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TMDE MODERNIZATION PROGRAM

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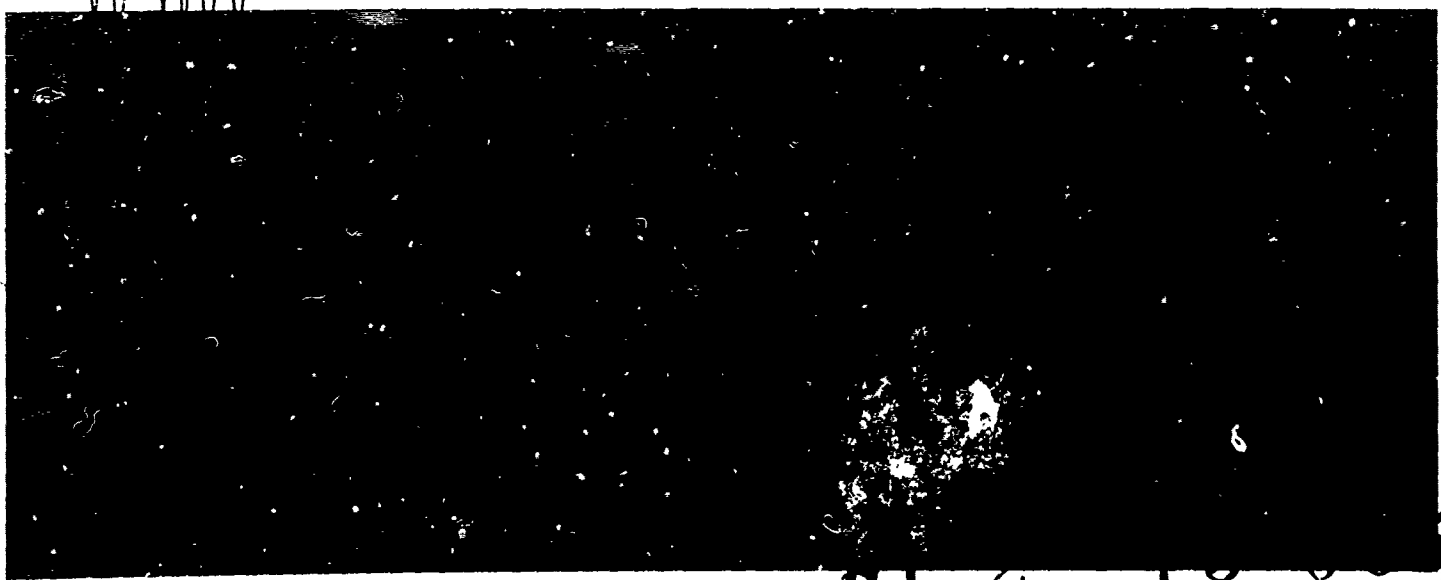
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Prepared for
U.S. ARMY COMMUNICATIONS AND ELECTRONICS
MATERIEL READINESS COMMAND
FORT MONMOUTH, NEW JERSEY 07703
under Contract DAEA18-72-A-0005/BG01

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 by
 A. Simmons
 R. Kavanaugh
 B. Paiz

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FOREWORD

This technical report describes the work performed by ARINC Research Corporation from May 1980 to December 1980 for the U.S. Army Communications and Electronics Materiel Readiness Command (CERCOM), Fort Monmouth, New Jersey, under Contract DAEA18-72-A-0005/BG01. It presents the background, objectives, technical approach, and results of Subtasks 4A, 4B, and 4C. Other tasks assigned under the contract will be summarized in a separate report.

ARINC Research Corporation wishes to express its appreciation for the cooperation and assistance provided by Mr. Richard E. Pribyl of the Directorate of Maintenance Engineering, Special Equipment Support Division, CERCOM. We also wish to thank Mr. Eli J. Dworkin, Chief, Special Equipment Support Division, for his interest and guidance during the project.

ABSTRACT

ARINC Research Corporation conducted a review and analysis of various aspects of the TMDE Modernization Program (TMP) to determine the minimum number of separate makes and models that will replace existing general purpose TMDE in the Army. In addition, a Time-Phased Plan (TPP) for the introduction of TMDE acquired as a result of the TMP was developed, and the effects of not delivering modernized TMDE on schedule were identified.

SUMMARY

ARINC Research Corporation was tasked by the U.S. Army Communications and Electronics Materiel Readiness Command (CERCOM) to review and analyze elements of the U.S. Army TMDE Modernization Program (TMP) pertaining to off-the-shelf (OTS) electronic test equipment (ETE) and to report the results.

The objectives of the review and analysis were to determine the minimum number of individual makes and models (M/M) of TMDE that would be required to replace the existing general purpose (GP) TMDE inventory, develop a Time-Phased Plan (TPP) for the TMP, and evaluate the impact of not completing the TMP on schedule. The information base for this project consisted of previous reports compiled by ARINC Research, Government documents (see Appendix A), and Letter Requirements (LRs) developed by the DARCOM/TRADOC Joint Working Group (JWG).

The principal conclusions reached as a result of this project are summarized as follows:

- The minimum number of M/M required to replace the U.S. Army GP TMDE inventory is 73. This number may rise slightly if each mainframe and plug-in combination required to satisfy a specific LR is nomenclatured separately.
- An estimated 2,222 individual M/M of GP TMDE can be replaced by the 73 M/M.
- Several GP TMDE families and OTS ETE functional descriptions (FDs) that pertain to the required 73 M/M do not have corresponding LRs. These families should be reviewed and LRs prepared, if necessary. The OTS ETE FDs applicable to several of the LRs are out of date and should be reviewed, upgraded, and validated.
- The Nondevelopmental Item (NDI) acquisition process is applicable to the procurement of OTS ETE. This process was used to develop the TPP.
- The TPP provides the guidance necessary to implement the TMP and to determine initial resource requirements. The TPP is currently applicable to 59 LRs for fiscal years (FY) 1981 to 1987.

- Overall cost and replacement data for the 59 LRs were not available. Data were available for 26 LRs, and these data were used to extrapolate cost data.
- Funds available for the TMP/TPP are insufficient and will result in long-term delays in acquiring the modernized TMDE. A review of the data presented in this report indicates that a full complement of modernized TMDE will not reach the Army in the field on schedule. There is a shortfall of approximately \$88.88 million between funds required and funds programmed.
- The absence of state-of-the-art TMDE to support mission requirements will adversely affect the materiel readiness of weapon systems requiring TMDE support and will burden the Army's logistics system with unnecessary costs to support obsolete TMDE.

On the basis of the foregoing conclusions, the following recommendations are offered:

- The LRs and OTS ETE FDs applicable to the 73 M/M should be prepared, reviewed, updated, and validated, as required. The updating of each FD should begin approximately 18 months before the fiscal-year/fiscal-quarter procurement is planned for the item.
- The TPP should be coordinated and implemented.
- Resources required to implement the TPP should be determined, and activities required to acquire these resources should be started.
- Major emphasis should be placed on acquiring the funding needed to fully implement the TMP/L. P.
- An LCC economic analysis should be completed for all of the LRs in the TMP.
- Benefits of the TMP should be reported to DARCOM, TRADOC, DA, and DoD through a series of briefings.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

During the past several years, the U.S. Army Communications and Electronics Materiel Readiness Command (CERCOM) has tasked ARINC Research Corporation, under several different contracts, to perform studies and analyses to assist in the development of the TMDE Modernization Program (TMP). This program is directed toward the acquisition of off-the-shelf (OTS) electronic test equipment (ETE) to satisfy the requirements for test, measurement, and diagnostic equipment (TMDE) in the U.S. Army.

Under Task 4 of Contract DAAB07-78-A-6606/3G02, ARINC Research Corporation is required to formulate conclusions and recommendations concerning the "Best Mix of TMDE" and the applicability of OTS ETE for the general support (GS) maintenance level on the basis of a review and analysis of the data collected in Task 3. However, during the contract effort it was concluded that the "Best Mix of TMDE" required by GS units must be determined in consonance with the CERCOM TMP in order to assure that current planning for OTS ETE is reflected in the "Best Mix of TMDE." It is also necessary to determine how the GS units, and the Army, will be affected if these OTS ETE do not enter the inventory as scheduled. Accordingly, the following tasks had to be accomplished before the contract work could be completed:

- Subtask 4A - Identify makes and models of current Army inventory TMDE that will be replaced in the TMP
- Subtask 4B - Establish a time-phased plan for introducing TMDE under the TMP
- Subtask 4C - Evaluate the impact of not delivering modernized TMDE on schedule

These tasks are classified as subtasks to Task 4, while the original Task 4 is reclassified as Subtask 4D. This technical report summarizes the results of Subtasks 4A, 4B, and 4C, which were accomplished under Contract DAEA18-72-A-0005/BG01.

1.2 PROJECT OBJECTIVES

The overall project objectives are to assist in the implementation of the TMP and to determine the "Best Mix of TMDE" at the GS maintenance level. Specific objectives of this report are as follows:

- To determine the minimum number of separate makes and models of general purpose (GP) TMDE required to support the operation and maintenance of U.S. Army systems currently fielded
- To develop a time-phased plan to describe the replacement of the current Army GP TMDE inventory
- To evaluate the impact on the Army of not fully implementing the TMP on schedule

1.3 OVERVIEW OF WORK PERFORMED

Before Subtasks 4A, 4B, and 4C were conducted, the U.S. Army GP TMDE inventory, as described in DA PAM 700-20/21, was reviewed and each item listed was placed in a TMDE family such as Signal Generator, VHF, or Voltmeter, AC. The measurement envelope of each family was documented, and the availability of OTS ETE to satisfy those measurement requirements was determined and OTS ETE functional descriptions (FDs) developed to represent each family. Finally, a TMDE Cross-Reference List (TCRL) was developed to identify the ARINC Research (OTS ETE) FDs that could be used to acquire OTS ETE that might replace a specific Army TMDE. In addition, an automated TMDE data base was developed to store, sort, and compare the TMDE performance characteristics. The documents describing these activities, performed under earlier contracts with CERCOM, are listed in Appendix A, Part I.

