CAA-SR-84-33

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The project consisted principally of a turnkey transfer, from CAA to the Aviation Systems Command, of the Overview and PARCOM Models, developed on a previous study (Aircraft Spares) to provide a quick reaction methodology for forecasting aircraft fleet wartime sustainability and spare parts requirements. The project also included testing of the Dyna-METRIC Model, to meet a perceived shortcoming of Overview and PARCOM--their inability to represent a "partial substitution" parts replacement policy. PARCOM was extended to include partial substitution and to replace Overview.

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Block 20 - ABSTRACT continued

Dyna-METRIC can assess fleet sustainability with partial substitution, but is expected to be most useful for higher resolution (multi-echelon and indenture) analyses.

STUDY REPORT
CAA-SR-84-33

ADF860015

OVERVIEW/PARCOM TURNKEY PROJECT (OPTP)

NOVEMBER 1984

PREPARED BY
FORCE SYSTEMS DIRECTORATE

US ARMY CONCEPTS ANALYSIS AGENCY
8120 WOODMONT AVENUE
BETHESDA, MARYLAND 20814-2797

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The findings of this report are not to be construed as an official Department of the Army position, policy, or decision unless so designated by other official documentation. Comments or suggestions should be addressed to:

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FOREWORD

In addition to this Study Report, the four documents listed below were produced as part of the study effort:

(1) Partial Substitution and Other Modifications to the PARCOM Model, CAA-TP-84-11

(2) Test of the Dyna-METRIC Aircraft Readiness and Sustainability Assessment Model, CAA-TP-84-12

(3) Parts Requirements and Cost Model (PARCOM) Documentation, PARCOM User's Guide, CAA-D-84-10

(4) Parts Requirements and Cost Model (PARCOM) Documentation, PARCOM Functional Description, CAA-D-84-15

Documents (1) and (2) are included herewith. Documents (3) and (4), if not included herewith, are available on request from the Concepts Analysis Agency or the Defense Technical Information Center (DTIC).

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
US ARMY CONCEPTS ANALYSIS AGENCY
8120 WOODMONT AVENUE
BETHESDA, MARYLAND 20814

REPLY TO
ATTENTION OF:

21 FEB 1985

CSCA-FSC

SUBJECT: Overview/PARCOM Turnkey Project (OPTP)

Deputy Chief of Staff for Logistics
Department of the Army
ATTN: DALO-ZD
Washington, DC 20310-1718

1. Reference:

a. Letter, DALO-ZD, Department of the Army, 14 May 1984, subject as above.

b. Letter, CSCA-FSC, US Army Concepts Analysis Agency, 7 December 1984, subject as above.

2. Reference 1a directed the US Army Concepts Analysis Agency (CAA) to provide the Overview and PARCOM Models from the Aircraft Spares Study to the US Army Aviation Systems Command (AVSCOM) in a turnkey transfer of computer programs and model documentation. Reference 1a also directed CAA to test the Dyna-METRIC Model for various features of interest to spare parts analysis, and to investigate improvements to Overview and PARCOM to enable those models to represent partial substitution of spare parts. In response to these directions, three documents were provided for your review and comments (reference 1b): an OPTP Study Report, a technical paper on the PARCOM work, and a technical paper on the Dyna-METRIC testing. Also provided were a PARCOM User's Guide and a PARCOM Functional Description.

3. This OPTP Study Report includes your formal reply. Final versions of the other documents are also enclosed. As noted in the Forward to the Study Report, the general distribution will consist only of the study report and the two technical papers. Your office, DTIC, and AVSCOM will also receive copies of the PARCOM User's Guide and Functional Description. Questions and inquiries should be directed to the Assistant Director, Force Systems Directorate (ATTN: CSCA-FS), US Army Concepts Analysis Agency, 8120 Woodmont Avenue, Bethesda, Maryland 20814-2797, AUTOVON 295-1607.

E. B. Vandiver

E. B. VANDIVER III
Director

CONCEPTS ANALYSIS AGENCY
CAA
UNITED STATES ARMY

OVERVIEW/PARCOM TURNKEY PROJECT (OPTP)

STUDY SUMMARY
CAA-SR-84-33

THE REASONS FOR PERFORMING THIS STUDY were (1) to assist the US Army Aviation Systems Command (AVSCOM) in the establishment of an operational capability for use of the Overview Model and the Parts Requirements and Cost Model (PARCOM) in aircraft spares analysis, and (2) to enable future analyses to address a partial-substitution parts replacement policy as well as full- and no-substitution parts replacement policies.

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

(1) Production versions of Overview and basic PARCOM (version developed in the Aircraft Spares Study) were delivered to AVSCOM, the designated user, and AVSCOM personnel were trained in the logic and use of the models. Extended PARCOM (developed in this study) has been delivered in draft form and is undergoing final documentation. PARCOM User's Guide and Functional Description revisions, to include features of extended PARCOM, will be available this calendar year.

(2) The Dynamic Multi-echelon Technique for Recoverable Item Control (Dyna-METRIC) Model is capable of producing comparable results to Overview and PARCOM, given the same aggregated depot and theater representations and data base.

(3) Dyna-METRIC and extended PARCOM can assess fleet performance capability under full, no, and partial substitution. Both models can determine parts requirements under full and no substitution, but only extended PARCOM can do so under partial substitution.

(4) Basic PARCOM may be used now for quick reaction, gross estimation of wartime aircraft fleet flying hour capability and spare parts requirements and costs. For such applications, PARCOM is preferable to Dyna-METRIC due to ease of operation and interpretation of results.

