	1	0.36
1st Avn. Det.	-	-	-	-	-	-	-	-	2	-	2	1.26
Co. A 15th TC Bn.	-	-	-	-	-	-	1	-	5	-	6	3.51
Co. B 15th TC Bn.	-	-	-	-	-	1	2	-	-	-	3	1.04
Co. C 15th TC Bn.	-	-	-	1	2	-	1	-	-	-	4	1.28
Co. D 15th TC Bn.	-	-	-	3	-	1	2	-	-	-	6	1.88
HHC 15th TC Bn.	-	-	-	-	-	-	1	-	-	-	1	0.36
Totals (15 Units)	-	-	-	28	29	14	22	-	7	-	100	33.93

*20.4 Percent of Total

**Maintenance Equivalent

***Aircraft Assignments in July 1967

Figure 10-9. 1st Cav (Airmobile) Division Aircraft Assignments***
Less Than Company Size Aircraft Units

closest to the Headquarters could be an on-site decision.

Application of the Detachment concept to the 1st Airmobile Division affects approximately 80 percent of the total maintenance equivalent capability of the Battalion. From Figure 10-8, it was noted that the 354 aircraft required 132.27 maintenance equivalents for their support, while the aircraft in less than company size (Figure 10-9) required 33.93, a total Battalion capability of 166.20 maintenance equivalents.

It is now necessary to investigate the assignment of Detachments to these units, in light of the distribution of aircraft to the company size aircraft units in the 1st Cavalry and 1st Infantry Divisions.

Organization of Direct Support Detachments

The application of the DS Detachment concept to the 1st Cavalry and the 1st Infantry Divisions required that new configurations of the standard TOE 55-500 series be developed which would be adaptable to the already existing tactical units. In the present TOE 55-500, provision is made for a Detachment to support 25 UH-1s (TOE 55-500R). TOE 55-500E provides a Detachment for the support of 16 OV-1s, in conjunction with TOE 11-500D for support in the avionics and electronics. TOE 55-510T provides a team for the support of 16 CH-47s.

The initial step taken in the application of the Detachment concept to the Division was a review of the actual aircraft

assignment by unit as previously set forth in Figures 10-8 and 10-9. The units that had less than 15 aircraft were considered too small to warrant the assignment of a Detachment, and would be provided support by one DS Maintenance Company organized under TOE 55-407T (the present DS Companies assigned to the 15th TC Battalion of the 1st Cavalry (Airmobile) Division). The other aircraft, presented in Figure 10-8, were considered authorized in units large enough to be assigned Detachments.

A review of the number and type of aircraft assigned to these units, together with those of the 1st Infantry Division presented in Figures 10-1 and 10-6, indicated that UH-1 aircraft were normally assigned in three ranges: 8 to 12 aircraft, 15 to 20 aircraft, 21 to 30 aircraft. The CH-47s, with very limited exceptions, were normally assigned in full company strength of 16 aircraft. The OH-13 was assigned in groups of approximately 10 or 15 aircraft. The OV-1 helicopters were assigned in full strength companies of 16 aircraft, or in units of 3 to 6 aircraft each.

On the basis of the above, the TOEs for the Detachments and the DS Companies were reviewed in detail, identifying the MOSSs and grade structure within each required to support the respective number and types of aircraft, and a modified TO was prepared for each of the above groups. The actual maintenance function spaces recommended for each of the DS Detachments is presented in Figure 10-10 for each type of aircraft by the number of aircraft being supported.

Team Designation	UH-1 Teams			CH-47 Team	OH-13 Teams			OV-1 Teams		
	A	B	C		A	B	A*	B**		
No. of Aircraft	8-12	15-20	21-30	15-20	8-12	13-17	3-6	14-18		
26 N 20	-	-	-	-	-	-	1	-		
31 Q 30 E5	-	-	-	4	-	-	3	2		
41 C 20 E4	-	-	-	-	-	-	1	-		
44 E 20 E5	1	1	1	1	-	-	-	1		
45 J 20 E4	1	1	1	-	-	-	-	-		
67 A 10 E3	3	6	9	5	2	4	1	3		
67 F 20 E6	-	-	-	-	-	-	2	2		
67 K 20 E4	-	-	-	-	-	-	2	6		
67 K 20 E5	-	-	-	-	-	-	1	6		
67 N 20 E4	-	-	-	-	3	5	-	-		
67 N 20 E5	-	-	-	-	2	3	-	-		
67 N 20 E4	3	7	11	-	-	-	-	-		
67 N 20 E5	3	7	11	-	-	-	-	-		
67 R 40 E6	-	1	2	-	-	-	-	-		
67 R 40 E7	1	1	1	-	1	1	-	-		
67 U 30 E4	-	-	-	11	-	-	-	-		
67 U 30 E5	-	-	-	10	-	-	-	-		
67 W 20 E6	1	2	3	4	1	1	-	-		
67 Z 40 E6	-	-	-	3	-	-	-	-		
67 Z 40 E7	-	1	-	1	-	-	1	2		
67 Z 50 E8	-	-	1	-	-	-	-	1		

*No-Sig. Det.

**W/Sig. Det. TOE-11-5003

Figure 10-10. Recommended Maintenance Spaces for DS Detachments by Number and Type of Aircraft (Continued)

Team Designation	LH-1 Teams			CH-47 Team	OH-13 Teams		OV-1 Teams	
	A	B	C		A	B	A*	B**
No. of Aircraft	8-12	13-20	21-30	15-20	8-12	13-17	3-6	14-18
68 A 10 E3	1	2	3	3	-	-	1	4
68 B 20 E4	1	2	3	2	-	-	-	2
68 B 20 E5	1	2	3	2	-	-	1	1
68 D 20 E4	1	-	1	1	1	-	-	-
68 D 20 E5	-	1	1	1	-	1	-	-
68 F 20 E4	1	1	1	1	1	1	1	1
68 F 20 E5	-	1	1	1	-	1	-	1
68 F 20 E4	1	-	1	2	1	-	-	1
68 F 20 E5	-	1	1	2	-	1	-	1
68 G 20 E4	1	3	4	4	1	2	1	2
68 G 20 E5	1	1	2	2	1	1	1	2
68 H 20 E4	-	-	-	2	-	-	1	1
68 H 20 E5	-	-	-	1	-	-	-	1
68 J 20 E4	-	-	-	-	-	-	1	1
68 J 20 E5	-	-	-	-	-	-	-	1
Total	21	41	61	63	14	21	19	43

*No-Sig. Det.

**W/Sig. Det. TOE-11-500D

Figure 10-10. Recommended Maintenance Spaces for DS Detachments by Number and Type of Aircraft (Concluded)

DS DETACHMENT CONCEPT APPLICATION FACTORS

Application to 1st Infantry Division

The units within the 1st Infantry Division having sufficient numbers of aircraft to warrant consideration for Detachments were set forth in Figure 10-6 above. Included on Figure 10-6 was an indication of the recommended teams which could be assigned to each of these units. Figure 10-13 presents a summary of the total number of teams applicable to the 1st Infantry Division. It is noted that a total of six teams would be required, containing a total of 170 maintenance function personnel. The administrative support required for these Detachments is a total of 21 spaces (Figure 10-11).