In Subtask 4A the data developed in these earlier contracts were supplemented with data on oscilloscopes and frequency counters (which were not included in the earlier studies) and the TCRL was updated accordingly. In addition, the Letter Requirements (LRs) developed by the DARCOM/TRADOC Joint Working Group (JWG) were encoded and placed in the data base and compared with the FDs developed by ARINC Research. From these data sources, the minimum number of separate makes and models of GP TMDE required to support the operation and maintenance of U.S. Army electrical/electronic systems and to replace or supplement the existing U.S. Army TMDE inventory was determined.

In Subtask 4B documents related to integrated logistic support (ILS) and acquisition of nondevelopmental items (NDIs) were reviewed and a TMDE NDI acquisition strategy was developed. In addition, a "Time-Phased Plan" for the introduction of TMDE documented by the LRs as part of the TMP was prepared.

Subtask 4C consisted of evaluating how the Army would be affected if the TMP were not fully funded and modernized TMDE were not delivered on schedule. This evaluation was accomplished through a series of scenarios that depicted the impact, at various levels of funding, on overall program cost, cost saving, logistics, and materiel readiness.

1.4 REPORT ORGANIZATION

Chapter One has presented the project background and objectives. Chapter Two describes the study approach, Chapter Three the results, and Chapter Four the conclusions and recommendations. Three appendixes document data used in the conduct of the project:

- Appendix A - Bibliography of Source Documents
- Appendix B - Description of the TMDE Cross-Reference List (TCRL)
- Appendix C - Life-Cycle-Cost Model

CHAPTER TWO

TECHNICAL APPROACH

2.1 ESTABLISH PROJECT BASELINE

As background to the discussion of the technical approach used in Subtasks 4A, 4B, and 4C, Sections 2.1.1 through 2.1.3 summarize earlier activities accomplished by ARINC Research Corporation in support of the TMP. These activities were used to establish the baseline for accomplishing the three subtasks.

2.1.1 U.S. Army TMDE Inventory

The U.S. Army TMDE inventory consists of approximately 5,000 separate makes and models (M/M). Approximately 4,000 of these M/M are listed in the DA TMDE Register (DA PAM 700-20/21). Approximately 1,000 M/M within the Army remain to be included in the register; most of these are non-standard items and of very low density, i.e., fewer than 10. Within the 5,000 M/M there are several distinct categories of TMDE:

- GP Electronic TMDE*
- Special Purpose Electronic (SP) TMDE*
- Automatic Test Equipment (ATE)
- Calibration Standards
- Weights/Measures
- Hydraulic/Mechanical
- COMSEC
- Laboratory/Industrial

While the TMP is directed toward replacement of GP TMDE, it has some application to SP TMDE. It is estimated that there are approximately 2,000 to 2,500 separate M/M of GP TMDE and between 600 and 900 separate M/M of SP TMDE in the Army TMDE inventory.

*Hereafter, the term GP TMDE and SP TMDE imply GP electronic TMDE and SP electronic TMDE, respectively.

2.1.2 Summary of GP TMDE Activities and Accomplishments

From August 1974 to May 1975, ARINC Research Corporation conducted an economic analysis of selected TMDE from the U.S. Army Communications Command (USACC) TMDE Preferred Items List (PIL). The results of this study validated the PIL concept, i.e., the reduction of proliferation of TMDE by using OTS ETE, and developed a life-cycle-cost (LCC) model for determining the total LCC of selected TMDE. The data derived from this study were used by CERCOM in the successful development and processing of three Class Determinations and Findings (Class D & F) for TMDE and in the further development of an LCC model that determined the economics of replacing field items with a preferred item. That model was used in Contract DAAB07-78-A-6606/BG06, and the LCC results were used to provide cost data for Subtask 4C (see Appendix C).

In May 1976 CERCOM requested ARINC Research to develop OTS ETE FDs for GP TMDE. This effort began with a detailed review and analysis of the Army TMDE inventory as described in the DA TMDE Register (DA PAM 700-20/21), SB 700-20, and various PILs that were available at that time for review. The technical characteristics and application of each listed TMDE were reviewed, analyzed, and categorized, and the item was assigned to a TMDE family (e.g., Signal Generator, HF) that reflected its salient characteristics. Initially, there were 79 separate GP TMDE families. The identifying and technical data of each TMDE were encoded and stored in the computerized TMDE data base. Other categories of TMDE, e.g., SP TMDE, Calibration Standards, and ATE, were excluded from this study; however, identification data for the excluded items were encoded and stored in the data base. From this data base, various reports were derived that facilitated the development of the OTS ETE

On the basis of the technical characteristics of each GP TMDE family, a test/measurement envelope or composite for that family was developed. These data served as a starting point for determining whether there were available OTS ETE that would meet or exceed the test/measurement capabilities of Army TMDE. The objective was to identify state-of-the-art OTS ETE TMDE that had the technical features that would enable them (1) to replace Army TMDE within a TMDE family, (2) to be acquired competitively, and (3) to provide data for development of the OTS ETE FDs. This process resulted in the combining of several TMDE families under one OTS ETE FD and in the preparation of a number of OTS ETE FDs to cover one family. Thus the OTS ETE FDs were developed from Army TMDE inventory data and were expanded to include state-of-the-art capabilities available in OTS ETE that could be acquired competitively. The FDs were formatted in accordance with MIL-T-28800, encoded, and included in the ARINC Research TMDE data base. As a result, a total of 98 OTS ETE FDs representing 69 GP TMDE families were developed. With the exception of oscilloscopes and frequency counters, which were specifically excluded by CERCOM, the 69 TMDE families represent all categories of GP TMDE found in the Army TMDE inventory.

The technical data in the TMDE data base for the FDs and for the Army GP TMDE were used to develop the TCRL. That document indicates which FD can be used to acquire OTS ETE that has the potential for replacing a specific Army TMDE. Thus the TCRL is a starting point for determining which TMDE can be functionally or partially replaced by the acquisition of a new TMDE that conforms to the OTS ETE FDs shown in the TCRL. Appendix B provides a more detailed description of the TCRL.

The activities described above were completed in July 1977. Subsequently, 9 FDs and 7 TMDE families were reviewed, upgraded, and documented in ARINC Research Publication 1076-01-3-1770, dated July 1978, and 18 FDs and 18 TMDE families were reviewed, upgraded, and documented in ARINC Research Publication 1574-01-1-2076, dated December 1979. As a result, 7 FDs and 5 TMDE families were eliminated or combined with other FDs and are summarized in Table 2-1.

Table 2-1. SUMMARY OF TMDE FAMILIES ELIMINATED OR COMBINED	
TMDE Family Name	Remarks
Eliminated	
Signal Generator, UHF-A*	Requirement deleted by CERCOM.
Signal Generator, VHF-A*	Requirement deleted by CERCOM.
Combined	
Ammeter, DC**	Combined with Multimeter Family - Specification Number 29.
Spectrum Analyzer, RF**	Combined with Spectrum Analyzer, SHF Family - Specification Number 68.
Sweep Generator, Audio**	Combined with Generator, Signal Function Family - Specification Number 19.
Voltmeter, AC**	Combined with Voltmeter, RMS - Specification Number 41.
Voltmeter, Digital**	Combined with Multimeter Family - Specification Number 29.
*Source: ARINC Research Publication 1076-01-3-1770, July 1978.	
**Source: ARINC Research Publication 1574-01-1-2076, December 1979.	