(5) Dyna-METRIC has unique features which are potentially valuable for higher resolution analyses than possible with PARCOM. Because testing was limited to a lower resolution problem not exercising those features, further evaluation of Dyna-METRIC is indicated.

(6) PARCOM, as enhanced in this project, obviates any further need for Overview in spare parts analysis.

THE MAIN ASSUMPTION was that partial substitution can be usefully defined in terms of a partition of part types into a full-substitution set and a no-substitution set.

THE PRINCIPAL LIMITATION was that definitions of partial substitution other than the assumed definition might not be addressable by the models used.

THE SCOPE OF THE STUDY was to provide operational models and training to AVSCOM, the designated user, and to investigate the addition of an ability to analyze partial substitution, through testing of Dyna-METRIC and modifications to PARCOM. The AH-1S helicopter was to be used in a representative European scenario for model tests and comparisons.

THE STUDY OBJECTIVES were:

(1) To transport the Overview and basic PARCOM Models developed in the Aircraft Spares Study to AVSCOM, to demonstrate the models' use, and to train the AVSCOM model operators.

(2) To test the ability of the Dyna-METRIC Model to represent theater level operations, sparing to aircraft availability goals, and a partial substitution parts replacement policy.

(3) To investigate representation of partial substitution with Overview and PARCOM.

THE BASIC APPROACH was:

(1) To prepare Overview and basic PARCOM for delivery to AVSCOM and train the model users.

(2) To make Dyna-METRIC operational on the CAA computer system, to test it under scenario and parts conditions similar to those of the Aircraft Spares Study, and to check its ability to represent partial substitution.

(3) To devise a method for representing partial substitution with either or both Overview and PARCOM and then to demonstrate the method.

THE STUDY SPONSOR was the Deputy Chief of Staff for Logistics, Headquarters, Department of the Army.

THE STUDY EFFORT was directed by Mr. Saul L. Penn, Force Systems Directorate, US Army Concepts Analysis Agency.

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

Tear-out copies of this synopsis are at back cover.

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OVERVIEW/PARCOM TURNKEY PROJECT
(OPTP)

CHAPTER 1

INTRODUCTION

1-1. STUDY PURPOSE. The Overview/PARCOM Turnkey Project (OPTP) is an outgrowth of the Aircraft Spare Stockage Methodology (Aircraft Spares) Study,[1] completed and documented in April 1984. The general officer Study Advisory Group for that study, meeting to review the study results on 1 March 1984, made three principal recommendations, namely that the Concepts Analysis Agency (CAA):

a. Deliver, in turnkey fashion, the Overview Model (as enhanced in Aircraft Spares) and the Parts Requirements and Cost Model (PARCOM) (developed in Aircraft Spares) to the US Army Aviation Systems Command (AVSCOM),

b. Test the Dyna-METRIC Model for its ability to represent a partial-substitution parts replacement policy, which was not treated in Aircraft Spares, and

c. Attempt workarounds or model improvements to enable Overview and PARCOM to represent partial substitution.

1-2. BACKGROUND

a. The main purpose of the Aircraft Spares Study was to provide the Army with an analytical tool for quick reaction, gross estimation of (1) the capability of an aircraft fleet to meet wartime flying hour and availability objectives and (2) where current spare parts inventories were inadequate, the additional parts and cost requirements to meet those objectives. The study determined that the Overview Model, developed by Synergy, Inc., for the Air Force and, later, modified by Synergy for use in the Army's MAX FLY Study,[2] could be further modified to automatically assess aircraft fleet performance capability and parts requirements with the gross precision desired, but only in a full-substitution parts replacement mode. This full-substitution policy permitted the exchange of serviceable parts for unserviceable ones among aircraft which were not mission capable due to supply (NMCS) when a replacement spare was unavailable at user level. Such a policy minimizes the number of aircraft which would be incapable of mission performance due to a failed part. The study team recognized that such a policy is too optimistic; that it is more realistic, for procurement, planning, and forecasting purposes, to analytically represent the processing of failed parts according to a no-substitution policy in which failed parts could be replaced only by spares. Furthermore, it was found that the Overview Model was not configured to treat system availability goals and, also, that it could not be readily adapted to determine parts requirements to maximize achieved flying hours under specified budget limits. To address these shortcomings, a new model, PARCOM, was developed by the study team.

b. PARCOM, in both its basic (aircraft spares) and enhanced (this study) versions, is a deterministic, expected value, low-resolution model. It generates, primarily, (1) parts required to meet flying hour or availability objectives and (2) fleet performance capability with a given parts inventory. While PARCOM may be used to determine rough estimates of theater-level parts and cost requirements, it is better used, because of its aggregating nature, to indicate the problem parts and to focus investigation on the possible causes of those problems. Typical problems could be insufficient spares, excessive repair times, excessive order and ship times, and insufficient (or excessive) in-theater repair.

c. As a test of the Overview and PARCOM capabilities to meet the study purpose, a set of questions typical of those which might be posed to the sponsor, ODCSLOG (Office of the Deputy Chief of Staff for Logistics), was devised. Table 1-1 lists these questions. The capability of the two models to answer these questions is set forth in detail in the above-referenced study. Briefly, Overview could answer the flying program assessment and parts requirements questions, but not the constrained budget and availability goal questions, and then only for a full-substitution parts replacement policy. PARCOM could answer all but the last question (where an average availability goal is specified) for both full- and no-substitution policies, but it could not address the second of the constrained budget questions (regarding maximization of flying hours) for a full-substitution policy. One additional model, Dyna-METRIC, developed by the Rand Corporation for the Air Force, appeared to have potential for answering the same type of questions and some others of interest, but was not tested in the Aircraft Spares Study due to study time constraints. Dyna-METRIC was also reported to have a partial-substitution capability, not then feasible with Overview or PARCOM. However, Dyna-METRIC capability to represent a theater-scale Army scenario was unknown.

