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PHASE III FINAL REPORT

ECONOMIC ANALYSIS OF SELECTED TEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT FROM THE U.S. ARMY COMMUNICATIONS COMMAND PREFERRED ITEMS LIST

Volume 1: Management Summary

May 1975

Prepared for
THE U.S. ARMY ELECTRONICS COMMAND
FORT MONMOUTH, NEW JERSEY
and
THE U.S. ARMY COMMUNICATIONS COMMAND
FORT HUACHUCA, ARIZONA
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The U.S. Army Electronics
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Prepared by

H. Rosenberg

ARINC Research Corporation
a Subsidiary of Aeronautical Radio, Inc.
2551 Riva Road
Annapolis, Maryland 21401

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FOREWORD

ARINC Research Corporation is conducting an economic analysis of Test Measurement and Diagnostic Equipment (TMDE) from the U. S. Army Communications Command (USACC) Preferred Items List (PIL). The analysis is being performed for the U. S. Army Electronics Command, Fort Monmouth, and USACC, Fort Huachuca.

This study is being conducted in five phases, with the overall objective being to evaluate the potential economic benefits of adoption of the complete PIL. Details of Phase III, an economic analysis of selected TMDE, are described in this report. The report is divided into two volumes, the first volume (this document) being a management summary, and the second providing detailed results.

Phases I and II of the TMDE economic analysis were reported upon in previous publications of ARINC Research Corporation.

SUMMARY

An economic analysis was performed to evaluate potential cost benefits of standardizing the U.S. Army Communications Command Preferred Items List (PIL) for Test Measurement and Diagnostic Equipment (TMDE).

The study encompassed three types of PIL TMDE and the more than 50 non-PIL TMDE these can potentially replace.

Results of the analysis clearly indicate that for all three types of PIL TMDE, standardization would produce significant cost savings for USACC. The potential savings would amount to more than $4 million if the three PIL items are standardized and phased-in to replace the non-PIL items currently in the USACC inventory.

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Section 1

INTRODUCTION

This report presents an overview of an economic analysis performed by ARINC Research Corporation for the U.S. Army Electronics Command (USAECOM), Fort Monmouth, New Jersey, and the U.S. Army Communications Command (USACC), Fort Huachuca, Arizona. The analysis was conducted on three candidate Test Measurement and Diagnostic Equipment (TMDE) from the Preferred Items List (PIL) of USACC and the 55 corresponding makes and models of TMDE these can potentially replace. The purpose of the study was to assess potential economic benefits of standardizing the USACC Preferred Items List of TMDE. This study has encompassed to date the following three sequential phases:

- Phase I – Development of a TMDE life cycle cost (LCC) estimation methodology and selection of three PIL TMDE for detailed economic analysis.
- Phase II – Determination of the availability of data required to conduct the economic analysis of the three selected TMDE.
- Phase III – Economic analysis of the selected TMDE.

This economic analysis was limited to the three PIL TMDE selected during Phase I and the non-PIL TMDE they can replace. The subject TMDE were categorized into the following three groups, each containing PIL and corresponding non-PIL items.

a. Group A, consisting of spectrum analyzers – the AN/USM-366(V) (a PIL TMDE) and 11 non-PIL TMDE.

b. Group B, consisting of frequency counters, both main frame and plug-ins. Included are:

Type	PIL TMDE (S/N)	Non-PIL TMDE (Qty)
Main Frame	CP-772A/U	28
Plug-in	CV-2002/U	6
Plug-in	CV-2003B/U	2
Plug-in	CV-3059/U	2

c. Group C, consisting of rf power meters – the 432A (a PIL TMDE) and six non-PIL TMDE.

A major assumption made for the economic analysis was that each PIL TMDE can potentially replace only one non-PIL TMDE in the USACC inventory. Therefore the potential for reducing the total density of TMDE in the USACC inventory, inherent in the PIL concept (because the more versatile PIL items can actually replace more than one non-PIL TMDE), was not addressed quantitatively in this study.