The foregoing activities produced the data shown in Table 2-2. This table displays the number of individual GP TMDE families (in TMDE family code sequence), the number of individual family members (i.e., separate makes and models), and the families that were combined with another family

Table 2-2. TMDE FAMILIES AND OTS ETE FUNCTIONAL DESCRIPTIONS (FDS)								
TMDE Family Code	TMDE Family Name	Number of M/M in TMDE Family	OTS ETE Functional Description Number	Date Functional Description Prepared	Functional Description Name	Remarks	LR Number	FY Buy Year
001	Ammeter, AC	17	--			Combined with TMDE Family 002/ FD 23		
002	Ammeter, Clamp-On	6	23	12/79	Ammeter, AC, Clamp-On		90	
003	Ammeter, DC	10	--	--		Combined with TMDE Family 032/ FD 29	89	
004	Audio Intensity Meter	5	87	7/77	Audio Intensity Meter			
005	Audio Level Meter	11	--	--		Combined with TMDE Family 071/ FD 81		
006	Audio Oscillator	64	1	1/77	Audio Oscillator		33	
008	Bridge	38	25	7/78	Bridge, Universal		66	1986
009	Cable Test Set	20	88	12/79	Cable Test Set, Time Domain Reflectometer		01	1984
010	Calorimeter	5	42	5/77	Calorimeter		02	
011	Capacitor Test Set	"	--	--		Combined with TMDE Family 008/ FD 25		
013	Data Error Rate Test Set	7	72	6/77	Data Error Test Set		07	1985
014	Distortion Analyzer	18	74	6/77	Distortion Analyzer		79	1984
016	Envelope Delay Test Set	5	75	6/77	Envelope Delay Test Set		06	1986
020	Frequency Meter	4"	47	5/77	Frequency Meter A		11	
			48	5/77	Frequency Meter B			
			49	5/77	Frequency Meter C			
			50	5/77	Frequency Meter D			
			51	5/77	Frequency Meter E			
			52	5/77	Frequency Meter F		88	
			53	5/77	Frequency Meter G			
			54	5/77	Frequency Meter H			
			55	5/77	Frequency Meter I			
021	Gauss Meter	4	89	7/77	Gauss Meter		87	
022	Impedance Meter	3	--	--		Combined with TMDE Family 088/ FD 25		
023	Impulse Noise Counter	1	76	6/77	Impulse Noise Counter		12	1984
025	Insulation Test Set	25	26	3/77	Insulation Test Set		13	1985

(continued)

Table 2-2. (continued)							
TMDE Family Code	TMDE Family Name	Number of W/M in TMDE Family	OTS ETE Functional Description Number	Date Functional Description Prepared	Functional Description Name	Remarks	FY Buy Year
027	Logic Analyzer	5	77	6/77	Logic Analyzer		82 1987
029	Megohmmeter	2	27	6/77	Megohmmeter		14 1983
030	Microwave Link Analyzer	10	56	5/77	Microwave Link Analyzer		15 1985
031	Modulation Meter	12	57	5/77	Modulation Meter		03 1983
032	Multimeter	176	28	12/79	Multimeter, Digital, Handheld		17 1982
			29	12/79	Multimeter, Digital		18 1982
033	Noise Figure Meter	2	--	--		Combined with TMDE Family 055/ FD 13	19
034	Noise Power Ratio Test Set	4	58	5/77	Noise Power Ratio Test Set		20 1986
035	Ohmmeter	13	59	5/77	Noise Generator, Twelve Channel		21 1986
			30	3/77	Ohmmeter		
			31	3/77	Ohmmeter (Earth Tester)		22 1985
036	Oscillographic Recorder	20	91	7/77	Oscillographic Recorder (Two Channel)		23 1985
			92	7/77	Oscillographic Recorder (Eight Channel)		84 1985
037	Phase Jitter Meter	5	78	6/77	Phase Jitter Meter		31 1986
038	Phase Meter	5	60	5/77	Phase Meter		83 1987
040	Power Meter, RF	21	61	12/79	Wattmeter, RF		76 1983
041	Power Meter, SHF	17	63	12/79	Power Meter, SHF		77 1984
042	Q-Meter	9	93	7/77	Q-Meter		86
043	Field Strength Meter	18	43	5/77	Field Strength Meter A		
			44	5/77	Field Strength Meter B		
			45	5/77	Field Strength Meter C		
			46	5/77	Field Strength Meter D		
045	Semi-Conductor Test Set	17	94	7/77	Semi-Conductor Test Set		63 1985
047	Signal Generator, Function	39	19	12/79	Generator, Signal, Function		47 1982
049	Sweep Generator, SHF	44	21	12/77	Sweep Generator, SHF		51 1982
050	Signal Generator, Pulse	48	04	7/78	Generator, Signal Pulse		48 1982
051	Signal Generator, HF	26	03	1/77	Signal Generator, HF		34 1981
052	Sweep Generator, HF	12	20	1/77	Sweep Generator, HF		49

(continued)

Table 2-2. (continued)							
TMDE Family Code	TMDE Family Name	Number of M/M in TMDE Family	OTS PTE Functional Description Number	Date Functional Description Prepared	Functional Description Name	Remarks	FY Buy Year
053	Signal Generator, SHF	36	05	1/77	Signal Generator, SHF A		39
			06	1/77	Signal Generator, SHF B		40
			07	1/77	Signal Generator, SHF C		1981
			08	1/77	Signal Generator, SHF D		42
			09	1/77	Signal Generator, SHF E		44
			10	1/77	Signal Generator, SHF F		1987
			11	1/77	Signal Generator, SHF G		1987
			12	1/77	Signal Generator, SHF H		1982
054	Signal Generator, Square Wave	11	--	--		Combined with TMDE Family 047/ FD 7	
055	Signal Generator, Thermal Noise	17	13	1/77	Signal Generator, Thermal Noise A		1986
			14	1/77	Signal Generator, Thermal Noise B		1985
056	Signal Generator, Tracking	3	64	1/77	Signal Generator, Tracking	Used with TMDE Family 110/ FD 70	1984
059	Spectrum Analyzer, Audio	12	65	12/79	Spectrum Analyzer, Low Frequency		1984
060	Spectrum Analyzer, Baseband	6	66	5/77	Spectrum Analyzer, Baseband	Used with TMDE Family 110/ FD 70	1984
061	Spectrum Analyzer, RF	38	--	--		Combined with TMDE Family 062/ FD 68	55
062	Spectrum Analyzer, SHF	29	68	12/79	Spectrum Analyzer, RF		1983
063	Standing Wave Ratio (SWR) Meter	21	69	5/77	Standing Wave Ratio (SWR) Meter		57
065	Stroboscope	10	95	7/78	Stroboscope		1986
066	Teletype Test Set Analyzer	29	33	3/77	Teletype Test Set Analyzer	Used with TMDE Family 067/ FD 34	60
067	Teletype Test Set Generator	13	34	3/77	Teletype Test Set Generator	Used with TMDE Family 066/ FD 33	30
			35	3/77	Teletype Test Set	Combination Teletype Analyzer and Generator	1983

(continued)

Table 2-2. (continued)

Table 2-2. (continued)

TMDE Family Code	TMDE Family Name	Number of M/M in TMDE Family	OTS ETE Functional Description Number	Date Functional Description Prepared	Functional Description Name	Remarks	LR Number	FY Buy Year
110	Voltmeter, Frequency Selective	14	70	5/77	Voltmeter, Frequency Selective	See "Remarks," TMDE Families 056 and 060	71	1984
111	Vibration Test Set	8	97	7/77	Vibration Test Set	Combined with TMDE Family 002/ FD 23		
112	Audio System Test Set	5	71	6/77	Audio System Test Set			
116	Motor/Generator Test Set	13	--	--		Combined with TMDE Family 032/ FD 29		
117	Tachometer, Electronic	16	32	1/77	Tachometer, Electronic	Combined with TMDE Family 032/ FD 29		
118	Continuity Test Set	6	--	--				
119	Optical Test Set	2	90	7/77	Optical Test Set			
121	Voltmeter, Differential	14	38	7/78	Voltmeter, Differential			
122	Dial Equipment	13	73	6/77	Dial Equipment Test Set			

(see "Remarks" column). Table 2-2 also depicts the FDs representing each family, by FD number, date prepared, and specific name. Finally, the LR Numbers* assigned to those LRs prepared by the DARCOM/TRADOC JWG and containing characteristics comparable to OTS ETE FDs are shown, together with the fiscal year in which the Army intends to replace the item. ARINC Research originally concluded that the Army had 79 distinct GP TMDE families, excluding oscilloscopes and frequency counters. However, in the time since that conclusion was made, the number of active TMDE families has been reduced to 64 GP TMDE families as a result of advances in TMDE technology. The individual members of these 64 families have the potential for replacement by newly acquired TMDE that reflect the technical characteristics of the 91 OTS ETE FDs listed. Potentially, 1,487 separate makes and models in the Army inventory can be replaced by these FDs as defined in the TCRL.

2.1.3 Summary of SP TMDE Activities and Accomplishments

In June 1979 ARINC Research was tasked by CERCOM to determine the feasibility of replacing SP TMDE with OTS ETE. Again, the DA TMDE Register was the primary data source; and the automated processes, procedures, and data base established during the GP activities described in Section 2.1.2 were used to review and analyze SP TMDE.

Initially, 593 SP TMDE, as listed in the register, were identified and their respective identification and technical data were encoded and included in the TMDE data base for further processing. As a result of this process, 51 SP TMDE families and their individual members were identified and grouped. This concluded the first part of the study.

The second part of the study was a detailed review and analysis of 20 SP TMDE selected by CERCOM (all classified as Standard A in SB 700-20) and the specific end items they supported. The individual equipment technical manuals were used as the source documents for this activity. Whenever feasible, a separate combination of GP U.S. Army PIL TMDE and ARINC Research OTS ETE specifications were identified as potential replacements for each specifically required test or measurement.

ARINC Research reached the following conclusions from this study of the feasibility of replacing SP TMDE with OTS ETE or with groups of GP TMDE:

- It appears that many SP TMDE can be replaced by individual GP TMDE at the Direct Support (DS)/GS/Depot (D) maintenance levels. However, many of these SP TMDE should be retained at the organizational maintenance level for convenience and because of the small number of authorized GP TMDE at that level.
- SP TMDE that do not have functionally equivalent GP TMDE (e.g., special wiring harnesses, mechanical holding fixtures) must be retained in the inventory at required levels of maintenance.

*The LR Number assigned by ARINC Research is a duplicate of the "Performance Characteristic Number" assigned by DARCOM/TRADOC JWG to each LR.