1-3. APPROACH. In view of the above perceptions and recommendations, it was decided to pursue OPTP as follows:

a. Focus initial attention on preparation of the Overview Model and PARCOM for delivery to the designated user, AVSCOM. Revisions to the Overview code were to be spelled out, PARCOM was to be thoroughly documented, and personnel from the user agency were to be trained and assisted in the use of both models.

b. Bring Dyna-METRIC to CAA and make it operational, with assistance from the developer as necessary. A test was to be devised and carried out to check Dyna-METRIC's capability for representing the same theater-wide scenario and parts replacement policies as treated in Aircraft Spares with the Overview Model and PARCOM. The results from all three models were then to be compared. If this test was successful, the capability of Dyna-METRIC for representing partial substitution was to be explored.

c. Devise a way of using either or both Overview and PARCOM to represent partial substitution, since there was no assurance that Dyna-METRIC would be able to treat partial substitution satisfactorily. By considerations of the nature of partial substitution, perhaps some simple workaround(s), requiring no model logic changes (just manipulation of the inputs and run order), would suffice; but model logic changes would also be considered.

1-4. GUIDE TO THE REMAINDER OF THE REPORT. The detailed results of the Dyna-METRIC and PARCOM work are presented in separate technical papers,[3,4] published in conjunction with this study report. Chapter 2 summarizes that work and presents representative results. Chapter 3 presents, as findings, the principal accomplishments, conclusions, and recommendations of the study.

Table 1-1. Demonstration Question Set for Aircraft Spares Study

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Typical flying hour based questions

- **Assessment of current parts inventory**
    - For how many consecutive days could the wartime flying hour program (FHP) be fully met?
    - What fraction of the cumulative FHP objective could be achieved?
    - What would the current procurement costs of the inventory be?
- **Requirements determinations**
    - What is the minimum cost mix of parts required to achieve 100 percent of the cumulative FHP?
        - -- What is the cost of those parts?
        - -- What parts dominate the process? How?
        - -- What is the fractional increase in the cost of parts to achieve the cumulative FHP?
    - For a given budget (say $10M) and FHP, what parts should be bought?
        - -- to maximize sustained performance?
        - -- to maximize cumulative flying hours?
- **Marginal performance.** What is the marginal improvement in cumulative FHP as expenditures increase?

Typical aircraft availability questions

- **Marginal performance.** What is the marginal improvement in average availability as expenditures increase?
- **Daily availability goal.** What is the cost of meeting an additional objective of at least 85 (or some other) percent availability every day of the FHP?
- **Average availability goal.** What is the cost of meeting 85 (or some other) percent average availability while meeting the FHP?

CHAPTER 2

RESULTS

2-1. OVERVIEW/PARCOM DELIVERY. Test versions of the Overview and basic PARCOM code, along with draft copies of a PARCOM User's Guide and PARCOM Functional Description, were delivered to AVSCOM for familiarization purposes in April, 1984. For Overview documentation, AVSCOM was referred to the model developer's User Manual.[5] Basic PARCOM was easily installed on AVSCOM's IBM equipment, though the model was used on UNIVAC equipment at CAA. Considerable difficulty in operating Overview on the IBM equipment, initially experienced at AVSCOM, was eliminated through joint operation of the model over a portable terminal at CAA. Subsequent operation of the model at the user's facility was successful. Meanwhile, training was conducted at CAA from 16-19 July for a contingent of eight persons from various organizations at AVSCOM on the principles and operation of Overview and PARCOM. The completion of this training, delivery of updated documentation at the course, and successful operation of the two models at AVSCOM constituted fulfillment of the principal requirement of the project. The PARCOM User's Guide[6] and Functional Description[7] have been finalized, are being disseminated to AVSCOM and selected recipients, and are available to others upon request.

2-2. DYNA-METRIC TEST

a. Basically, Dyna-METRIC is a more complex, higher resolution model than Overview and PARCOM and can be expected to treat and examine certain features of the logistics scenario in more detail. Also, Dyna-METRIC is a probabilistic model which takes into account the distribution of failure rates and pipeline quantities about a mean. Overview and PARCOM are deterministic models which deal strictly with expected values (the means themselves and not distributions about them).

b. A series of tests of the Dyna-METRIC Model was performed, to establish, in general, its potential utility for Army aircraft spares analysis and, in particular, its capability to represent a partial-substitution parts replacement policy. The testing was restricted, primarily, to a single base and single depot, respectively representing aggregations of theater and Continental United States repair and supply points. This was to allow a compatible basis for comparison with results of Overview and PARCOM, which had already been used in this mode in the Aircraft Spares Study. Initial tests were based on full and no substitution. Later, partial substitution was tested. Some of the principal results are shown in Figures 2-1 and 2-2 and Table 2-1. The results are for a theater fleet of AH-1S helicopters in a representative European wartime scenario. The comparisons shown are only with PARCOM, since that model has been revised to include all key Overview capabilities (see paragraph 2-3a).