The supply support personnel must be added to these personnel. Relating the aircraft authorizations from Figure 10-6 to the supply support requirements from Figure 10-12, a total of 19 supply support spaces are recommended, 17 of which are basic supply personnel and two are signal specialists.

In the support of the aircraft assigned in less than company-strength units, Figure 10-7 indicated that a total of 29 aircraft (27 of which were OH-13s), required the support of a Detachment assigned at Battalion Headquarters level. It is recommended that, for this number of aircraft, a composite Detachment consisting of one OH-13 Team A and one OH-13 Team B, be used in support of these aircraft, augmented by a Detachment Commander with a rank of Lieutenant.

	UH-1 Teams			CH-47 Team	OH-13 Teams		OV-1 Teams	
	A	B	C		A	B	A	B
Officers								
Capt.	-	-	1	1	-	-	-	-
1st.	1	1	-	-	-	-	-	1
W/Officers	1	1	1	1	-	1	-	1
NCO's								
E8	-	-	-	1	1	-	1	-
7	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-
Other Enlisted	1	3	5	9	1	2	1	6
Total	3	5	7	12	2	3	2	8

Figure 10-11. Administrative Support for DS Detachment Teams

No. of Aircraft Per Detachment	No. of Supply Personnel Basic	Augmentation for Electronics*
10 - 15	4	+ 2 Sig. Sply. Clks.
16 - 20	5	+ 2 Sig. Sply. Clks.
21 - 30	6	+ 3 Sig. Sply. Clks.
30 - 40	7	+ 3 Sig. Sply. Clks.

*Authorized for CH-47/OV-1 Aircraft Support

Figure 10-12. Supply Support for DS Detachment Teams

Company Detachments			
Type of Team*	No. of Teams	Total Maintenance Spaces	Administrative Support
UH-1 Team A	1	21	3
Team B	1	41	5
Team C	1	61	7
CH-47 Team	-	-	-
OH-13 Team A	2	28	4
Team B	-	-	-
OV-1 Team A	1	19	2
Team B	-	-	-
Total	6	170	21

Support Battalion Detachment			
Type of Teams*	No. of Teams	Total Maintenance Spaces	Administrative Support
OH-13 Team A	1**	14	2
Team B	1**	21	4***
Total	2	35	6

* See Figure 10-10 for Team Structure

** Includes one OH-13 Team A and OH-13 Team B combination, augmented by 1 Lt. as Detachment Commander

***1 Lt. Detachment Commander Augmentation

Figure 10-13. Summary - DS Detachment Requirements for
1st Infantry Division,
(Based on Aircraft Assignments of July 1967)

In total, the 1st Infantry Division would then require eight teams with a total of 205 maintenance spaces and 27 administrative support personnel.

The supply support requirements of the Battalion level Detachment could be satisfied by six basic supply personnel. These personnel, combined with the 19 required by the Detachments, provide a total of 25 supply spaces in support of the 1st Infantry Division aircraft. These spaces, added to the maintenance and administrative spaces, would provide a total complement of 257 aviation personnel required to support the 99 aircraft assigned in July 1967. It is noted that these spaces are in excess of the 181 spaces presently authorized the DS Company assigned to the ROAD Division. However, as pointed out earlier in this Report, E Company of the 701st Battalion, 1st Infantry Division, was authorized a modified TOE which provided for aviation supply functions within the company, rather than the consolidated supply activity of the Battalion increasing the total to 202 spaces (MTOE 55-89G). Thus, the cost of applying the DS Detachment concept to the 1st Infantry Division would be an increase of 55 spaces.

Application to 1st Cavalry (Airmobile) Division

The units within the 1st Cavalry (Airmobile) Division considered adaptable to the DS Detachment concept were set forth in Figure 10-8. Also indicated on this Figure were the number and types of teams which could be assigned to the various units, in accordance with the number and type of aircraft authorized. Figure 10-14 is a summary of the total

DS Detachment requirements to support the 1st Cavalry (Airmobile) Division for these specified units. It will be noted that a total of 23 teams are required which will provide spaces for 859 maintenance personnel. Applying the criteria from Figure 10-11 for administrative support, a total of 119 additional spaces are required.

Supply support personnel required in the support of these Detachments, in accordance with the criteria set forth in Figure 10-12, would constitute an additional 90 basic supply spaces. Two additional signal specialists would be required for the OV-1 aircraft and six signal specialist spaces for the support of the CH-47, resulting in a total of 98 supply personnel.

The total staffing requirements, in the application of the DS Detachment to the 1st Cavalry Division, would then be 1076 personnel in the Detachments.

As previously pointed out, a DS Company organized under TOE 55-407T, is still required in the support of those aircraft assigned in less than Company size units (as set forth in Figure 10-9). This DS Company is authorized 331 total spaces resulting in a total DS requirement of 1407 personnel within the 1st Airmobile Division. Since the Division is now authorized 1428 spaces, this constitutes a potential saving of 21 spaces. This saving was actually achieved by the elimination of the administrative support requirements at the Battalion level, which is currently being provided the four DS Companies assigned to the 15th TC Battalion. The DS Company which is required at the Division can be attached to the Consolidated Maintenance Battalion as a special unit in support of Aviation.

Type of Team†	No. of Teams	Total Maintenance Spaces	Administrative Support
UH-1 Team A	2	42	6
Team B	10	410	50
Team C	2	122	14
CH-47 Team	3	189	36
OH-13 Team A	4	56	8
Team B	1	21	3
OV-1 Team A	1	19	2
Team B	-	-	-
Total	23	859	119

*See Figure 10-10 for Team Structure

**Based on aircraft assignments of July 1967

Figure 10-14. Summary - DS Detachment Requirements for
1st Cavalry (Airmobile) Division**

Changes in aircraft assignments will, of course, change the total space requirements to the extent of support required by type and model of aircraft. Computations for this study were based on the actual Divisional assignments as of July 1967.

Integration of Detachments and Supported Units

As noted earlier, savings in personnel requirements under the Detachment concept have been obtained by eliminating certain administrative and overhead personnel, on the basis that supported units will provide support in the areas. It is believed that additional savings could be obtained by actually integrating the Detachment into the supported unit organizational structure. Under this concept, the supported unit would be responsible for providing all Command, overhead and administrative support for the integrated organization. The precise amount of personnel savings cannot be stated without a detailed analysis of the specific job areas involved, but it is estimated that from 25% to 50% of the administrative support personnel requirement cited above could be eliminated. Application of this concept to existing Detachments as well as recommended Detachments for Divisional Aircraft support would, it is believed, reduce total personnel requirements in Maintenance Units in Vietnam below the number authorized at the time of this study.

An additional advantage to be gained from application of this concept lies in the area of Command and Control. Integration will result in the operating Unit Commander having complete control of all of the resources required to accomplish Organizational and a high percentage of the Direct Support Maintenance required to

Aircraft Type	No. of Aircraft		Readiness Rates		Days Saved Per A/C	Total A/C Days Saved *
	Detachment Supported	Other	Detachment	Air-mobile		
O-1	4	-	-	-	-	-
U-6	1	-	-	-	-	-
OV-1	3	-	83.6	66.5	62.42	187.3
OH-13	64	28	-	-	-	-
UH-1B/UH-1C	68	43	80.1	74.0	13.51	1,499.6
UH-1D/UH-1H	164	22	79.6	71.1	27.38	5,092.7
CH-47	50	7	66.7	54.8	37.96	2,163.7
TOTALS	354	100	-	-	-	8,943.3 (24.5 A/C yrs.)