- The use of groups of multipurpose GP TMDE in place of SP TMDE may result in a significant cost saving (or avoidance). Further study will be required to substantiate this conclusion.
- While there may be commercial items of OTS ETE that could functionally replace SP TMDE, these items are themselves SP TMDE. Replacing SP TMDE by these limited-function, noncompetitive items would require careful assessment in such areas as mean time between failures (MTBF), mean time to repair (MTTR), mean time to calibrate (MTTC), and initial cost.

From the results of the SP TMDE study, it is estimated that approximately 40 percent of the separate makes and models (M/M) of SP TMDE in the Army TMDE inventory can be replaced with GP OTS ETE or with current U.S. Army GP PIL TMDE at the DS/GS/D maintenance levels. This would yield a reduction of approximately 237 separate M/M. If this situation existed today, SP TMDE would be relegated primarily to organizational-level maintenance for convenience purposes, for quality assurance functions, and for truly unique equipments or equipment configurations. Further, it is estimated that the overall population of SP TMDE could be significantly reduced, leading to a reduction in logistic support costs and procurement costs.

2.2 SUBTASK 4A: IDENTIFY MAKES AND MODELS OF CURRENT ARMY INVENTORY TMDE THAT WILL BE REPLACED IN THE TMP

To accomplish Subtask 4A, the documents listed in Appendix A, Part I, and the draft LRs prepared by the DARCOM/TRADOC JWG were reviewed. ARINC Research assigned each LR a series of identification numbers consisting of the fiscal year in which it was planned to purchase the equipment, an LR number originally assigned by the JWG, and the equivalent ARINC Research OTS ETE FD number, if applicable, e.g., 1984*LR12*76. The technical data in each LR were encoded and stored in the TMDE data base for subsequent comparisons with the LR's equivalent FD. In addition, the LRs for oscilloscopes and frequency counters were assigned FD numbers and processed for inclusion in the TMDE data base. The TCRL was updated to include oscilloscopes and frequency counters. These activities culminated in the determination of the minimum number of separate M/M of GP TMDE required to replace the existing GP TMDE inventory. The selected M/M can support the operations and maintenance of U.S. Army electronic systems currently fielded.

2.3 SUBTASK 4B: ESTABLISH A TIME-PHASED PLAN FOR INTRODUCING TMDE UNDER THE TMP

The Time-Phased Plan (TPP) was developed on the basis of the priorities established by the DARCOM/TRADOC JWG for each draft LR, for a given fiscal year, and review and analysis of the documents listed in Appendix A, Parts II and III. Four of these documents -- Chapter 6 of AR 70-1, APRO 803, DARCOM-C 20-3, and DARCOM Supplement 1 to AR 700-127 -- were the main sources of information used to develop the NDI acquisition events and milestones established in the TPP. Individual existing regulatory documents

describing methods or procedures applicable to the TMP NDI acquisition process were associated with a specific event, as required. However, no attempt was made to include the details of these documents in the TPP.

By use of the available data, a TMP overview, depicting major events and milestones, sequenced in time and relationship, was developed. Individual event/milestone charts for each fiscal year were also developed. TMDE families within a fiscal year were divided into quarters, with events/milestones adjusted accordingly, to define as precisely as possible the progress of the acquisition cycle over each fiscal year.

The primary concern of the TMP is the support of the user's needs. Other areas of concern are the clarification of the role of participants, the compression of the acquisition cycle, and the assurance that the TMDE meets or exceeds test/measurement requirements, is supportable, and reflects the state of the art.

2.4 SUBTASK 4C: EVALUATE THE IMPACT OF NOT DELIVERING MODERNIZED TMDE ON SCHEDULE

To accomplish Subtask 4C, the LCC and replacement data derived from the 25 LCC Economic Analyses (EAs), developed by ARINC Research Corporation under Contract DAAB07-78-A-6606/BG06, were reviewed and applicable information extracted. From these data, the number of M/M to be replaced, the cost to retain the current inventory, the cost of the replaced item, and the potential cost savings for the life of the items were developed. Except for the 25 EAs, cost, replacement, and potential savings data were insufficient for an analysis. Therefore, these data were established as the baseline for projection purposes.

To develop the projection for FYs 1982, 1983, 1984, 1985, 1986, and 1987, an average (mean) cost and a median cost per LR were developed and applied to each group of preferred items for FY 1982 to 1987; the extrapolations were then computed. The three categories of funding -- fully funded (100 percent), partially funded (50 percent), and a no-funding situation (0 percent) -- form the basis for the three scenarios discussed in Chapter Three.

CHAPTER THREE

PROJECT RESULTS

3.1 RESULTS OF SUBTASK 4A: IDENTIFY MAKES AND MODELS OF CURRENT ARMY INVENTORY TMDE THAT WILL BE REPLACED IN THE TMP

3.1.1 LR Data Development

A list of 88 LRs and 87 draft LR documents was provided to ARINC Research by CERCOM. The LRs establish the requirements for the TMP. A draft LR was not available for Signal Generators B (LR 34). The 88 LRs are listed in Table 3-1 in LR number sequence. The following data are also listed:

- Generic nomenclature (source: DARCOM/TRADOC JWG)
- ARINC Research-assigned LR number (source: DARCOM/TRADOC JWG/ARINC Research)
- FY buy year (source: DARCOM/TRADOC JWG)
- Draft LR name and date prepared (source: DARCOM/TRADOC JWG)
- Number of M/M replaced according to LR (source: DARCOM/TRADOC JWG)
- TMDE family code, OTS ETE specification number, and date prepared (source: ARINC Research)
- Number of TCRL replacements (source: ARINC Research)
- Remarks (source: DARCOM/TRADOC JWG/ARINC Research)

Each LR was reviewed, and its identification and technical characteristics were encoded and included in the TMDE data base. The LRs for the six oscilloscopes (LRs 24 to 29) and three frequency counters (LRs 08 to 10) were also assigned ARINC Research specification numbers (S1 to S9, respectively) and were encoded and included in the TMDE data base. The purpose was to include replacement data for the oscilloscopes and counters in the TCRL.

3.1.2 LRs and OTS ETE FDs

The technical characteristics of each LR and its corresponding OTS ETE FD were compared in order to determine the compatibility between

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Table 1-1. ITEM REQUIREMENTS (1) SUMMARY TABLE											
Contract Item/Location	LR Number	FY Buy Year	Item's LR Name	Date Draft LR Prepared	Number of NDA's replaced by LR	Title, Family Code	OTS LR Functional Description	Date Functional Description Prepared	Number of TCR Replacements		Remarks
									Functional	Optical	
Variable Test Box	25	1964	able Test Box	5/60	7	000	00	12/70	14	5	Review requirements
Variable Test Box	26	1964	able Test Box	5/60	4	010	42	5/70	4	1	
Variable Test Box	27	1964	able Test Box	5/60	0	011	53	5/77	10	5	
Variable Test Box	28	1964	able Test Box	5/60	4	122	73	6/77	6	12	
Variable Test Box	29	1964	able Test Box	5/60	4	016	75	0/77	4	0	
Variable Test Box	30	1964	able Test Box	5/60	6	013	72	6/77	8	0	
Variable Test Box	31	1964	able Test Box	5/60	0	010	87	0/77	09	1	
Variable Test Box	32	1964	able Test Box	5/60	5	011	88	0/77	23	5	
Variable Test Box	33	1964	able Test Box	5/60	0	125	89	0/77	9	4	
Variable Test Box	34	1964	able Test Box	5/60	1	020	47	5/77	00	00	Use LR 00
Variable Test Box	35	1964	able Test Box	5/60	1	023	36	6/77	2	0	
Variable Test Box	36	1964	able Test Box	5/60	11	27	26	1/77	10	22	
Variable Test Box	37	1964	able Test Box	5/60	1	27	27	5/77	6	17	
Variable Test Box	38	1964	able Test Box	5/60	1	31	50	7/77	14	0	
Variable Test Box	39	1964	able Test Box	5/60	0	032	0/77	0/77	00	00	Exclude with LR 17
Variable Test Box	40	1964	able Test Box	5/60	1	032	40	1/77	03	09	
Variable Test Box	41	1964	able Test Box	5/60	11/77	031	27	1/77	141	40	
Variable Test Box	42	1964	able Test Box	5/60	0	033	00	00	00	00	LR not required (see Table 1-2, Family Code 033)
Variable Test Box	43	1964	able Test Box	5/60	1	11	06	7/77	1	1	Exclude with LR 50 and 59
Variable Test Box	44	1964	able Test Box	5/60	1	11	07	7/77	2	0	
Variable Test Box	45	1964	able Test Box	5/60	0	11	11	7/77	9	5	
Variable Test Box	46	1964	able Test Box	5/60	12	10	01	1/77	13	0	
Variable Test Box	47	1964	able Test Box	5/60	0	000	01	0/77	00	00	Use LR 25
Variable Test Box	48	1964	able Test Box	5/60	43	031	02	0/77	103	00	
Variable Test Box	49	1964	able Test Box	5/60	2	034	03	0/77	14	0	
Variable Test Box	50	1964	able Test Box	5/60	0	099	34	0/77	13	0	
Variable Test Box	51	1964	able Test Box	5/60	5	000	35	0/77	00	00	Use LR 24
Variable Test Box	52	1964	able Test Box	5/60	5	005	36	0/77	31	0	
Variable Test Box	53	1964	able Test Box	5/60	7	007	37	1/77	00	00	Review requirements

(continued)