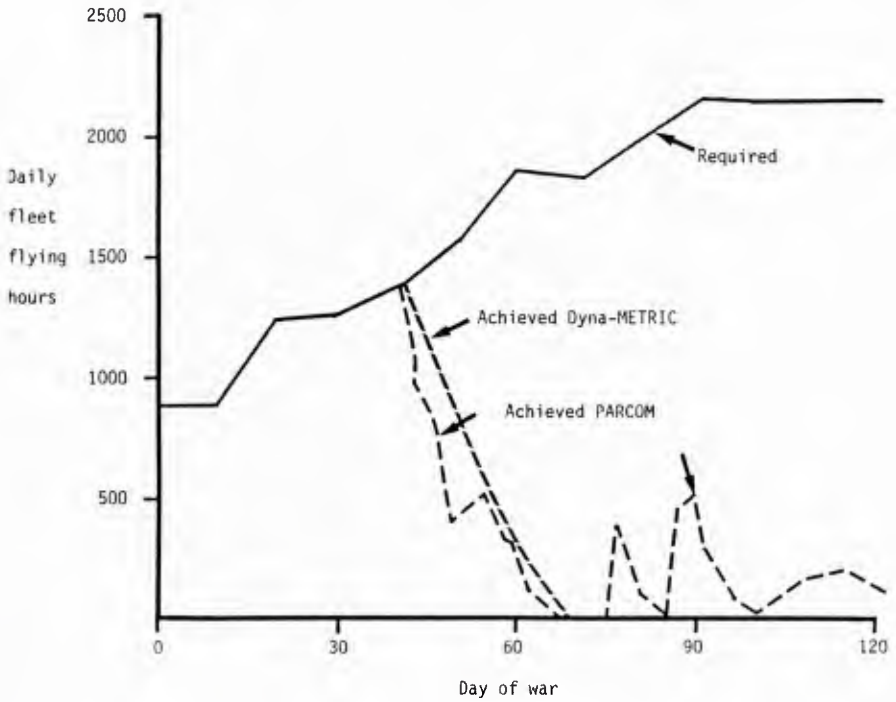

Figure 2-1. Capability Assessment with Current Inventory; No Substitution, Dyna-METRIC Model and PARCOM

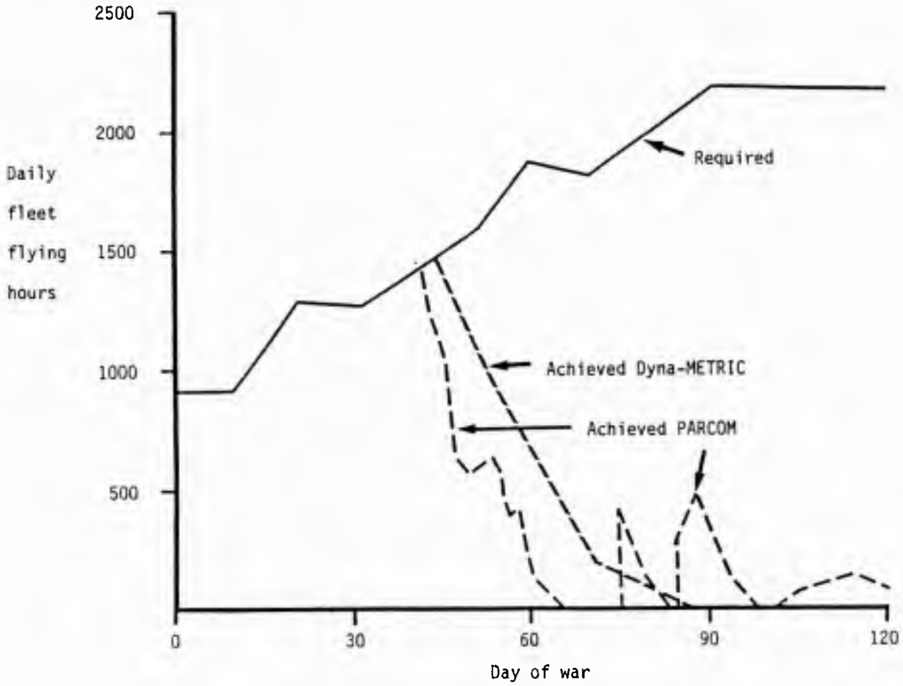

Figure 2-2. Capability Assessment with Current Inventory; Partial Substitution, Dyna-METRIC Model and PARCOM

Table 2-1. Comparison of Aircraft Spare Requirements; No Substitution, Dyna-METRIC Model and PARCOM

Six most expensive parts, listed by decreasing unit cost						
Part	Dyna-METRIC			PARCOM		
	Quantity	Total cost ($M)	Percent of total requirement	Quantity	Total cost ($M)	Percent of total requirement
Stability control amplifier	379	30.54	71.0	386	31.11	72.3
Transmission assembly	126	6.42	14.9	137	6.98	16.2
Hub assembly main rotor	28	1.04	2.4	30	1.11	2.6
RT-1157/APX-100	7	0.06	.1	6	0.05	.1
Feeder assembly gun	51	0.39	.9	44	0.33	.8
Gun control assembly	53	0.40	.9	42	0.32	.7
		38.85	90.2		39.90	92.7
Totals for all parts		$43.00 million (160 part types)			$43.09 million (98 part types)	