*Per year

**Based on aircraft assignments of July 1967

Figure 10-15. Potential Impact of DS Detachments on 1st Cavalry Division A/C Readiness**

Aircraft Type	No. of Aircraft		Readiness Rates		Days Saved Per A/C	Total A/C Days Saved *
	Detachment Supported	Other	Detachment	Air-mobile		
OV-1	3	-	83.6	74.6	32.9	98.7
OH-13	17	27	-	-	-	-
UH-1B	26	2	80.1	69.7	35.4	991.2
UH-1D	24	-	79.6	70.1	34.7	832.8
TOTALS	70	29	-	-	-	1,922.7 (5.3 A/C Yrs.)

*Per year

**Based on aircraft assignments of July 1967

Figure 10-16. Potential Impact of DS Detachments on 1st Infantry Division A/C Readiness**

support his aircraft. The major requirements for establishing work priorities related to aircraft mission requirements, control of resources, utilization of manpower and the most efficient use of Organizational and Direct Support tools, equipment and skills are centralized in one Command.

IMPACT ON AIRCRAFT READINESS

The application of the DS Detachment to the 1st Infantry Division resulted in 55 additional maintenance spaces required. In the case of the 1st Cavalry Division, it resulted in a potential saving of 21 spaces. However, the real significance of the impact of the concept is in the potential increase in aircraft readiness rates which cannot be measured directly in dollar value when the aircraft are assigned to a combat area. However, for comparative purposes, the cost factors can be related to initial investment.

The potential impact of the DS Detachment concept application to the 1st Cavalry Division and the 1st Infantry Division are illustrated on Figures 10-15 and 10-16, as they would affect aircraft readiness.

1st Cavalry Division

In the case of the 1st Cavalry Division, 354 aircraft out of the total of 454 can be supported by Detachments. The readiness rates that were attainable for the various type, model and series of aircraft supported by Detachments are compared to those that were achieved by the Airmobile Division as set

forth elsewhere in this Report. Assuming that an equivalent readiness rate can be achieved by the units which have Detachment assignments, the total potential annual implication is a saving of approximately 8,943 aircraft days (24.5 aircraft years or 5.36 percent of the total 454 aircraft). This potential saving can be translated to a dollar value by relating the potential aircraft years saved to the pro-rated investment cost. Considering only the types of aircraft involved in the Detachment supported units, weighted by the relative population of each, the average cost per aircraft in the 1st Cavalry Division, Detachment supported, would be \$283,867. Assuming, on the basis of present Army procedures, that the expected life of an average Army aircraft is nine years, the average weighted cost per aircraft can now be attributed to an annual investment of \$42,652 per year for the 1st Cavalry Division aircraft. On the basis of the 24.5 aircraft years saved above, this represents an investment saving of \$1,044,974 per year for each Cavalry Division fielded under the Detachment concept proposed herein. This represents about 6.4 percent of the total annual investment in aircraft for the Division.

1st Infantry Division

The relative saving that could be attributed to the 1st Infantry Division would be comparatively low because of the reduced number of aircraft associated with the 1st Infantry, in comparison with the 1st Cavalry Division. Of the total of 99 aircraft, 70 would be Detachment supported, and the other 29 related to a Detachment at Battalion Headquarters. The average weighted cost of these aircraft (Detachment supported) would be \$268,470 per

aircraft, (\$29,830 per year pro-rated over a nine year life). The potential increases in readiness rates of these aircraft are demonstrated in Figure 10-16 for the Detachment compared with the Conventional ROAD Division concept. The potential impact of the DS Detachment on aircraft readiness for the Division as a whole, represented also on Figure 10-16, would be a potential annual saving of 1,923 aircraft days, or 5.3 aircraft years (5.35 percent of the total of 99 aircraft assigned to the 1st Infantry).

At the annual investment of \$29,830 per aircraft per year, this would represent a potential saving of \$158,099 per year for each ROAD Division in this configuration, (8.56 percent of the total annual aircraft investment for the Division). Under the COSTAR concept, with the reduction of aircraft to 55 per Division, this saving would be proportionately decreased, depending on the manner in which the aircraft are assigned to the units.

SUMMARY

From the above, it is clear that the Detachment concept could increase the aircraft readiness of both Divisions from approximately 70 to 80 percent. The impact of the Detachment concept on the ROAD Division, with its relatively few aircraft, is much smaller than the results attainable by the 1st Cavalry Division. However, the increased potential combat readiness of 5.3 aircraft years per ROAD Division is of real significance to the Commander.

As a nominal result, the cost avoidance in increased aircraft readiness for the 1st Infantry Division has been shown as \$158,099 per year, or 8.56 percent of the total aircraft investment. However, the application of the Detachment concept will require 55 personnel spaces over the total number now provided for aviation maintenance support. The 1st Cavalry Division potential cost avoidance is \$1,044,974 or 6.4 percent of the total annual aircraft investment for the entire Division. In addition, a saving of 21 maintenance spaces can be made through application of the concept, as proposed. Parallel studies should be made of other organizational structures not currently supported by Detachments to determine the feasibility of expanding the concept to such organizations.

ANNEX A

ANNEX A

MAINTENANCE PERSONNEL COMPARISON, ALTERNATIVE MAINTENANCE CONCEPT

The primary purpose of this area of investigation is to identify the nature of personnel spaces which are authorized the various DS units organized under the alternative concepts in this study. Each of the appropriate TOEs were reviewed and all maintenance function associated personnel were abstracted in accordance with their MOS and grade. Table 1 in this Annex includes the detailed tabulation of these results. A summarization and evaluation of the maintenance personnel within each of the alternative concepts is included in Chapter 4 to this Report.

Title, MOS & Grade	TOE									
	55- 457E	55- 510T AB	55- 500R W/C10	55- 406T	55- 407T	55- 89E	11- 500D RX	55- 500E JE	55- 458E GS	
GCA Rpmn. -26D20 E5	-	-	-	-	-	-	1	-	2	
Airborne Sensor Specialist-26E20 E4	-	-	-	3	-	-	-	-	-	
E5	-	-	-	4	-	-	-	-	-	
ABN Radar Rpmn. -26M20 E5	-	-	-	-	-	-	7	-	2	
ABN Infra.Rpmn. -26N20 E5	-	-	-	-	-	1	6	-	4	
Radar Maint. Superv. -26W20 E6	-	-	-	2	-	-	-	-	-	
Avionics Rpmn. -31Q30 E5	6	4	-	-	12	4	-	2	12	
Avionics Rpmn. -31Q40 E6	1	-	-	-	-	-	-	-	2	
E7	-	-	-	-	1	-	-	-	2	
Totals	7	4	-	9	13	5	14	2	24	