Generic Nomenclature	LR Number	Y Buy Year	Draft LR Name	Date Draft LR Prepared	Number of M/M Replaced by LR	TMD Family Code	OTS ETE Functional Description Number	Date Functional Description Prepared	Number of TCRL Replacements		Remarks
									Functional	Partial	
Phase Jitter Meter	31	1986	Phase Jitter Meter	5/80	4	037	78	6/77	5	0	Deleted
Resistor Decade	32	--	Decade Resistor	5/80	1	201	N/A	N/A	--	--	Include with LR 65
Signal Generator A (Audio)	33	--	Signal Generator, Low Frequency, Audio Oscillator	10/79	42	006	01	1/77	--	--	LR not available
Signal Generator B 50 kHz - 80 MHz	34	1981	--	--	--	051	03	1/77	17	20	Include with LR 38
Signal Generator C 450 kHz - 512 MHz	35	--	Signal Generator, VHF	10/79	24	1%	18	7/78	--	--	Include with LR 38
Signal Generator D 500 MHz - 1.2 GHz	37	--	Signal Generator, UHF	10/79	1	107	15	3/78	--	--	Include with LR 38
Signal Generator E 2.0 - 18.0 GHz	38	1982	Signal Generator, UHF	10/79	8	107	16	7/78	73	74	
Signal Generator F 800 MHz - 2.4 GHz	39	--	Signal Generator, SHF	10/79	3	053	05	1/77	--	--	Include with LR 43
Signal Generator G 1.8 - 4.0 GHz	40	--	Signal Generator, SHF	10/79	6	053	06	1/77	--	--	Include with LR 43
Signal Generator H 3.8 - 7.0 GHz	41	1981	Signal Generator, SHF	UNK	4	053	07	1/77	4	3	
Signal Generator I 7.0 - 11.0 GHz	42	--	Signal Generator, SHF	11/79	1	053	08	1/77	--	--	Include with LR 43
Signal Generator J 11.0 - 15.0 GHz	43	1982	Signal Generator, SHF	11/79	5	053	12	1/77	25	10	
Signal Generator K 2.0 - 18.0 GHz	44	--	Signal Generator, SHF	5/80	2	053	09	1/77	--	--	Include with LRs 43 and 45
Signal Generator L 15.0 - 21.0 GHz	45	1987	Signal Generator, SHF	Unknown	TBD	053	10	1/77	0	0	
Signal Generator M 18 - 26.5 GHz	46	1987	Signal Generator, SHF	Unknown	TBD	053	11	1/77	2	1	
Signal Generator N 26.5 - 40 GHz	47	1982	Signal Generator, Function	11/79	15	047	19	12/79	44	29	
Signal Generator (Function)	48	1982	Signal Generator, Pulse	11/79	16	050	04	7/78	37	30	
Signal Generator Sweep A 100 kHz - 110 MHz	49	--	Signal Generator, Sweep	11/79	6	052	20	1/77	--	--	Include with LR 51
Signal Generator Sweep B 10 MHz - 1.0 GHz	50	--	Signal Generator, Sweep	11/79	6	109	22	1/77	--	--	Include with LR 51
Signal Generator Sweep C 1.0 - 40.0 GHz	51	1982	Signal Generator, Sweep	11/79	11	049	21	1/77	64	54	
Signal Generator, Thermal Noise Spectrum Analyzer A 10 MHz - 40 GHz	52	1986	Signal Generator, Thermal Noise Spectrum Analyzer	5/80	3	055	13	1/77	13	6	
Spectrum Analyzer B 4 kHz - 9.1 MHz	53	1983	Spectrum Analyzer	5/80	14	062	68	12/79	53	13	
	54	1984	Spectrum Analyzer	5/80	5	060	66	5/77	6	10	

(continued)

Table J-1. (continued)											
Generic Nomenclature	Pr Number	IV Buy Year	Draft LR Name	Date Draft LR Prepared	Number of Revisions Proposed by LR	TMOR Family Code	OTS PFE Functional Description Name	Date Functional Description Prepared	Number of TCSL Replacements		Remarks
									Functional	Partial	
Spectrum Analyzer + 100 kHz - 1.5 GHz	55	--	Spectrum Analyzer	5/80	7	061	--	--	--	--	LR not required (see Table 2-2, Family Code 061), include with LR 53
Spectrum Analyzer D 15 Hz - 50 kHz	56	1984	Spectrum Analyzer	5/80	4	059	65	12/79	14	8	
Standing Wave Ratio Meter	57	--	Standing Wave Ratio Meter (SWR)	5/80	10	063	69	5/77	--	--	Include with LR 75
Stereoscope	58	1986	Stereoscope	5/80	3	065	95	7/78	4	7	
Teletype Test Set	59	1983	Teletype Test Set	5/80	15	067	35	3/77	40	0	
Teletype Test Set, Analyzer	60	--	Teletype Test Set	5/80	15	066	33	3/77	--	--	Review requirements
Temperature Indicator	61	--	Temperature Indicator	5/80	2	070	96	7/77	0	7	Review requirements
Test Set, Semiconductor	62	1985	Test Set, Semiconductor	11/79	15	045	94	7/77	25	4	
Transmission Test Set	63	1986	Transmission Test Set	5/80	4	071	82	6/77	7	2	
Transmission Test Set (Telephones)	64	1982	Transmission Test Set (Telephones)	5/80	2	071	81	12/79	145	71	
Universal Bridge	65	1980	Universal Bridge	5/80	1	008	25	7/78	40	8	
Vector Impedance Meter	66	1987	Vector Impedance Meter	5/80	1	073	84	6/77	1	1	
A Voltmeter	67	--	A Voltmeter	5/80	13	076	--	--	--	--	LR not required (see Table 2-2, Family Code 076), include with LR 65
Voltmeter, Differential	68	--	A Voltmeter	5/80	3	121	38	7/78	12	6	
Digital Voltmeter	69	1984	Digital Voltmeter	11/79	7	078	--	--	--	--	LR not required (see Table 2-2, Family Code 078), include with LR 18
Voltmeter, Frequency Selective	70	--	Digital Voltmeter	5/80	3	110	70	5/77	4	10	
Voltmeter, Multifunction	71	1983	Multifunction M Voltmeter	11/79	5	079	40	12/79	13	1	
Voltmeter, True RMS and DB Meter	72	1983	True RMS Voltmeter and DB Meter	5/80	5	080	41	12/79	51	26	
Voltmeter, Vector	73	1987	Vector Voltmeter	5/80	5	074	85	6/77	5	1	
Wattmeter A 250W - 2.5 GHz	74	1983	Wattmeter (100 kW)	5/80	5	082	67	12/79	28	8	
Wattmeter B 30 MW - 500 MHz	75	1983	Wattmeter (100 W)	5/80	12	040	61	12/79	17	2	
Wattmeter C 1 MW - 18 GHz	76	1983	Wattmeter (10 kW)	5/80	5	041	63	12/79	15	10	
X-Y Recorder	77	1985	X-Y Recorder	5/80	6	084	98	7/77	5	1	
Distortion Analyzer	78	1984	Distortion Analyzer	5/80	12	014	74	6/77	18	4	

(continued)

Generic Nomenclature	LR Number	P's Buy Year	Draft LR Name	Date Draft LR Prepared	Number of M/M Replaced by LR	TMDL Family Code	OTS FTE Functional Description Number	Date Functional Description Prepared	Number of TCRS Replacements		Remarks
									Functional	Partial	
Television Generator A	86	1987	Television Generator, Sweep and Marker	Unknown	TBD	068	79	6/77	2	5	
Television Generator H	81	1987	Signal Generator, Color Television	Unknown	TBD	068	80	6/77	6	2	
Logic Analyzer	82	1987	Logic Analyzer	Unknown	TBD	027	77	6/77	6	7	
Phase Meter	83	1987	Phase Meter	Unknown	TBD	038	60	5/77	5	1	
Oscillographic Recorder B (8 Channels)	84	1985	Oscillographic Recorder	Unknown	TBD	036	92	7/77	7	6	
Sweep Generator, Audio (0.1 Hz to 200 KHz)	85	--	Signal Generator, Sweep Audio	Unknown	TBD	081	--	--	--	--	LR not required (see Table 2-2, Family Code 081), include with LR 47
Q-Meter	86	--	Q-Meter	Unknown	TBD	042	93	7/77	3	4	Review requirements
Loss Meter	87	--	Loss Meter	Unknown	TBD	021	89	7/77	5	2	Review requirements
Frequency Meter 1 (1 MHz to 2 GHz)	88	--	Frequency Meter	Unknown	TBD	020	51	5/77	--	--	Include with LR 10
Amplifier, DC	89	--	Amplifier, DC	Unknown	TBD	003	--	--	--	--	LR not required (see Table 2-2, Family Code 003), include LR 18
Amplifier, Clamp-On	90	--	Amplifier, Clamp-On	Unknown	TBD	001	23	12/79	--	--	Include with LR 17 as option
Signal Generator, Tracking	91	1984	Tracking Signal Generator	Unknown	TBD	056	64	1/77	--	--	

documents. Review of the technical characteristics indicates that some of the LR/FD combinations are incompatible. Further analysis is required to verify the status of those combinations. Since the OTS ETE FDs were developed on the basis of the availability of commercial products, those FDs with compatible LRs can be satisfied with an OTS ETE instrument. When there are disparities between the LR and the applicable FD, the availability of OTS ETE to satisfy the requirement must be determined. Further, when the date on which the FD was prepared will be more than one year earlier than the intended "FY Buy Year," the FD should be reviewed, upgraded, and validated to ensure that the item it describes is compatible with the total known or anticipated military requirements, reflects the state of the art, and can be acquired competitively. To ensure competition in the acquisition of OTS products, the technical requirements of individual LRs and FDs may have to be relaxed.