c. Essentially, Dyna-METRIC and PARCOM produced similar results for similar scenarios and problems. As can be seen in the figures, assessed fleet capabilities, in terms of days of war that the required flying hour program could be fully met (days of sustainability), were nearly the same. While not evident in the figures, flying hours achieved with Dyna-METRIC, once the program is not fully met, decline faster than with PARCOM. This is because in Dyna-METRIC parts and, hence, aircraft failures, are based on required flying hours rather than achieved flying hours. However, the decline in flying capability with Dyna-METRIC is offset by the occasional occurrence of more than one failure per NMCS aircraft, due to Dyna-METRIC's probabilistic distribution of failures. This causes fewer total NMCS aircraft than would otherwise be the case. The oscillations in the figures' PARCOM results reflect the arrivals of additional aircraft in theater, with a concurrent increase in fleet capability. PARCOM treats these arrivals on a daily basis, while Dyna-METRIC averages them over operator-determined, multiday periods.

d. Table 2-1 shows that, for no substitution, the costs of parts required to meet program goals are essentially the same with the two models. Note that only one or two parts are the key drivers. Though not shown here, with full substitution, parts requirements are almost identical. With no substitution, requirements for cheap parts, while substantially different in quantity, have essentially the same total cost (at least for this scenario and the selected set of parts). A noteworthy Dyna-METRIC shortcoming, relative to PARCOM (as enhanced in this study), is that Dyna-METRIC in a partial-substitution mode can not determine parts requirements, but only fleet capability. Based on published documentation, Dyna-METRIC has the potential for multiechelon, multiindenture* discrete AVUM (aviation unit maintenance) and AVIM (aviation intermediate maintenance) representation, which PARCOM, in its present configuration, does not. This expected, though as yet untested, capability is not seen as critical to the determination of gross estimates of theater-level parts requirements and fleet performance, but should be applicable to higher resolution questions. PARCOM, by virtue of its simplicity of preparation and ease of interpretation, is still preferred for coarse analysis.

2-3. PARCOM DEVELOPMENTS AND TEST

a. Originally, the intent was to investigate representation of partial substitution in both Overview and PARCOM. It quickly became apparent, however, that Overview would be unsuitable for such representations, since it could not even play a no-substitution policy. Accordingly, PARCOM became the focus of attention for representation of partial substitution. With the incorporation of partial substitution into PARCOM, the idea of totally replacing Overview with PARCOM became very attractive, since there was so little Overview could do that PARCOM could not. The principal remaining Overview feature not yet in PARCOM was the phasing in of parts (into theater) over time. With the addition of logic to distribute parts over time, PARCOM would be able to supersede Overview. The details of the efforts to incorporate partial substitution and distribution of parts over time into PARCOM are reported in the partial-substitution technical paper.[4] This effort is summarized below.

b. Essentially, partial substitution, as represented in the modified PARCOM, requires two distinct operations; first, all parts are divided into two sets, substitutable and nonsubstitutable, according to specified screening criteria. The two criteria used, separately and jointly, for PARCOM (and Dyna-METRIC) testing were: (1) that all parts having theater NRTS

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*Multiindenture refers to the fact that most large components have subcomponents, which Dyna-METRIC can treat separately if the detailed data on them is available.

(not repairable this station) rates over 50 percent be designated as substitutable and (2) that all parts requiring 30 days or more to repair be substitutable. Next, the two parts sets (substitutable and not substitutable) are processed concurrently in a PARCOM scenario with the daily allowable stockouts* of one set being the difference between the total daily allowable stockouts and the daily allowable stockouts of the other set. For each day the parts requirements and costs are determined for every feasible integral combination of allowable stockouts, and the least expensive mix that allows the flying hour and availability goals to be met is selected as the parts requirement for that day. The maximum, overall scenario days, of the daily requirements for each part is then the add-on requirement for that part. To do fleet capability assessments, given the purchase of the required parts mix, daily NMCS aircraft for partial substitution is calculated separately for the no-substitution and full-substitution sets. The separate NMCS computations are then combined to generate the fleet capability assessment in terms of achieved availability (the fraction of the fleet that is non-NMCS). Capability assessment (availability and flying hours achieved) for a fleet with a spares inventory less than that required to meet the flying program objective is done in an iterative manner, with logic similar to that applied in the basic version of PARCOM.[7]

c. When necessary to distinguish it from the basic version, the version of PARCOM modified to include partial substitution and essential features of Overview is called "extended PARCOM." Extended PARCOM was tested with simple examples, whose results could be checked manually. The example runs yielded the same answers as the manual calculations. Extended PARCOM was then tested with the same scenario and data base used in the Aircraft Spares Study (and, earlier, in the MAX FLY Study) and with the partial-substitution selection criteria described earlier. Table 2-2 summarizes certain requirements results for all three substitution policies. As expected, partial-substitution add-on costs and part types lie between the values for full and no substitution. The closeness of the cost requirements for full and partial substitution is due to the fact that the particular parts that had to be purchased with partial substitution over and above those common to the full-substitution case were not very expensive. Permitting partial substitution, with the criteria for designating substitutable parts as selected, drove the cost down from what it would have been with no substitution to near the minimum achievable, were full substitution allowed, with the attendant accomplishment of the required flying hour program. However, if one compared the fleet capability with current inventory under no substitution to that under partial substitution with the above substitution selection criteria, the gain in performance would be negligible, as seen in Figure 2-3. In summary, while achieving performance goals may be costly, full substitution will minimize the numbers of parts required and the total

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*Allowable stockouts are the total number of parts shortages permissable, i.e., the number which will determine a quantity of NMCS aircraft which still allows the daily flying hour and availability goals to be met.

cost. For the test conditions, partial substitution will allow meeting the same objectives at a small additional cost, when the allowable substitution set is constrained to specific part types according to the criteria selected herein. If no expenditure for additional parts is allowed, however, some other designation criteria for the substitutable set may have to be selected (e.g., high failure rate parts rather than parts with long repair or shipping times).