Title, MOS & Grade	TOE								
	55- 457E	55- 510T AB	55- 500R KD	55- 406T	55- 407T	55- 89E	11- 500D PX	55- 500E JE	55- 458E GS
Fire Ctl. Computer Rprmn.- 34G20 E5	-	-	-	-	-	-	1	-	-
Avn. Elec. Team Chief - 35P40 E6	-	-	-	-	-	-	1	-	-
Avn. Comm. Equip. Rprmn.- 35L20 E5	-	-	-	-	-	-	1	-	-
Avn. Nav. Equip. Rprmn. - 35M20 E5	-	-	-	-	-	-	1	-	-
Avn. Flt. Cont. Eq. Rprmn. - 35N20 E5	-	-	-	-	-	-	1	-	-
Fire Ctl. Rprmn. - 41C20 E4	-	-	-	-	-	1	-	-	-
Photo-Surv. Rprmn. - 41G20 E5	-	-	-	5	-	-	3	-	2
Totals	-	-	-	5	-	1	8	-	2

Title, MOS & Grade	TOE								
	55- 457E	55- 510T AB	55- 500R KD	55- 406T	55- 407T	55- 89E	11- 500D RX	55- 500E JE	55- 458E GS
Machinist - 44E20 E5 E6	2 -	1 -	1 -	- -	2 -	2 -	- -	1 -	2 1
Armament Maint. Apprentice -45A10 E3	1	-	-	-	-	1	-	-	1
A/C Armament Rprmn. - 45J20 E4 E5	4 3	- -	1 -	- -	2 2	- -	- -	- -	6 -
A/C Armament Rprmn. - 45J40 E6	1	-	-	-	-	-	-	-	1
A/C Maint. Crewmen - 67A10 E3	10	5	9	-	15	12	-	3	12
Airplane Tech. Insp. - 67F20 E6	3	-	-	-	-	1	-	2	2
Multi-Eng. Airpl. Rprmn. - 67K20 E4 E5	- -	- -	- -	- -	- -	2 2	- -	6 6	8 8
Totals	24	6	11	-	21	20	-	18	41

Title, MOS & Grade	TOE									
	55- 457E	55- 510T AB	55- 500R KD	55- 406T	55- 407T	55- 89E	11- 500D RX	55- 500E JE	55- 458E GS	
Single-Rotor, Turb. Obsvn./Util. Hel. Mech. - 67N20 E4 E5	- -	- -	11 11	- -	35 35	30 25	- -	- -	- -	
Single-Rotor, Turb. Obsvn./Util. Hel. Mech. - 67N40 E4 E5 E6	- - -	- - -	- - -	- - -	- - -	- 4 4	- - -	- - -	17 17 -	
Single Eng., Single- Rotor Hel. Maint. Chief - 67R40 E6 E7	- -	- -	1 1	- -	- -	- -	- -	- -	- -	
Multi-Eng. Single- Rotor Hel. Mech. - 67T30 E4 E5	22 21	- -	- -	- -	- -	- -	- -	- -	- -	
Totals	43	-	25	-	70	63	-	-	34	

Title, MOS & Grade	TOE								
	55- 457E	55- 510T AB	55- 500R KD	55- 406T	55- 407T	55- 89E	11- 500D RX	55- 500E JE	55- 458E GS
Multi-Eng., Tand- Rotor Hel. Mech. - 67U30 E4 E5	- - -	11 10	- -	- -	- -	- -	- -	- -	- -
Hel. Tech. Insp. - 67W20 E6	9	2	2	4	16	3	-	-	2
A/C. Rpr. Chief - 67Z40 E5 E6 E7	- 1 4	- 4 1	- - -	- - -	2 10 3	- 4 1	- - -	- - 1	- 5 3
- 67Z50 E8	-	-	1	-	1	-	-	1	-
A/C. Comp. Rpr. Apprent.- 68A10 E3	10	3	3	-	10	6	-	4	14
A/C. Eng. Rprmn. - 68B20 E4 E5	7 7	2 2	3 3	- -	8 8	4 4	- -	2 1	8 8
Totals	38	35	12	4	58	22	-	9	40

Title, MOS & Grade	TOE								
	55- 457E	55- 510T AB	55- 500R KD	55- 406T	55- 407T	55- 89E	11- 500D RX	55- 500E JE	55- 458E GS
A/C Eng. Rprmn. - 68B30 E6	-	-	-	-	-	-	-	-	1
A/C. Powertrain Rprmn. - 68D20 E4 E5	1 1	1 1	1 1	- -	2 2	2 2	- -	- -	4 4
Rotor & Prop. Rprmn. - 68E20 E4 E5	1 1	1 1	1 1	- -	2 2	2 2	- -	1 1	4 4
Aircraft Electrician - 68F20 E4 E5	1 1	2 2	1 1	- -	4 4	2 2	- -	1 1	4 4
Airframe Rprmn. - 68G20 E4 E5	14 4	4 2	4 2	- -	19 6	12 2	- -	2 2	14 7
- 68G30 E6	-	-	-	-	-	-	-	-	1
Totals	24	14	12	-	41	26	-	8	47

Title, MOS & Grade	TOE								
	55- 457E	55- 510T AB	55- 500R KD	55- 406T	55- 407T	55- 89E	11- 500D RX	55- 500E JE	55- 458E GS
A/C. Hydr. Rprmn. - 68H20 E4 E5	2 1	2 1	- -	- -	4 4	2 2	- -	1 1	4 4
A/C. Instr. Rprmn. - 68J20 E4 E5	1 1	- -	- -	- -	2 2	1 -	- -	1 1	2 2
Totals	5	3	-	-	12	5	-	4	12
Grand Total	141	62	59	18	215	142	22	41	209

ANNEX B

ANNEX B

COMPARATIVE EVALUATION, MAINTENANCE SUPPORT EQUIPMENT AUTHORIZATIONS

In the evaluation of specialized resources and capabilities of Direct Support maintenance units, Chapter 4 to this report, it was necessary to review the applicable TOEs under which the Direct Support units that were sampled during this study were organized. All DS units sampled were actively engaged in the support of U.S. Army aircraft in Vietnam.

The selection of items included in this review were only those directly associated with the maintenance function of the units and/or required for its operations within this capacity. Equipment required for administrative, personnel support, logistics, etc., were not identified.

No attempt has been made to order the maintenance items within any categorization, identification nomenclature, line item, etc. Rather, this was an attempt to bring together in one matrix, a complete listing of maintenance equipment so that they could be related across TOEs as a function of their particular role in the support of Army aviation.

Included in this review are the nomenclature of the maintenance item, the line item number identification, and the particular TOE to which it is authorized. It will be noted that there is an ancillary code identified with selected items. This code, used as a

basis for the evaluation of the major items of equipment resources in Chapter 4, has been established in the following categories:

- Code A - Analyzers
- Code B - Helicopters
- Code C - Shelters
- Code D - Shop Sets
- Code E - Generators - Signal
- Code F - Maintenance Kits
- Code G - Test Sets
- Code H - Tool Sets
- Code I - Simulators

The categorization of maintenance items by the above code permits the comparison of the number of types of items on the basis of its primary function rather than the specific line item number. Therefore, a particular type test set in a DS detachment might be available in the Direct Support Company as well, but identified by a different line item number due to the fact that it might contain a few additional parts because of the level to which the equipment is authorized. It was considered that the availability of a test set was more important to acknowledge rather than the availability of a specifically identified test set with a detailed specification of its capabilities.

This information is presented in its entirety to demonstrate the depth of investigation performed in this evaluation of relative equipment assignments among the various maintenance concepts.