3.1.3 TMDE Cross-Reference List (TCRL)

The TCRL was updated to include frequency counters and oscilloscopes; and it now includes replacement data, by FD number and individual M/M, for all of the GP TMDE listed in the DA TMDE Register. The TCRL indicates that 2,222 of M/M of GP TMDE can be replaced by the FDs listed in Table 2-2. The actual M/M and applicable FDs are listed in the TCRL.

For those instruments which are partially compatible with two or more OTS ETE FDs, as listed in the TCRL, the LR that designates their replacements must be determined with care, to ensure that a required capability is not arbitrarily removed from the field. This requirement provides further justification for determining the total application of a fielded TMDE before scheduling its replacement. The format of the TCRL is described in Appendix B.

Replacement data listed in Table 3-1 indicate that there are differences between the individual LRs and the TCRL as to the exact number of M/M that should be replaced. This should be resolved to determine the total application of the replacement TMDE and the exact number of units required to "buy out" (replace) all applicable M/M.

3.1.4 Minimum Number of Makes and Models (M/M)

To determine the minimum number of M/M required to replace the Army's GP TMDE inventory, the data from Tables 2-2 and 3-1 were reviewed. On the basis of this review, it was determined that 59 activity LRs remained and that 5 LRs of the 88 LRs considered should be evaluated further by the DARCOM/TRADOC JWG. The 59 LRs were scheduled for procurement in a designated fiscal year. In addition, 19 FDs do not have an LR number and could represent potential requirements. Of those 19 FDs, it appears that 9 of them (i.e., FDs 43, 44, 45, 46, 71, 86, 87, 90, and 97) could represent valid requirements and should be considered at the next meeting of the JWG. In summary, there are 59 activity LRs, 5 LRs that could become activity LRs, and 9 FDs that could also become activity LRs. These LRs and FDs (73 M/M) could potentially replace the 2,222 M/M of GP TMDE documented in the

TCRL. This is a ratio in excess of 30 to 1. If the 237 M/M of SP TMDE that were estimated to be replaceable by GP TMDE are included (see Section 2.1.3), a total of 2,459 individual M/M have the potential for replacement by the 73 M/M.

3.1.5 Mainframes/Plug-Ins

The number of M/M may increase over the 73 M/M previously determined, depending on how the TMDE procured under certain LRs are nomenclatured. For example, to satisfy LR 51 (Signal Generator Sweep C, 1 GHz to 40 GHz) a mainframe and up to six plug-ins must be procured to cover the frequency requirements. This may result in 6 M/M instead of 1 as specified by the LR. Other instruments that operate in the super high frequency (SHF) bands may be affected in a similar manner. In addition, because of the wide variety of plug-ins found in the commercial marketplace for oscilloscopes, the 4 oscilloscopes could expand to as many as 100 separate M/M.

3.1.6 Specifications and Functional Descriptions

Throughout the early life of the TMP, specifications were the source documents for stating the requirement and listing the technical characteristics of test instruments. As the TMP has progressed and centered on commercial OTS ETE as the preferred method for meeting Army TMDE requirements, it has become apparent that the word "specification" invokes images of military standards and references to numerous documents that are seldom readily available to the commercial ETE vendors. To eliminate as many future misunderstandings as possible, the name "specification" has been dropped in favor of the name "functional description." The functional description (FD) will list the technical characteristics and application limits of an OTS ETE product required to meet Army needs. It will be free of DoD document references and military symbols and will stand alone.

3.2 RESULTS OF SUBTASK 4B: ESTABLISH A TIME-PHASED PLAN FOR INTRODUCTION OF TMDE UNDER THE TMP

The requirements for TMDE for the U.S. Army in the TMP are being established by LRs, as developed by the DARCOM/TRADOC JWG. Of the 59 activity LRs, the five for FY 1981 have been approved. The remaining 54 activity LRs are in "draft" and are in various stages of the final approval process. Tables 3-2 and 3-3 list the LRs and identify the fiscal year (FY) in which procurement is planned. The Time-Phased Plan (TPP) assumes that the LRs will be approved and the equipments acquired in the FY specified. The TPP is based on the NDI acquisition strategies described in Chapter 6 of AR 70-1 and APRO 803, modified as necessary to adapt the process to the realities of the acquisition of OTS ETE products. The TPP establishes the overall role of each participating command. Individual participating commands should supplement the TPP, where necessary, to describe internal policies or procedures needed to complete their particular portions of the plan. The specific results of this subtask are reported in Sections 3.2.1 through 3.2.4.

Table 3-2. LR REQUIREMENTS FOR FISCAL YEAR 1981		
LR Number	FD Number	LR Name
08	S7	Frequency Counter A, 0 to 500 MHz
09	S8	Frequency Counter B, 10 Hz - 18 GHz
10	S9	Frequency Counter C, 300 KHz - 18 GHz
34	03	Signal Generator, HF, 50 KHz - 80 MHz
41	07	Signal Generator, SHF, 7 - 11 GHz

3.2.1 TMP/NDI Policy

The objectives of the TMP are to improve the materiel readiness of Army weapon systems, to enhance test and measurement capabilities that will increase productivity and reduce TMDE proliferation, and to reduce significantly TMDE life-cycle support costs. These objectives will be accomplished by acquiring state-of-the-art OTS ETE to replace currently fielded TMDE. The individual responsibilities and functions of the major and subordinate commands participating in the TMP are summarized as follows:

- U.S. Army Materiel Development and Readiness Command (DARCOM). DARCOM is the materiel developer; it has one vote in all In-Process Review (IPR) actions for TMDE procured under the TMP.
 - CERCOM -- Acts as DARCOM executive agent, provides necessary inputs into Required Operational Capability (ROC)/LR documents, and initiates Basis of Issue Plan (BOIP)/Qualitative and Quantitative Personnel Requirements Information (QQPRI) actions for all procurements made under the TMP.
 - U.S. Army Communications Research and Development Command (CORADCOM) -- Provides inputs on technical matters pertaining to TMDE, as required.
 - U.S. Army Central TMDE Activity (CTA) -- Performs the functions described in AR 750-43 and provides an interface for new requirements by coordinating these requirements with both the combat and materiel developers.
- U.S. Army Training and Doctrine Command (TRADOC). TRADOC is the combat developer; it has one vote in all IPR actions for TMDE procured under the TMP.
 - U.S. Army Logistics Center (LOGCEN) -- Acts as the TRADOC executive agent for all procurements made under the TMP.
 - TRADOC System Manager, Test, Measurement, and Diagnostic Systems (TSM, TMDS) -- Acts as the combat developer's proponent for

Table 3-3. LR REQUIREMENTS BY FISCAL YEAR				
Priority Sequence	LR Number	FD Number	LR Name	Previous FY Buy Year
Fiscal Year 1982				
1	18	29	Digital Multimeter, 4-1/2 Digits	1982
2	25	52	Oscilloscope, DC, 100 MHz	1982
3	43	12	Signal Generator, SHF, 2 - 18 GHz	1982
4	17	28	Digital Multimeter, 3-1/2 Digits	1982
5	38	16	Signal Generator, VHF-UHF, 450 KHz - 2.4 GHz	1982
6	48	04	Signal Generator, Pulse	1982
7	51	21	Signal Generator, Sweep, 100 KHz - 40 GHz	1982
8	47	19	Signal Generator, Function	1982
9	27	54	Oscilloscope, DC, 200 MHz	1982
10	65	81	Transmission Test Set (Telephone)	1983
Fiscal Year 1983				
1	72	40	Multifunction RF Voltmeter	1982
2	53	68	Spectrum Analyzer, 10 MHz - 40 GHz	1983
3	59	35	Teletype Test Set	1983
4	03	57	Modulation Meter	1983
5	73	41	True RMS Voltmeter and DB Meter	1983
6	75	62	Wattmeter (.0 kW), 2 MHz to 2.3 GHz	1983
7	77	63	Wattmeter (10 MW), 1 MHz - 18 GHz	1984
8	76	01	Wattmeter (500 W), 30 MHz - 50 MHz	1983
9	29	56	Oscilloscope, DC, 500 MHz	1982
10	26	53	Oscilloscope, Storage, DC, 100 MHz	1982
Fiscal Year 1984*				
	01	88	Cable Test Set	1983
	69	38	Differential Voltmeter	1983
	56	65	Spectrum Analyzer, 15 Hz - 50 KHz	1983
	54	66	Spectrum Analyzer, 4 KHz - 9.1 MHz	1983
	71	70	Frequency Selective Voltmeter	1984
	91**	64	Signal Generator, Tracking	1984
	04	73	Dial Equipment Test Set	1984
	79	74	Distortion Analyzer	1984
	12	76	Impulse Noise Test Set	1984
Fiscal Year 1985*				
	07	72	Error Rate Counter	1984
	15	56	Microwave Link Analyzer	1984
	63	94	Test Set Semiconductor	1982
	13	26	Insulation Test Set	1983
	14	27	Megohmmeter	1983
	22	31	Null Balance Earth Tester	1985
	78	98	X-Y Recorder	1983
	23	91	Oscillographic Recorder (2 Channel)	1985
	84	92	Oscillographic Recorder (8 Channel)	1982
Fiscal Year 1986*				
	11	78	Phase Jitter Meter	1984
	52	13	Signal Generator, Thermal Noise	1984
	64	82	Transmission Test Set	1984
	06	75	Envelope Delay Test Set	1985
	66	25	Universal Bridge	1985
	20	58	Noise Loading Test Set A	1984
	21	59	Noise Loading Test Set B	1985
	58	95	Stroboscope	1985
Fiscal Year 1987*				
	67	84	Vector Impedance Meter	1985
	74	56	Vector Voltmeter	1983
	82	77	Logic Analyzer	1985
	83	60	Phase Meter	1985
	81	80	Signal Generator, Color Television	1985
	45	10	Signal Generator, SHF, 18 GHz - 26.5 GHz	1985
	46	11	Signal Generator, SHF, 26.5 GHz - 40 GHz	1985
	80	79	Television Generator, Sweep and Marker	1985
*Priority sequence has not been established.				
**Purchase with LRs 71 and 54 as a system.				

all actions; i.e., prepares ROCs/LRs and BOIP, prepares user Independent Evaluation Plans (IEPs), performs user evaluations, and prepares user Independent Evaluation Reports (IERS), as all these pertain to the procurement of TMDE under the TMP.