Table 2-2. Add-on Requirements to Meet Flying Hour Goal; PARCOM

Policy	Cost, $M	Number of part types	Most costly part	
			Number	Percent of total cost
Full substitution	20	6	246	99
Partial substitution	21	60	246	94
No substitution	43	99	386	72

d. The products of OPTP do not include delivery and documentation of a complete, extended PARCOM (only the basic PARCOM has been delivered and documented). A limited follow-on effort will provide:

(1) Publication of revisions to the (basic) PARCOM User's Guide and Functional Description.

(2) Documentation and delivery of the program source code for the extended PARCOM (a draft version has already been sent to AVSCOM).

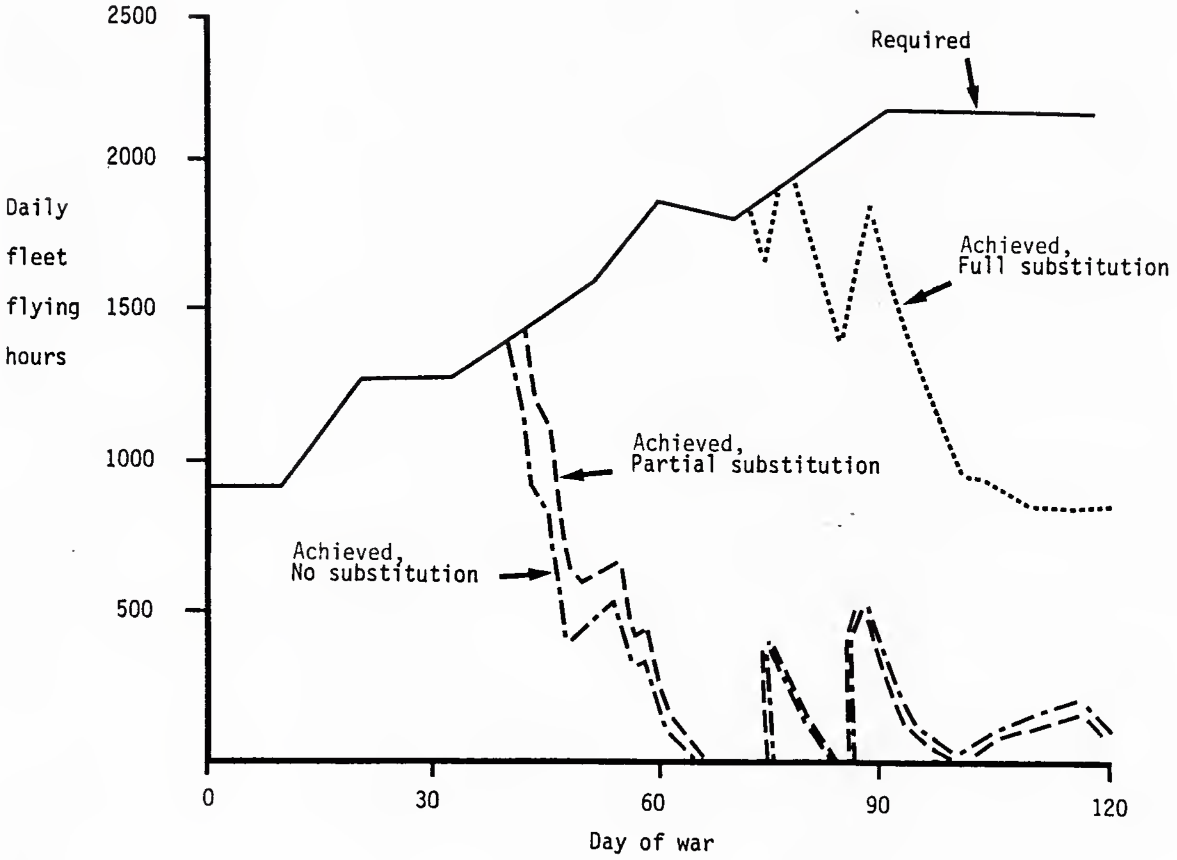

Figure 2-3. Capability Assessment with Current Inventory; PARCOM

CHAPTER 3

FINDINGS

3-1. MODEL DELIVERY. Production versions of Overview and basic PARCOM were delivered to AVSCOM, the designated user. Model code, documentation, and training were provided.

3-2. ASSESSMENT OF PARCOM. Basic PARCOM is capable now of providing quick reaction, gross estimation of aircraft fleet flying hour capability and spare parts requirements and costs for a wartime scenario. It is compact, transparent, and quick running. Its consolidated output package provides a large number and variety of easily interpreted reports, tailored to answer the sponsor's questions.

3-3. ASSESSMENT OF DYNA-METRIC. Dyna-METRIC is capable of producing comparable results to Overview and PARCOM, given the same aggregated depot and theater representations and the same data base. It is not recommended for theater analysis, however, due to the complexity of its preparation and interpretation relative to the above models. Dyna-METRIC should be more applicable to higher resolution analysis of aircraft spare parts logistics problems than the above-mentioned models. Competence in Dyna-METRIC's understanding and use, and confidence in its results, have been acquired through testing and demonstration. However, more such testing seems warranted before committing the model to the higher resolution applications.