Section 2

LIFE CYCLE COST METHODOLOGY

An LCC methodology was developed in accordance with current USACC policies for procurement and logistics support of TMDE. This methodology served as the basis for a computerized LCC model used to perform the economic analysis of PIL and non-PIL TMDE. The LCC model considers 11 cost elements, with the general equation being:

$$\begin{aligned} Cost_{TMDE} = {} & C_{Training} + C_{Hardware} + C_{Personnel} \\ & + C_{Transportation\ (First\ Destination)} \\ & + C_{Transportation\ (Maintenance)} + C_{Consumables} + C_{Introduction} \\ & + C_{Holding} + C_{Documentation} + C_{Installation} - C_{Disposal}. \end{aligned}$$

Conditions applicable to the above equation are that 1) the life cycle of 10 years for TMDE begins in 1975 and terminates in 1984, and 2) disposal is treated as a cost asset.

Section 3

LIFE CYCLE COST ANALYSIS

Life cycle cost analyses were performed for various scenarios and cases that represent possible alternatives to standardizing PIL TMDE. The scenario and case LCC exercises are discussed in Sections 3.1 and 3.2, respectively. Section 3.3 describes the nonquantifiable benefits from PIL standardization identified during this analysis; and Section 3.4 discusses the results of a sensitivity analysis of key input data elements to the LCC evaluations.

3.1 SCENARIO LCC EXERCISES

3.1.1 Description of Scenarios

Economic analysis of the three selected PIL TMDE and corresponding non-PIL TMDE was performed for three different scenarios representing the life cycle events of TMDE deployed by USACC.

Scenario 1 considers the life cycle cost of TMDE when each item is procured in 1975, operated and maintained for 10 years, and disposed of in 1984. This scenario was used to compare the LCC of PIL TMDE with that of non-PIL TMDE under equivalent conditions.

Scenario 2 investigates the economic impact of replacing the non-PIL TMDE in the USACC inventory at a yearly rate approximately equal to 10 percent of the total density to be replaced. This scenario considers three options for replacing non-PIL items:

a. Option 1 – Phasing-in of PIL TMDE to replace non-PIL TMDE (i.e., complete standardization of the PIL)

b. Option 2 – Replacement of non-PIL TMDE with non-PIL TMDE, a situation that might occur if standardization were not implemented or if the PIL did not exist.

c. Option 3 – Replacement of existing non-PIL TMDE by phasing-in a selective mixture of PIL and non-PIL TMDE, a condition which might occur if it were deemed of value at some time in the 10-year life cycle to upgrade the TMDE inventory through the acquisition of advanced state-of-the-art equipments.

Scenario 3 investigates the economic impact of replacing the non-PIL TMDE in the USACC inventory in accordance with a 10-year phase-in plan developed by USACC. Scenario 3 has the same three replacement options as Scenario 2.

3.1.2 Results and Conclusions

Table 1 summarizes the data obtained from the LCC exercises for the three scenarios. It can be seen that:

a. For scenario 1, the life cycle costs of PIL TMDE are significantly less for all three groups than those of corresponding non-PIL TMDE. If the three PIL items were standardized, the cost savings for Groups A, B, and C would be \$1.46 million, \$1.97 million, and \$1.85 million, respectively. A combined cost benefit of \$5.28 million would be realized if all three PIL items were standardized.

b. For scenario 2 (10% fixed replacement), the life cycle costs of option 1 (phase-in of PIL items) is \$1.06 million less than that of option 2 (phase-in of non-PIL items).

c. For scenario 3 (USACC Plan), the total life cycle cost of option 1 (phase-in of PIL TMDE) is significantly less than that for option 2 (phase-in of non-PIL TMDE) for all three TMDE groups. If the three PIL items were standardized, the cost savings for Groups A, B, and C would be \$1.23 million, \$1.55 million, and \$1.18 million, respectively, with a combined cost benefit of \$3.96 million.

d. For scenario 2, the life cycle costs of option 3 (phase-in of PIL and non-PIL TMDE mixture) are approximately \$1 million less than for option 2. For scenario 3, the life cycle costs of option 3 are \$1.2 million less than for option 2. From this it is concluded that when PIL TMDE are standardized, technology upgrading by phasing in a second PIL TMDE would not result in significantly higher life cycle costs.