Maint Item Code	Nomenclature	Old Line Item #	TOE							
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E	55- 500 R E
D	Shop Equip., GM,FM Set -B/55-1181/	440127	0	1	0	0	0	0	0	0
G	Ammeter ME-221()/U	602082	1	1	1	0	0	0	2	0
G	Ammeter ME-222()/U	602083	0	0	0	0	1	0	0	0
A	Analyzer TS-684/URM-30	602615	0	1	0	0	0	0	0	0
A	Analyzer - Portable Compass TS-1662/ASW	602636	0	1	0	0	0	0	2	0
G	Antenna Gp. RC-292	603250	0	1	2	0	0	0	0	0
A	Analyzer Bench Test AN/ASM-125	605580	0	1	0	0	0	0	2	0
D	Charger Radiac Detector PP-1578/PD	609625	0	7	1	1	1	5	2	0
D	Charger Battery PP- 1451/G	609632	0	2	2	1	1	8	2	0
G	Resistance Bridge ZM-4/U	611201	0	1	0	0	0	0	0	0
G	Control Gp. AN/GRA-6	611280	0	1	0	0	0	0	0	0
G	Multimeter TS-505()U	614850	0	4	3	0	0	0	0	0
G	Fixture Rotary Torque Tester MX-3719-() ASW-12(V)	616234	0	1	0	0	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE							
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E	55- 500 R E
G	Fixture, Mech. Linear Actuator MX-3720/ASW- 12(V)	616235	0	1	0	0	0	0	0	0
G	Filter Variable Elec. F-660/U	616168	0	0	1	0	0	0	2	0
G	Freq. Meter AN/USM-159	616837	1	2	0	1	2	0	2	0
G	Freq. Meter AN/USM-26	616840	0	1	1	1	0	0	4	0
G	Freq. Meter AN/TSM-16	614940	1	0	1	0	0	0	0	0
E	Generator Sig. AN/URM-64	618123	0	1	1	0	1	0	2	0
E	Generator Sig. AN/URM- 103	618124	1	2	1	1	0	0	2	0
E	Generator Sig. AN/USM-44	618133	3	2	1	1	2	3	4	0
E	Generator Sig. AN/URM- 127	618151	1	2	0	0	0	0	4	0
E	Generator Pulse SG-366/U	618076	0	0	1	0	0	0	2	0
G	Indicator Dial ID-989	621106	0	0	1	0	0	0	0	0
G	Indicator Standing Wave Radio AN/URM-120	621124	0	2	1	1	2	1	2	0
E	Generator Sig. SG-382/U	618156	0	0	1	0	0	0	2	0
A	Electronic R Blade Tracker AN/USN/188	622091	0	2	0	0	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE								
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E	55- 500	
										R	E
D	Holder - Semi-conductor Device	620486	0	0	1	0	0	0	0	0	0
G	Indicator St. Wave AN/UPM-108	621162	0	0	1	0	0	0	0	0	0
F	Maint. Kit - Elect Equip. - 693	624973	0	0	0	1	2	0	0	0	0
F	Maint. Kit - 731 ARC-51X	624975	0	1	0	0	0	0	2	0	0
F	Maint. Kit - 722 ARC-102	624976	0	1	0	0	0	0	2	0	0
F	Maint. Kit - 733 ARC-54	624977	0	1	0	1	0	0	2	0	0
F	Maint. Kit - 570/ASN	624979	0	1	0	0	0	0	0	0	0
F	Maint. Kit - 664/UA	624969	0	0	1	0	0	0	2	0	0
F	Maint. Kit - 652 APS-94	624981	1	0	1	0	0	0	2	0	0
F	Mechanical Linkage TL- 633U	625620	0	1	0	1	0	0	0	0	0
F	Maint. Kit - 662/UP	624989	1	0	1	0	0	0	0	0	0
G	Multimeter AN/URM-105	628139	0	1	1	0	1	0	0	0	0
G	Multimeter TS-352/U	628230	5	9	4	4	7	4	24	0	0
G	Multimeter ME-26/U	628314	8	0	2	1	2	2	8	0	0
G	Oscilloscope AN/USM-140	628951	4	1	2	1	0	0	8	0	0
G	Oscilloscope OS-8/U	628960	0	2	0	1	2	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE							55- 500	
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E		
										R	E
G	Ohmmer ZH-21/U	628794	1	0	1	0	1	0	2	0	0
G	Multimeter TS-585/U	629030	7	2	0	1	0	0	2	0	0
G	Oscilloscope AN/USM-117	628941	0	0	2	0	0	0	0	0	0
E	Generator Pulse AN/UPM-15	633830	0	1	1	0	0	1	2	0	0
D	Power Supply PP-3135/U	631549	0	0	1	0	0	0	2	0	0
G	Radiacmeter IM-93/UD	634670	0	16	2	2	12	6	0	0	0
G	Radiacmeter IM-174/PD	634671	0	1	1	1	1	0	0	0	0
G	Prod. Test Mix-2517	632944	0	0	1	0	0	2	0	0	0
D	Reeling Mach Cable-Hand RL-39	660000	0	2	3	0	2	1	0	0	0
D	Reeling Mach Cable-Hand RL-31	660120	0	1	0	0	1	1	0	0	0
E	Generator Sig. SG 73/ARN	664500	1	2	0	1	0	0	0	0	0
E	Generator Sig. TS-452/U	664790	1	1	0	1	1	0	2	0	0
E	Generator Sig. AN/URM-25	665028	2	2	1	1	2	2	4	0	0
E	Generator Sig. SG-336	664550	0	0	0	0	0	0	2	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE								
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E		
									R	E	
H	Simulators Infra-red AN/TAN-2	665245	0	0	0	0	0	0	2	0	0
H	Compass Transm. SM- 272/ASN	665240	0	1	0	0	0	0	2	0	0
H	Environ. Press SM 335/ASM	665242	0	1	0	0	0	0	0	0	0
H	Gyroscope Contr. SM 254/ ASM	665281	0	1	0	0	0	0	2	0	0
H	Servo Sign. AN/ASM-112	665285	0	1	0	0	0	0	0	0	0
H	Navigation Sig. AN/ASM- 113	665293	0	1	0	0	0	0	0	0	0
H	Gyroscope Sig. SM 253/ASM	665380	0	1	1	0	0	0	2	0	0
H	Test Signals AN/TAM-1	665295	0	0	1	0	0	0	2	0	0
E	Generator Sig BC-376	682695	0	0	0	1	2	1	2	0	0
G	Test Sets Oscillator AN/TRM-10	682775	0	1	0	0	0	2	2	0	0
G	Current Plug-in 7S 1838/ARC-6	683363	0	0	0	0	0	0	2	0	0
G	Comp. Syst. AN/ASM-63	683260	0	1	0	0	0	0	2	0	0
G	Electric Circuit Plug- in Unit TS 2061/ARC-54	683367	0	1	0	0	0	0	2	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE							55- 500	
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E	R	E
G	Flight Lin. AN/ASM-80	683375	0	1	0	0	0	0	2	0	0
G	Leveling Amp.TS-1701/ ASN	683380	0	1	0	0	0	0	2	0	0
G	Slaving Amp.TS-1702/ ASN	683415	0	1	0	0	0	0	2	0	0
G	Transf. Bd.TS-1703/ASN	683418	0	1	0	0	0	0	0	0	0
G	Prop. Synch. AN/ASM-126	685604	1	1	0	0	0	0	0	0	0
G	Stab. Equip. TS-1894/ASN	685608	0	1	0	1	0	0	0	0	0
G	Indicator AN/ASM-111	685627	0	1	0	0	0	0	0	0	0
G	Electrical Power AN/JPM-93	685657	2	2	1	0	1	0	4	0	0
G	Indicator AN/ASM-110	685663	0	1	0	0	0	0	0	0	0
G	Electron Tube TV-7/U	685665	2	5	2	1	5	2	2	0	0
G	Motor Gen. AN/GSM-65	685675	0	1	0	0	1	0	2	0	0
G	Gyro Magn. Comp. AN/ASM- 61	685676	0	1	0	0	0	1	2	0	0
G	Radar AN/APM-66	685679	1	1	0	1	0	0	2	0	0
G	Radar AN/APM-156	685684	1	1	0	1	1	0	4	0	0
G	Radar AN/UPM-98	685697	1	1	0	0	0	1	2	0	0
G	Transistor, TS-1836/U	685783	0	2	1	1	2	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE						
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E
									55- 500 R E
G	Test Harness CX7539	682538	0	0	1	0	0	0	0
G	Tester Rotary Actuator TS-1663 ASW-12(V)	686029	0	1	0	0	0	0	0
F	Tool Kit Battery Svce. TK-90/G	689932	1	1	0	1	2	0	0
F	Tool Set Stab. Syst. Flight Linets - 1893/ ASN	690185	0	1	0	1	0	0	0