3-4. REPRESENTATION OF PARTS SUBSTITUTION POLICIES. Dyna-METRIC and extended PARCOM can assess aircraft fleet flying hour capability under full-, no-, and partial-substitution parts replacement policies. Both models can assess parts requirements under full and no substitution, but only extended PARCOM can do so under partial substitution.

3-5. FUTURE NEED FOR OVERVIEW. Extended PARCOM eliminates any further need for Overview in Army aircraft spare parts analysis.

APPENDIX A

STUDY CONTRIBUTORS

1. STUDY TEAM

a. Study Director

Mr. Saul L. Penn, Force Systems Directorate

b. Study Team Members

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Mr. Walter J. Bauman
MAJ Ronald D. McAdoo
Mr. Thomas A. Rose
Ms Vivian E. Jugan (now with Department of the Navy, Fleet Material Support Office)

2. PRODUCT REVIEW BOARD

MAJ John F. Affeldt (Chairman), Forces Directorate
Ms Sally Van Nostrand
MAJ John J. Dovich, Strategy, Concepts and Plans Directorate

APPENDIX B

STUDY DIRECTIVE

DEPARTMENT OF DEFENSE UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR LOGISTICS
WASHINGTON, D.C. 20310

14 MAY 1984

DALO-ZD

SUBJECT: Study Directive - Overview/PARCOM Turnkey Project

Director
US Army Concepts Analysis Agency
8120 Woodmont Avenue
Bethesda, MD 20814

1. PURPOSE OF DIRECTIVE. This directive establishes objectives and provides guidance for the conduct of the Overview/PARCOM Turnkey Project.

2. BACKGROUND. In August 1983 CAA was tasked to conduct the Aircraft Spares Study to develop candidate methodologies for the purpose of forecasting wartime aircraft spare parts requirements. The study recommended that two simulation models, the Overview Model and the Parts Requirements and Cost Model (PARCOM) be used to provide the Army with a quick reaction methodology for that stated purpose. The Study Advisory Group (SAG), meeting on 1 March 1984, recommended that CAA provide the Overview and PARCOM Models to the US Army Aviation Systems Command (AVSCOM) in a turnkey transfer of computer programs and model documentation, test the Dyna-METRIC Model to determine its ability to represent partial substitution and availability goals in theater level operations, and investigate improvements to Overview and PARCOM for partial substitution. This project addresses those recommendations.

3. STUDY SPONSOR. The Office of the Deputy Chief of Staff for Logistics (ODCSLOG), Aviation Logistics Office (DALO-AV).

4. STUDY AGENCY. US Army Concepts Analysis Agency (CAA).

5. TERMS OF REFERENCE

a. Scope

(1) This project consists of a turnkey transfer of the Overview and PARCOM Models from CAA to AVSCOM, a test of the Dyna-METRIC Model, and an investigation of partial substitution with the Overview and PARCOM Models.

(2) The project will focus on the AH-1S helicopter for model test and comparison purposes.

b. Objectives

(1) To transport the Overview and PARCOM simulation models developed in the Aircraft Spares Study to AVSCOM, to demonstrate the model's use, and to train the AVSCOM model operators.

(2) To test the ability of the Dyna-METRIC Model to represent (a) theater level operations, (b) sparing to aircraft availability goals, and (c) partial substitution of spares.

(3) To investigate representation of partial substitution with Overview and PARCOM.

c. Timeframe: FY 84-85.

d. Assumptions: CAA's PARCOM and Overview Models can be made operational on the designated computer at AVSCOM and AVSCOM will be prepared to receive and operate the models.

e. Essential Elements of Analysis

(1) Are the Overview and PARCOM Models amenable to production runs?

(2) Are the designated AVSCOM personnel trained to operate the models?

(3) Can the Rand Dyna-METRIC Model adequately represent theater level operations, sparing to availability goals, and partial substitution of spares?

(4) Can Overview and/or PARCOM adequately represent partial substitution?

6. RESPONSIBILITIES

a. ODCSLOG will:

(1) Coordinate the study effort with Army offices and agencies, e.g., DARCOM and AVSCOM.

(2) Provide for Study Advisory Group (SAG) review of the study results.

b. CAA will:

(1) Conduct the study.

(2) Obtain the suport of the Rand Corporation for testing the Dyna-METRIC Model.

(3) Provide in-process reviews (IPR) to the study sponsor and a final report and briefing to the sponsor and SAG.

c. AVSCOM will:

(1) Designate a point of contact for the study.

(2) Designate personnel to receive training at CAA.

(3) Provide updated AH-1S RAM data.

(4) Demonstrate operation of models by providing ODCSLOG with projected AH-1S spare requirements.

7. LITERATURE SEARCH. Not applicable.

8. REFERENCES. Aircraft Spare Stockage Methodology (Aircraft Spares) Study, CAA-SR-84-12, US Army Concepts Analysis Agency, April 1984.

9. ADMINISTRATION

a. Support

(1) Funds for travel, per diem, and overtime will be provided by the parent organization of each participant.

(2) Funds for Rand support of the Dyna-METRIC test will be provided by ODCSLOG.

b. Milestone Schedule

(1) Initial results will be provided by 31 July 1984.

(2) The model transport will be completed no later than 31 Oct 84.

(3) Other milestones will be identified in the study plan.

c. Control Procedures

(1) ODCSLOG will designate an ARSTAF point of contact for the study.