TABLE 1. RESULTS OF LCC SCENARIO EXERCISES

Scenario/ Option	TMDE Group	Description of LCC Exercise	Results
1/–	A	LCC of PIL vs. non-PIL TMDE	LCC of PIL TMDE is $1.46 million less than LCC of non-PIL TMDE
1/–	B	LCC of PIL vs. non-PIL TMDE	LCC of PIL TMDE is $1.97 million less than LCC of non-PIL TMDE
1/–	C	LCC of PIL vs. non-PIL TMDE	LCC of PIL TMDE is $1.85 million less than LCC of non-PIL TMDE
2/1	A	Phase-in of PIL TMDE to replace non-PIL TMDE (10%)	LCC of PIL phase-in is $1.06 million less than for non-PIL phase-in
2/2	A	Phase-in of non-PIL TMDE to replace non-PIL TMDE (10%)	
2/3	A	Phase-in of PIL and non-PIL mix (10%)	LCC of PIL and non-PIL mix is $1.0 million less than for non-PIL phase-in
3/1	A	Phase-in of PIL TMDE to replace non-PIL TMDE (per USACC Plan)	The LCC of PIL phase-in is $1.23 million less than LCC of non-PIL phase-in
3/2	A	Phase-in of non-PIL TMDE to replace non-PIL TMDE (per USACC Plan)	
3/1	B	Phase-in of PIL TMDE to replace non-PIL TMDE (per USACC Plan)	The LCC of PIL phase-in is $1.55 million less than LCC of non-PIL phase-in
3/2	B	Phase-in of non-PIL TMDE to replace non-PIL TMDE (per USACC Plan)	
3/1	C	Phase-in of PIL TMDE to replace non-PIL TMDE (per USACC Plan)	The LCC of PIL phase-in is $1.18 million less than LCC of non-PIL phase-in
3/2	C	Phase-in of non-PIL TMDE to replace non-PIL TMDE (per USACC Plan)	
3/3	A	Phase-in of PIL and non-PIL mix (per USACC Plan)	The LCC of PIL phase-in is $1.12 million less than LCC of non-PIL phase-in

3.2 CASE LCC EXERCISES

3.2.1 Description of Cases

Three cases reflecting economic conditions that could have a significant impact on standardization of the PIL TMDE were evaluated.

Case 1 measured the benefits that might accrue from the introduction of an initial parts stockage concept for TMDE maintenance, i.e., the economic advantage of decreasing the quantity of "backup" TMDE through the availability of a consumables provisioning inventory. Such backup TMDE are maintained in the inventory as spare equipment, used to replace mission-critical TMDE in need of repair; and serve as substitutes for equipment awaiting repair due to the unavailability of necessary spare parts or consumables. Whereas the current low density of each non-PIL TMDE precludes consideration of such an inventory program, the PIL concept increases the density of specific TMDE to a point where such a program might be of value.

Case 2 evaluated the relative effects (PIL vs. non-PIL) of inflation and discounted cash flow on TMDE life cycle costs using various combinations of inflation and discounted cash flow factors.

Case 3 evaluated the economic impact of standardization of the PIL such as would occur if the procurement quantity of one type of TMDE increased sufficiently to result in a discount from the manufacturer through volume procurements.