D	Vacuum Cleaner MX-13 FSN 7910-215-5786	694550	1	2	2	0	0	0	0
E	Inverter Vibr. PP-68/U	694790	0	1	0	0	4	0	0
G	Voltmeter ME-223/APN- 129	696745	1	1	1	0	0	0	0
G	Voltmeter ME-227/()U	696749	1	1	0	0	0	0	0
G	Multimeter ME-30/U	696825	2	2	1	1	2	2	0
G	Wattmeter ME-82/U	697505	0	2	0	0	0	0	0
B	Helicopter UH-1D	732600	0	0	0	0	0	2	0
B	Helicopter UH-1D	732703	0	1	1	0	0	0	0
B	Helicopter UH-1D	732610	0	0	0	0	2	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE							55- 500	
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E		
										R	E
F	Tool Kits A/C. Insp. Tech.	784030	0	16	4	2	12	4	0	0	2
F	Tool Kits A/C. Mech. Gen.	784040	0	87	1	30	65	73	18	0	19
F	Tool Kits Airfr. Rpmn's. A A/C.	784050	0	25	0	6	18	16	27	0	6
F	Tool Kits Elect. Rpmn's. A A/C.	784490	0	8	0	4	2	5	8	0	2
F	Tool Kits Eng. & P.T. Rpmn's. A A/C.	784495	0	24	0	6	16	14	8	0	3
F	Tool Kits Hydr. Rpmn's. A A/C.	784510	0	8	0	3	3	4	8	0	2
F	Instrum. Rpmn's. A A/C.	784520	0	4	0	0	2	1	4	0	2
F	Tool Kits Prop. & Rotor Rpmn's. A A/C.	784540	0	4	0	2	0	5	8	0	2
D	Test Stand. Turb. Engine	782580	0	0	0	0	0	0	1	0	0
D	Crane Wh-MTD M60-3T	920822	0	2	0	0	0	0	0	0	0
D	Fklt. Trk. Hel. Transp. Rough Terr. 3000 lb	922015	0	2	0	0	0	0	0	0	0
F	Maint. Kit Elec. 866/ ASN-64	962512	0	0	0	0	0	0	2	0	0
G	Penetrometer Airfield Cone	925775	0	1	0	0	0	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE						55- 500 R	55- 458E R	55- 89E R	55- 457E R	55- 510T R	55- 406T R	55- 407T R	11- 500D R
			55- 407T R	55- 406T R	55- 510T R	55- 457E R	55- 89E R	55- 458E R								
G	Attenuator CN-759	960494	0	1	0	0	0	0	0	0	0	0	0	0	0	0
G	Air Pressure Test Set SAS	960497	0	1	0	0	0	0	0	0	0	0	0	0	0	0
G	Attenuator Set	960495	0	0	2	0	0	0	0	0	0	0	0	0	0	0
G	Fuel Qty Test Set TS-20	961650	0	1	0	0	0	0	0	0	0	0	0	0	0	0
G	Link Test Set SAS	962203	0	1	0	1	0	0	0	0	0	0	0	0	0	0
C	Shelter Airmobile Avi- onics AN/APM-221	966301	0	0	1	0	0	0	0	0	0	0	0	0	0	0
C	Shelter Airmobile Avi- onics AN/APM-222	966302	0	0	2	0	0	0	0	0	0	0	0	0	0	0
C	Shelter Airmobile Avi- onics AN/ASM-193 Tool Set	966304	0	8	0	0	0	0	0	0	0	0	0	0	0	0
C	Shelter Airmobile Avi- onics for A/C Tool Sets	966306	0	9	2	0	0	0	0	0	0	0	0	0	0	0
C	Shelter Airmobile Avi- onics AN/APM-223	966303	0	0	1	0	0	0	0	0	0	0	0	0	0	0
H	Simulator A/C Disp. AN/ ASM-120	966528	0	1	0	1	0	0	0	0	0	0	0	0	0	0
C	Shelter Airmobile AN- VAS-4	966305	0	0	2	0	0	0	0	0	0	0	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE						55- 500 R	55- 458E	55- 89E	55- 457E	55- 510T	55- 406T	55- 407T	11- 500D
G	Test Set Amp. AN/ASV-121	966529	0	1	0	1	0	0	0	0	0	0	1	0	0	0
E	Sig. Generator SC-400	966484	0	0	1	0	0	0	0	0	0	0	0	0	0	0
G	Speed Trim SAS	966730	0	1	0	0	1	0	0	0	0	0	0	0	0	0
G	Test Sets AN/APM-190	968275	0	0	1	0	0	0	0	0	0	0	0	0	0	0
G	Test Sets Rec. Set Radar AN/CXM-2	968420	0	0	1	0	0	0	0	0	0	0	0	0	0	0
G	Test Sets Actuator SAS	968260	0	1	0	0	0	0	0	0	0	0	0	0	0	0
G	Test Sets Radar TS- 1314/U	968571	1	1	0	0	1	0	0	0	0	0	1	0	0	0
F	Tool Kit R&R Rpmn. TK- 167B/G	968880	0	12	0	0	0	0	0	0	0	0	0	0	0	0
F	Tool Synchro. Adjust TL- 675/ASN-33	969030	0	2	0	0	0	0	0	0	0	0	0	0	0	0
G	Test Set Radar Map Align.	968570	0	0	1	0	0	0	0	0	0	0	0	0	0	0
D	Parts Cont. X-4	971279	0	55	13	0	0	0	0	0	0	0	0	0	0	0
G	Test System	968579	0	0	1	0	0	0	0	0	0	0	0	0	0	0
B	Helicopter Obsv. Light (LOH)	973245	0	1	0	0	0	0	0	0	0	0	0	0	0	0
F	Mobilizer Airmobile Tool Set 4000-A-2	975520	0	25	10	0	0	0	0	0	0	0	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOL							
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E	55- 500 R E
D	Shop Sets Gd. Hdls. & Svcg. Airmobile FSN 1730-M54-011(W/SH)	977516	0	1	0	0	0	0	0	0
D	Shop Sets A/C Maint. Airmobile DS Sect. FSN 4920-M54-0050 (W/SH)	977518	0	5	0	0	0	0	0	0
D	Shop Sets A/C Maint. Airmobile Elec. Inst. & Hydr. Set No. 2	977519	0	1	0	0	0	0	0	0
D	Shop Sets A/C Maint. Airmobile Flow Det. Set No. 6	977520	0	1	0	0	0	0	0	0
D	Shop Sets A/C Maint. Machine & Eng. Set No. 4	977521	0	1	0	0	0	0	0	0
D	Shop Sets Prop. & Rotor Set No. 5	977522	0	1	0	0	0	0	0	0
D	Shop Sets Sheet Metal & Weld. Set	977523	0	1	0	0	0	0	0	0
D	Shop Sets Tool Crib No. 1	977524	0	1	0	0	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE							
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E	55- 500
D	Antenna Gp.AN/GRA-50	603276	0	0	1	0	0	0	0	0
A	Attenuator Fixed	603729	0	0	1	0	0	0	2	0
A	Attenuator Var.CN-796	603742	0	0	1	0	0	0	2	0
D	Reeling Mach.Cable Hd.	604010	0	0	1	0	0	0	0	0
G	Barretter Mt.MX-5635	604581	0	0	1	0	0	0	0	0
G	Mounting Gp.Det. Infra- Red OA-4155 AAS-14	606708	0	0	1	0	0	0	0	0
G	Cable Assy. Test Set MX-4078	607224	0	0	1	0	0	0	2	0
G	Cable Assy. Test Set MX-4083	607225	0	0	1	0	0	0	2	0
G	Cable Assy. Test Set MX-4080	607228	0	0	1	0	0	0	2	0
G	Cable Assy. Test Set MX-4079	607229	0	0	1	0	0	0	2	0
G	Coupler, Directional. CU-988	611740	0	0	1	0	0	0	0	0
G	Preamplifier AM-1841	632403	0	0	1	0	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE						55- 500	
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457T	55- 89E	55- 458E	55- R E
G	Test Set Radar AN/APM-209	684506	0	0	0	0	0	0	2	0 0
G	Test Set Radar AN/UPM-102	685686	0	0	1	0	0	0	0	0 0
G	Test Set Radar AN/UPM-33	685692	1	0	1	0	0	0	2	0 0
G	Test Set Sign. Comp. GAM-42	685736	1	0	1	0	0	0	2	0 0
G	Test Set Radar AN/AKM-2	685784	1	0	1	0	0	0	0	0 0
G	Test Set Armature TS-965/U	685640	0	0	0	0	0	0	2	0 0
E	Transf. Var. Pwr. CN-16/U	691070	0	0	1	0	0	0	2	0 0
E	Transf. Power M TS-380	691191	0	0	4	0	0	0	0	0 0
E	Transf. Ratio TS-384/U	691194	0	0	4	0	0	0	2	0 0
G	Test Set Indic. AN/CPM-41	685668	0	0	0	0	0	0	2	0 0
E	Multimeter ME-30/U	696825	2	0	1	0	2	0	4	0 0
G	Voltmeter Elec. ME-202/U	696815	0	0	0	0	0	0	2	0 0
E	Waveguide Assy. CG-2355	697356	0	0	1	0	0	0	0	0 0
D	Wire WD - I/TT on Rcel	698350	0	0	8	0	8	0	0	0 0