- U.S. Army Logistics Evaluation Agency (LEA). LEA represents the logistician; it has one vote in all IPR actions for TMDE procured under the TMP.

DoD policy directs the acquisition of OTS products to meet requirements whenever mission and cost constraints permit. The NDI acquisition process provides a method for acquiring OTS ETE products. This process allows the acquisition of materiel to meet authorized requirements without expending RDT&E funds and with a compressed acquisition cycle; *it differs significantly from the process used for development items*. Several advantages of the NDI process are: reduced logistic support cost, acquisition of state-of-the-art equipment with known reliability/compatibility, improved materiel readiness, and standardization of similar equipment types. One disadvantage in procuring an NDI system is that the Government does not dictate equipment design (minor modifications excluded).

The initial phase of the NDI process is normally managed by an Army development command and transitioned to a readiness command when the decision to buy an NDI is made. By a Memorandum of Agreement between CERCOM and CORADCOM, the total management of GP TMDE has been delegated to CERCOM. Therefore, CERCOM will act as both the materiel developer and commodity readiness command for the acquisition of OTS ETE, using the NDI acquisition process to minimize the overall cost of the TMP. When the decision is made to buy an NDI system, it will be assumed that the voting members of the participating commands (DARCOM, TRADOC, and LEA) are committed to the purchase.

3.2.2 NDI Support and Testing

NDI support and testing policies and procedures are different from those used during the normal military materiel acquisition process. For example, in the area of logistics support, maximum use of available contractor support is stressed, especially during the initial fielding of the equipment. This requires an evaluation of the contractor's capabilities and limitations and the establishment of an interface between the contractor's resources and the Army's logistic support system. The Army must also determine when it is most cost-effective to transition to full military support for each OTS ETE procured. In the area of testing, a market survey, backed by the military suitability evaluation, takes the place of development and operational tests. The acceptability of the product in the commercial marketplace, reinforced by discussions with users and review of user data, is established in this way rather than by developmental and operational testing performed on NDIs. Additional testing is limited to contract compliance tests, e.g., verification of technical parameters and a military user evaluation test.

3.2.3 Definitization of Requirements

Determination of whether the technical requirements of each specific LR can be satisfied by the acquisition of OTS ETE is the responsibility of CERCOM. To meet this responsibility, CERCOM will act as the interface between the Army and the ETE industry by establishing an open-door policy for all ETE representatives. CERCOM will encourage the ETE industry to continually advise the Army on new technologies, innovations, and product lines. Particular emphasis should be placed on combining functions of several TMDE families into one instrument, simplifying operating procedures, improving reliability and maintainability, and reducing calibration requirements. Establishing a continuous dialogue with the ETE industry will assist CERCOM in evaluating the ETE state of the art. Further, it will provide a forum for the Army and the industry to discuss integrated logistic support (ILS) requirements and methods for OTS ETE and to acquaint the manufacturers with TMP/NDI policies and procedures.

To determine the applicability of OTS ETE, CERCOM will make itself familiar with user requirements as defined by the existing Army TMDE inventory and by the TMDE needs of new systems being fielded. Other sources can be used to further define TMDE requirements and the impact of ETE innovations. These include Logistics Assistance Office (LAO) reports, field visits and surveys, TMDE calibration and repair data, backlog requirements, Tables of Organization and Equipment (TOEs), and Tables of Distribution and Allowance (TDAs).

Using available data as described above, as well as data from other DoD sources, CERCOM will develop OTS ETE FDs that meet or exceed known test/measurement requirements and are representative of TMDE families found in the Army. These FDs have several purposes:

- They will serve as a reference point for determining the feasibility of meeting ROC/LR requirements and replacing existing obsolete TMDE with OTS ETE.
- They will provide a document from which TRADOC can make an initial determination as to whether available OTS ETE is suitable to meet military requirements.
- They will provide the technical information source document required to make an NDI buy decision.

Because of the rapid technological changes being experienced in the electronics industry, the FDs will be reviewed and upgraded by CERCOM and reevaluated by the intended user at least every five years.

3.2.4 Time-Phased Plan (TPP)

In the development of the TPP acquisition strategy, events, and milestones, the following assumptions were made:

- The 59 draft LRs will be approved and funded in the fiscal year indicated in Tables 3-2 and 3-3.

- OTS ETE are available that meet the technical requirements of the LRS.
- The military suitability of OTS ETE has been evaluated and determined to be adequate, pending a detailed review, i.e., a user/market survey.
- The decision to buy OTS ETE using the NDI acquisition process has been coordinated and agreed to by the TMP decision-making body.

3.2.4.1 NDI Acquisition Management Model for OTS ETE

The NDI Acquisition Management Model for OTS ETE (see Figure 3-1) depicts a recommended approach for the procurement of OTS ETE to satisfy the requirements of the TMP. The model was used to develop the TPP. Each event/milestone (E/M) of the model is discussed below (the E/M numbers are keyed to the E/M numbers on the figure). The time period for each event is shown as the maximum time allowed for completion. In most cases the time period can be compressed if adequate resources are available and properly managed. Where applicable, the reference documents are cited and the principal responsible command(s) noted. As the model is refined, several of the documents cited or portions thereof may be eliminated. *Chapter 6 of AR 70-1 and APRO 803 should be used in conjunction with this discussion of the ETE NDI model.*

From the time of approval of the LR to the time the equipment is fielded, approximately 30 months is required. This time period can probably be further compressed once the rhythm of the TMP is established and some program experience is accumulated.

E/M-1: LR Preparation and Approval

In E/M-1, the LR is prepared and approved. The BOIP (tentative) and provisional QOPRI documents are prepared and approved prior to final approval of the LR. In addition, an initial FD describing the item to be acquired is prepared. Responsibility: combat and materiel developers.* Reference: Chapter 6 of AR 70-1 and ARs 71-2, 71-5, 71-9, and 611-1.

E/M-2: Initial User/Market Survey

A user/market survey is conducted, using the data contained in the LR and the FD, to determine the availability of commercial test equipment to satisfy the requirements stated in the two documents. Efforts are directed toward identifying at least five potential suppliers and determining the degree of competition that could be expected in response to a solicitation. The need to relax or tighten the technical characteristics described in the two documents are also identified and appropriate action initiated. Responsibility: materiel developer in coordination with the combat developer.

*Combat and materiel developers are TSM and TMDS, and CERCOM, respectively.