3.2.2 Results and Conclusions

Results of the LCC exercises for the three economic cases are summarized in Table 2. Major conclusions from this portion of the TMDE economic analysis are as follows:

a. For case 1, standardization of PIL TMDE could result in a further cost benefit of 10% beyond that determined for the scenario 1 exercises if an initial stockage program is implemented to replace the backup-TMDE concept.

b. For case 2, the application of inflation and discounted cash flow do not impact significantly on the overall conclusions of this study.

c. For case 3, standardization of PIL TMDE could result in a further cost benefit of 10% beyond that determined for the scenario 1 exercises if discounts are obtained from equipment manufacturers for volume procurements.

3.3 NONQUANTIFIABLE BENEFITS

Several nonquantifiable benefits might be realized if the PIL items are standardized. These benefits include:

a. Increased efficiency of personnel. Standardization of PIL TMDE would lead to a reduction in the number of different TMDE types with which operation,

TABLE 2. RESULTS OF LCC CASE EXERCISES

Case	TMDE Group	Description of Exercise	Results
1	A	Provisioning system for consumables to replace "backup TMDE"	The LCC of the PIL TMDE is $1.6 million less than for non-PIL TMDE when provisioning program is implemented
2	A	LCC of PIL and non-PIL TMDE; 0% inflation, 0% discounted cash flow LCC of PIL and non-PIL TMDE; 0% inflation LCC of PIL and non-PIL TMDE; 0% discounted cash flow	The LCC differences between PIL and non-PIL remain constant
3	B	LCC of PIL TMDE with volume discount	An additional 10% reduction for PIL TMDE over that of non-PIL TMDE
	C	LCC of PIL TMDE with volume discount	

calibration, and maintenance personnel have to be concerned, and hence their efficiency would improve. While this benefit is nonquantifiable, there would doubtless be an attendant decrease in the time required to utilize (i.e. operate) the TMDE and, consequently, a reduction in the total life cycle costs of PIL TMDE beyond that computed during this study.

b. Improved reliability of TMDE. An improvement in the reliability of TMDE could be realized upon standardization of that equipment. Standardization would permit closer attention to TMDE reliability problems (there being fewer equipment types with which to be concerned), and the product improvement programs thus encouraged could result in improved reliability. The overall effect of this improvement in reliability would be a decrease in life cycle costs as well as greater availability of TMDE.

c. Reduction of TMDE density. TMDE standardization would probably lead to the implementation of items that provide extended capability for test measurement and diagnosis beyond that available for the TMDE currently in the inventory. Hence the quantity of items needed to perform the required functions could be decreased. For example, the CP772A/U, a PIL item of Group B, offers an extended range for frequency measurements – up to 12.4 GHz with the use of three different plug-ins. At least six different non-PIL TMDE would be required to perform similar measurements. A reduction in the density of PIL TMDE of Group B would lead to a significant cost savings (e.g., about $4 million for a 20% reduction).

3.4 SENSITIVITY ANALYSIS

A sensitivity analysis was performed for the key input data elements of mean time between failures (MTBF), mean time to repair (MTTR), the cost of consumables, and number of hours that the TMDE is operated. Results of the sensitivity analysis are as follows:

a. MTBF. A very large decrease in MTBF for the PIL TMDE (e.g., 500% for Groups A and C; 100% for Group B) would be necessary to make their life cycle costs equal to that of the non-PIL TMDE.

b. MTTR. Very large increases in MTTR for the PIL TMDE are necessary to make their life cycle costs equal to that of non-PIL TMDE.

c. Cost of consumables. The cost of consumables would have to increase by more than 50% of the nominal value for each PIL TMDE to produce life cycle costs equal to that of the non-PIL TMDE.

d. Hours of operation.

   1) A 20% increase in the number of hours of operation for PIL TMDE of Groups B and C would be necessary to make their life cycle costs equal to that of the non-PIL TMDE within these groups.

   2) A 100% increase in the number of hours of personnel operation for PIL TMDE of Group A would be necessary to make its life cycle costs equal to that of the non-PIL in the group.

The major conclusion drawn from the above is that the results of the economic analysis are not particularly sensitive to possible variations of the key input parameters investigated.