Maint. Item Code	Nomenclature	Old Line Item #	TOE						55- 500	
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 39E	55- 458E	R E
G	Test Set Ind. AN/GPM- 52	683379	0	0	1	0	0	0	2	0 0
G	Test Set Photo Surv.	683408	0	0	1	0	0	0	0	0 0
G	Test Set Radar AN/GPM- 16	683801	0	0	1	0	0	0	2	0 0
G	Test Set Radar TS-147	685150	3	0	1	1	1	1	2	0 0
G	Test Set Converter Alt- LS501	685601	0	0	1	0	0	0	2	0 0
G	Test Set Optical Align. Infra-red	685603	0	0	1	0	0	0	2	0 0
G	Test Set Scanner Align.	685606	0	0	1	0	0	0	2	0 0
G	Test Set Power Sply. TS-1637	685615	0	0	1	0	0	0	0	0 0
G	Test Set Computer AN/APM- 188	685624	0	0	1	0	0	0	2	0 0
G	Test Set Indicator AN/ GPM-44	685671	0	0	1	0	0	1	2	0 0
G	Test Set Radar AN/APM- 176	683805	0	0	0	0	0	0	2	0 0
G	Comp. Freq. CM-77	685673	0	0	1	1	0	0	2	0 0

Maint. Item Code	Nomenclature	Old Line Item #	TOE							55- 500	
			11- 500D	55- 407T	55- 406T	55- SLOT	55- 457E	55- 89E	55- 458E	R	E
D	Wire WD - I/TT on Reel	698460	0	0	2	0	6	0	0	0	0
D	Wrench Set Torque K	699955	0	0	1	0	0	0	0	0	0
D	Accessory Kit MK-288	600060	0	0	0	1	0	0	0	0	0
D	Coax. Connector	600250	0	0	0	1	0	0	0	0	0
A	Analyzer Chger. Btry.	602622	1	0	0	1	0	0	0	0	0
A	Analyzer Spectrum	602640	1	0	0	1	0	0	0	0	0
E	Gen. Signal TS-382/U	603810	0	0	0	1	2	2	0	0	0
D	Shop Set, A-1	775400	0	0	0	1	3	1	0	0	0
D	Shop Set, A-2	775401	0	0	0	1	3	1	0	0	0
D	Shop Set, B-6	775425	0	0	0	1	1	0	0	0	0
D	Shop Set A (G H)	775670	0	0	0	1	3	1	0	0	1
D	Shop Set B (G H)	775671	0	0	0	0	1	0	0	0	1
D	Adapter UG-274	960360	0	0	0	1	0	0	0	0	0
D	Blade Tracker	960660	0	0	0	1	0	0	0	0	0
D	Elect. Shop - Avionics AN/ASN-146	961550	2	0	0	1	4	0	0	0	0
D	Elect. Shop - Avionics AN/ASN-147	961551	2	0	0	1	4	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE						55- 458E	55- 89E	55- 457E	55- 510T	55- 406T	55- 407T	11- 500D	53- 500	
																R	E
F	Maint. Kit - 402/ARC	962500	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
H	Simulator 335/ASM	966485	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
E	Generator Sig.SG-299/U	618172	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	Generator Sig.SG-298/U	618171	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	Generator Sig.AN/URM-48	318119	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0
F	Maint. Kit Elect. MK-457/AR	624999	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
G	Oscilloscope AN/USM-50A	628927	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
G	Oscilloscope AN/USM-81	628929	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
G	Test Set, Elec. AN/APM-137	683414	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	Test Set, Elec. Circuit An/GRM-55	683365	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
G	Test Set, Auto.Pilot ASM-66	685629	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
D	Shop Set - B-1	775420	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
D	Shop Set - B-2	775421	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
D	Shop Set - B-3	775422	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
D	Shop Set - B-4	775423	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
D	Shop Set - B-5	775424	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1