(2) CAA will prepare and submit DD Form 1498 to DTIC.

(3) Upon completion of the study, the study sponsor will provide a written evaluation IAW AR 5-5.

d. Communications. CAA is authorized direct coordination with AVSCOM.

DALO-ZD
SUBJECT: Study Directive - Overview/PARCOM Turnkey Project

10. COORDINATION. This tasking directive has been coordinated with CAA in accordance with procedures contained in AR 10-38.

FOR THE DEPUTY CHIEF OF STAFF FOR LOGISTICS:

Joseph P. Cribbins
JOSEPH P. CRIBBINS
Special Assistant to the Deputy
Chief of Staff for Logistics

APPENDIX C

REFERENCES

1. Penn, S. L., et al., Aircraft Spare Stockage Methodology (Aircraft Spares) Study, CAA-SR-84-12, US Army Concepts Analysis Agency, Bethesda, MD, April 1984 (UNCLASSIFIED)

2. Steinhagen, C. A., et al., Maximizing Daily Helicopter Flying Hours Study (MAX FLY Study), CAA-SR-83-11, US Army Concepts Analysis Agency, Bethesda, MD, August 1983 (SECRET)

3. Rose, T. A., Test of the Dyna-METRIC Aircraft Readiness and Sustainability Assessment Model, CAA-TP-84-12, US Army Concepts Analysis Agency, Bethesda, MD, November 1984 (UNCLASSIFIED)

4. Bauman, W. J., Partial Substitution and Other Modifications to the PARCOM Model, CAA-TP-84-11, US Army Concepts Analysis Agency, Bethesda, MD, November 1984 (UNCLASSIFIED)

5. Pickard, W. C., Zellner, P. A., and Bailey, D. R., Overview/ARLCAP User's Manual, Synergy, Inc., August 1983 (UNCLASSIFIED)

6. Bauman, W. J., Parts Requirements and Cost Model (PARCOM) Documentation, PARCOM User's Guide, CAA-D-84-10, US Army Concepts Analysis Agency, Bethesda, MD, October 1984 (UNCLASSIFIED)

7. Bauman, W. J., Parts Requirements and Cost Model (PARCOM) Documentation, PARCOM Functional Description, CAA-D-84-15, US Army Concepts Analysis Agency, Bethesda, MD, October 1984 (UNCLASSIFIED)

APPENDIX D

SPONSOR'S COMMENTS

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR LOGISTICS
WASHINGTON, D.C. 20310-0501

DALO-ZD 5 February 1985

SUBJECT: Overview/PARCOM Turnkey Project (OPTP)

Director
U. S. Army Concepts Analysis Agency
ATTN: CSCA-FSC
8120 Woodmont Avenue
Bethesda, MD 20814

1. We have completed a review of the Study (SAB) and Study Critique is furnished at Enclosure 1. There are no editorial comments.

2. We are working with AVSCOM to assure that the potentials of OPTP are fully explored as a model in support of developing spare/repair parts requirements. The work has completely met the objectives of this office. Please pass on to all concerned our appreciation for a job well done.

FOR THE DEPUTY CHIEF OF STAFF FOR LOGISTICS:

Joseph P. Cribbins
Joseph P. Cribbins
Special Assistant to the Deputy
Chief of Staff for Logistics

1 Encl
as

(NOT USED)

STUDY CRITIQUE

(This document may be modified to add more space for responses to questions.)

1. Were there any editorial comments? No. If so, please list on separate page and attach to the critique sheet.

2. Was the work accomplished in a timely manner? Yes. If not, please comment.

3. Does the work report address adequately the issues planned for the analysis? Yes. If not, please comment.

4. Were appropriate analysis techniques used? Yes. If not, please comment.

5. Are the findings fully supported by good analysis based on sound assumptions? Yes. If not, please explain.

6. Does the report contain the preferred level of details of the analysis? Yes. If not, please comment.

7. Is the written material fully satisfactory in terms of clarity of presentation, completeness, and style? Yes. If not, please comment.

STUDY CRITIQUE (CONTINUED)

8. Are all Figures and Tables clear and helpful to the reader? Yes. If not, please comment.

9. Does the report satisfy fully the expectations that were present when the work was directed? Yes. If not, please explain how not.

10. Will the Findings in this report be helpful to the organization which directed that the work be done? Yes. If so, please indicate how, and if not, please explain why not. Completed documentation and model expansion necessary to enable AVSCOM to evaluate how Overview/PARCOM model can be used to make real time spare parts analyses against OPTEMPO/Flying Hour requirements for peace and war.

11.. Judged overall, how do you rate the study? (circle one)

Poor Fair Average Good [✓ Excellent]

APPENDIX E

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GLOSSARY

AVIM	aviation intermediate maintenance
AVSCOM	US Army Aviation Systems Command
AVUM	aviation unit maintenance
CAA	US Army Concepts Analysis Agency
Dyna-METRIC	Dynamic Multi-echelon Technique for Recoverable Item Control (model)
FHP	flying hour program
M	million
MAX FLY	Maximizing Daily Helicopter Flying Hours (study)
NMCS	not mission capable due to supply
NRTS	not repairable this station
ODCSLOG	Office of the Deputy Chief of Staff for Logistics
OPTP	Overview/PARCOM Turnkey Project
Overview	Overview/ARLCAP (Army Logistics Capability) (model)
PARCOM	Parts Requirements and Cost Model