Maint. Item Code	Nomenclature	Old Line Item #	TOE								
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E		
									R	E	
D	Shop Set GM A/SS-10	945370	0	0	0	0	1	1	0	0	0
F	Tool Set 427 Basic	346111	0	0	0	0	8	0	12	0	0
F	Tool Set Supplemental	946112	0	0	0	0	2	0	12	0	0
A	Attenuator Var. TS-402/U	603730	0	0	0	0	0	2	2	0	0
F	Maint. Kit, Elec. MK-454/ASN-22	624994	0	0	0	0	0	1	0	0	0
F	Maint. Kit, Elec. MK-426/ARN	625002	0	0	0	0	0	1	0	0	0
F	Maint. Kit, Elec. MK-427/ARC	625007	0	0	0	0	0	1	0	0	0
F	Mod. Kit, Elec. MK-345/GR	627520	0	0	0	0	0	2	0	0	0
G	Power Sply. PP-1243/U	631586	0	0	0	0	0	2	0	0	0
F	Maint. Kit, Elec. MK-252/ARN	632459	0	0	0	0	0	1	0	0	0
D	Shop Sets C-1 Tool Crib	775450	0	0	0	0	0	0	1	0	0
D	Shop Sets C-4 Sheet Metal	775453	0	0	0	0	0	0	1	0	0
D	Shop Sets C-5 Welding	775454	0	0	0	0	0	0	1	0	0
D	Shop Sets C-7 Eng. & Hydr.	775456	0	0	0	0	0	0	1	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE						55- 500 R	55- 458E R	55- 89E R	55- 457E R	55- 510T R	55- 406T R	55- 407T R	55- 500D R
D	Shop Sets C-10 Paint Shp.	775459	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	Shop Sets C-2 Elec. Shop	775451	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	Shop Sets C-3 Flaw Det.	775452	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	Shop Sets C-6 Mach. Shp.	775455	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	Shop Sets C-8 Instr. Shp.	775457	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	Shop Sets C-9 Prop. & Rotor	775458	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	Shop Sets C-11 Power- train	775460	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	Shop Sets Grd. Hdlg. FM- Set C	775672	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A	Analyzer Chger. Btry.	602622	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A	Attenuator Fixed CN 801	603731	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A	Attenuator Var. CN 802	603743	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A	Attenuator Var. CN 491	603747	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A	Attenuator Var. CN 713	603748	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	Test Set Radar TS 488/P	609502	3	0	0	0	0	0	0	0	0	0	0	0	0	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE						55- 500	
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E	R
D	Elect. Shop AN/ASM-189	614935	0	0	0	0	0	0	4	0
D	Elect. Shop AN/ASM-190	614936	0	0	0	0	0	0	4	0
E	Generator Sweep SG 92/U	618165	0	0	0	0	0	0	2	0
E	Indic. Panaromic 173/U	621148	0	0	0	0	0	0	2	0
E	Indic. Stand Wave AN/ USM-37	621158	0	0	0	0	0	0	2	0
F	Maint. Kit MK-774/ARN- 158	624962	0	0	0	0	0	0	2	0
G	Power Sply. PP-962	631575	0	0	0	0	0	0	2	0
G	Voltmeter Elec. AN-USM- 98	696808	0	0	0	0	0	0	2	0
F	Maint. Kit Elec. 873/ APN-168	962513	0	0	0	0	0	0	2	0
F	Maint. Kit Elec. 874/ AYA-3	962514	0	0	0	0	0	0	2	0
F	Maint. Kit Elec. 875/ ASN-64	962515	0	0	0	0	0	0	2	0
F	Maint. Kit Elec. 876/ ASN-64	962516	0	0	0	0	0	0	2	0

Maint. Item Code	Nomenclature	Old Line Item #	TOE								
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E	55- 500 R E	
G	Test Facility MK-864/ APN-168	968251	1	0	0	0	0	0	2	0	0
G	Test Facility MK-865/ AYA-3	968252	1	0	0	0	0	0	2	0	0
G	Test Set Radar TS-1314/ U	968340	0	0	0	0	0	0	2	0	0
D	Shop Set Elec. Set A	440468	0	0	0	0	0	0	0	1	0
D	Shop Set Flaw Set A	440707	0	0	0	0	0	0	0	1	0
D	Shop Set Gd.Hdlg.Set A	440711	0	0	0	0	0	0	0	1	0
D	Shop Set Hydr. Set A	440719	0	0	0	0	0	0	0	1	0
D	Shop Set Sheet Metal Set A	440736	0	0	0	0	0	0	0	1	0
D	Shop Set Tool Crib Set A	440746	0	0	0	0	0	0	0	1	0
D	Shop Set Welding Set A	440755	0	0	0	0	0	0	0	1	0
F	Tool Set Airfr. Mech.A/C	454273	0	0	0	0	0	0	0	3	2
F	Tool Set Gen.Mech.A/C	454820	0	0	0	0	0	0	0	10	0
F	Tool Set A/C Arn.	454274	0	0	0	0	0	0	0	0	1
F	Tool Set Orgn.Maint.	455185	0	0	0	0	0	0	0	0	1

Maint. Item Code	Nomenclature	Old Line Item #	TOE							
			11- 500D	55- 407T	55- 406T	55- 510T	55- 457E	55- 89E	55- 458E	55- 500 R E
F	Tool Set Prop. & Rotor	455615	0	0	0	0	0	0	0	2 0
F	Tool Set Tech. Insp. A/C.	455960	0	0	0	0	0	0	0	1 0

Maint. Item Code	Nomenclature	New Line Item #	TOE 11- 500D (Only)
F	Maint. Kit, Electronic Equip. 288/URM	L98359	2
F	Maint. Kit, Electronic Equip. 570/ASN	L99866	1
F	Maint. Kit, Electronic Equip. 693/A	M01100	2
F	Maint. Kit, Electronic Equip. 722/ARC-102	M01374	1
F	Maint. Kit, Electronic Equip. 731/ARC-51X	M01511	1
F	Maint. Kit, Electronic Equip. 733/ARC-54	M01648	1
F	Maint. Kit, Electronic Equip. 866/ASN-64	240765	1

Maint. Item Code	Nomenclature	New Line Item #	TOE 11- 500D (Only)
G	Test Set, Transp. AN/ APM-123	V99347	1
E	Multimeter AN/USM-223	NLIN*	1
F	Maint. Kit, Elec. Equip. ASN/43	NLIN*	1
F	Maint. Kit, Elec. Equip. CV-1275	NLIN*	1
H	Simulator, Test Sig. AN/UAM-11	NLIN*	1
H	Simulator, Gyro & Compass Sig. 486/ASN	NLIN*	1
H	Simulator RF Sig. 454/TAQ- 1A	NLIN*	1
E	Generator, Sig. AN/URM-25	J52549	1
E	Generator, Sig. AN/URM-70	J53645	1
F	Maint. Kit MK-953	NLIN*	1
F	Maint. Kit Elec. Equip. 1006-AAS J4	NLIN*	1
F	Maint. Kit MK-989/AAS-14A	NLIN*	1

* No Line Identification Number