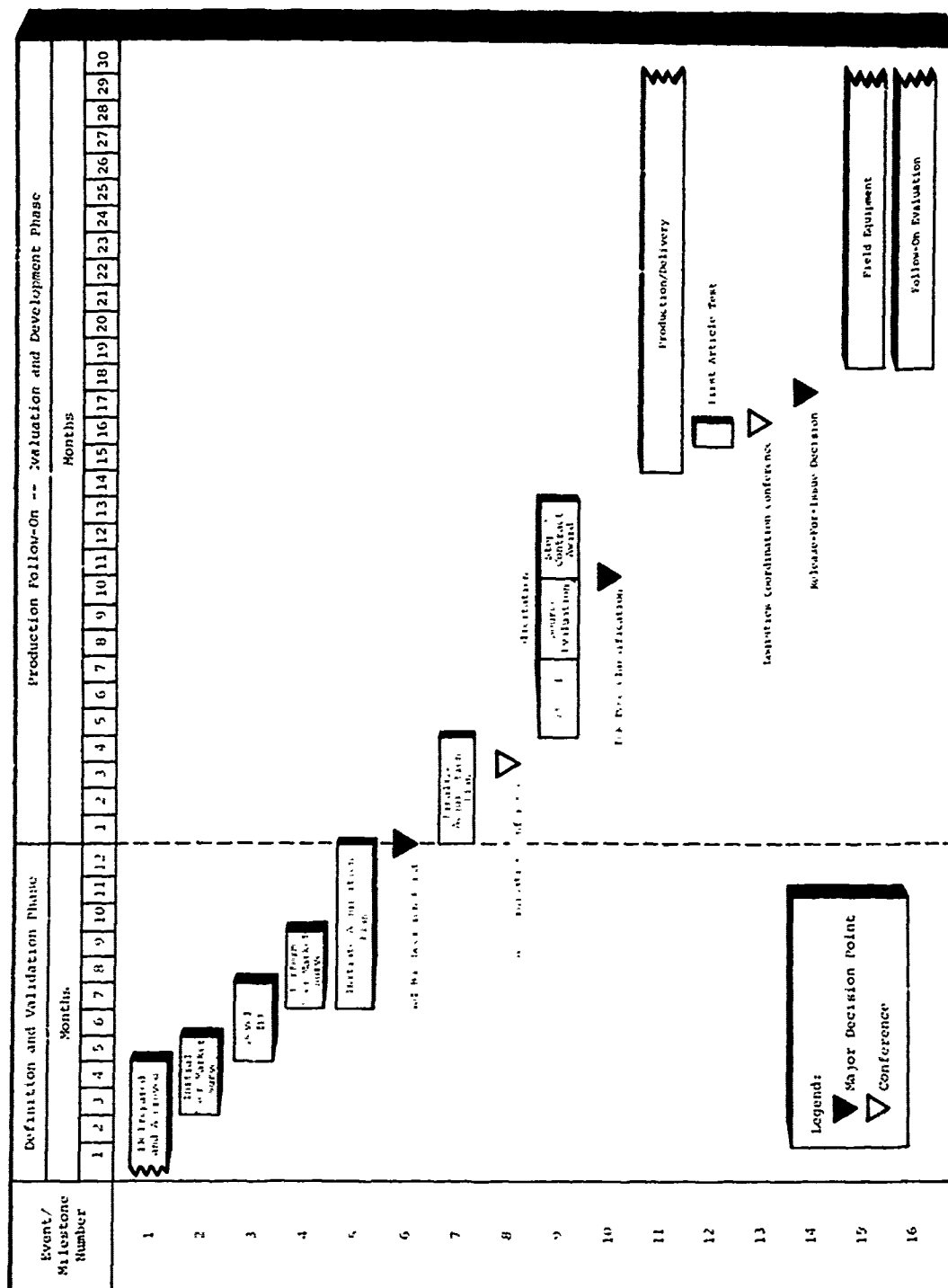


Figure 3-1. NDI Acquisition Management Model for OTS ETE

E/M-3: Independent Evaluation Plan (IEP)

The IEP identifies all issues that must be resolved in order to validate the military suitability of an instrument acquired by the NDI acquisition process. In addition to the issues or questions raised in the IEP, potential sources of information and the activities required to address and answer each issue will be identified. Responsibility: materiel developer in coordination with the combat developer. Reference: ARs 70-10 and 71-3.

E/M-4: User/Market Survey

The user/market survey is conducted to address issues identified in the IEP to determine the military suitability of available OTS ETE. At the conclusion of the survey an Independent Evaluation Report (IER) is prepared to document the results. The IER will, as required, establish evaluation criteria to be used in the solicitation and contract award. For example, an issue that cannot be resolved will be incorporated as a requirement into the solicitation as part of the technical data package.

The user/market survey will also provide data to finalize the FD. This may include the addition of technical characteristics to the FD to enhance test capabilities or to reduce logistic support cost by combining TMDE families into one FD. The FD is validated when at least one vendor's product can meet the stated requirements. To promote competition, it may be necessary to relax the constraints of the LR. At this point in the NDI acquisition process for OTS ETE, it is necessary to have complete agreement between the combat and materiel developers as to the requirements stated in the FD. Responsibility: combat and materiel developers.

E/M-5: Acquisition Plan (AP) Preparation

The AP includes all documentation required to type-classify an item "Standard A" in which the documents are identified and activities are initiated to complete them. In addition, those TMDE which are listed by M/M in the LR as being replaced are reviewed and validated, and a replacement sequence determined. The replacement sequence should be based first on replacing older TMDE and then those TMDE which require the greatest expenditure of O&M dollars to maintain. This is desirable since the acquisition cycle may extend more than two to five years, or adequate funds may not be available for a total replacement for each TMDE family. Finally, the acquisition strategy is formulated on the basis of the results of the user/market survey. Responsibility: materiel developer. Reference: ARs 70-27 and 700-127, DARCOM Supplement 1 to AR 700-127, and AMCP 750-16.

E/M-6: NDI Buy Decision Point

All events leading to E/M-6 will have been accomplished to convince the combat and materiel developers and LEA that the acquisition of an NDI will satisfy the requirements of the LR. The decision to proceed with the acquisition of an OTS ETE must carry a commitment from all members of the decision-making body, i.e., DARCOM, LEA, and TRADOC. Minor modifications

to the OTS ETE that may be required to meet LR requirements are permissible, provided that the modifications do not compromise the reliability or maintainability of the instrument. Responsibility: combat and materiel developers and LEA.

E/M-7: Acquisition Plan (AP)

The AP includes the preparation of all the documents required to acquire, type-classify, and provide logistic support to the item that will be procured. This includes, at a minimum, the following:

- Procurement Plan and Strategy (DAR 1-2102)
- Materiel Fielding Plan (DARCOM Suppl 1 to AR 700-127)
- Plan for Logistic Support (DARCOM Suppl 1 to AR 700-127)
- Logistic Support Analysis (AR 700-127)
- QQPRI (AR 611-1)
- BOIP (AR 71-2)
- IEP (ARs 70-10 and 71-3)
- Functional description of item to be procured
- Follow-on evaluation plan/methodology
- Request to Purchase TMDE and CTA Approval (AR 750-43)
- Training support plan

Included in the AP is an agreement between the combat and materiel developers and LEA on specific contract acceptance tests that will be conducted and on the warranty provisions required. Responsibility: materiel developer, with data inputs as required from other participating commands. Reference: AR 70-27.

E/M-8: Acquisition Plan Coordination Conference

The objective of E/M-8 is to review the AP and to ensure including, on schedule, the data required to successfully complete the type-classification process at the upcoming IPR. Responsibility: materiel developer in coordination with the combat developer and LEA.

E/M-9: Solicitation and Contract Award

E/M-9* is divided into step 1 - solicitation and source evaluation, and step 2 - contract award.

*The acquisition strategy may vary for each TMDE family, e.g., bid sample, sole source, instead of the two-step process described in E/M-9.

- Step 1 - Solicitation. The solicitation package consists of the following:
 - Functional description
 - Quantity and required delivery schedule, quantity options
 - A commercial clause, with proof required (to ensure that the Army procures a proven product)
 - Bid evaluation method, e.g., product suitability, LCC, contractor support, warranty
 - ILS requirements - vendor capability/support plan
 - Request for product history and names, locations, and telephone numbers of customers (with emphasis on military customers)
 - Configuration control requirements
 - Other contractual information, as required
- Source Evaluation. The source evaluation consists of an independent evaluation of each vendor's response by both the combat and materiel developers. The materiel developer will initially identify those vendor's bids which are technically and logistically acceptable. For products that are acceptable, the combat developer will determine the military compatibility and suitability of each offerer's product. The combat and materiel developers will jointly evaluate each vendor's support plan and product history (to include interviewing known customers of the product). Every effort should be made to obtain from existing customers the product statistical data on the products offered. An LCC analysis will be performed on those products found acceptable by both the materiel and combat developers to identify those products with the lowest cost of ownership to the Government. (See ARINC Research Publication 1078-02-1-1730 for suggested LCC procurement approach for OTS ETE.)
- Step 2 - Contract Award. On the basis of the various vendor's responses, the bid evaluation discussed above, and subsequent negotiations, the contract will be awarded. Responsibility: materiel and combat developers.

E/M-10: Type-Classification IPR

E/M-10 is the second major decision point and milestone in the NDI acquisition process for OTS ETE. The objective of the type-classification IPR is to document the acceptability and suitability of an OTS ETE to meet specified test or measurement requirements and to ensure its supportability. The type classification is based on the data contained in the AP and not on a specific vendor's OTS ETE. Responsibility: combat and materiel developers and LEA. Reference: AR 71-6.

E/M-11: Production and Delivery

During E/M-11 the product is produced and delivered to the Government as specified in the contract. Responsibility: materiel developer.

E/M-12: First-Article Test

The first-article testing takes place at the contractor's facility and is used to verify compliance with the terms of the contract. Specific emphasis is placed on quality assurance, configuration control, and the vendor's logistic support plan. Responsibility: materiel developer.

E/M-13: Logistics Coordination Conference

All logistic support activities and plans are reviewed to determine whether the equipment is ready to be fielded. In addition, the MFP is put in final form for distribution to the commands receiving the equipment. Responsibility: materiel developer.

E/M-14: Release-for-Issue Decision

The release-for-issue decision is the last major decision to be made in the OTS ETE acquisition process. It is made when the program manager is completely satisfied that the materiel to be fielded meets the technical requirements and is supportable in the field. Responsibility: materiel developer in coordination with the combat developer. Reference: DARCOM-R 700-34.

E/M-15: Field Equipment

In E/M-15 the equipment is issued in accordance with applicable documents and procedures. Responsibility: materiel developer.

E/M-16: Follow-On Evaluation

The objectives of the follow-on evaluation is to determine whether logistic support provided for the item is adequate and to monitor the performance of the equipment. The combat developer will evaluate the logistic support system developed for the item and inform the materiel developer of changes required for resolution. The materiel developer, through the LAOs and the U.S. Army Metrology and Calibration Center (USAMCC) and in coordination with the combat developer, will monitor the performance of the equipment in the field. These data will assist in structuring future solicitations for the TMP using the NDI acquisition process. Responsibility: combat and materiel developers.

3.2.4.2 TPP by Fiscal Year

The TPP by fiscal year (1981 to 1987) was developed on the basis of the OTS ETE NDI Acquisition Management Model discussed in Subsection 3.2.4.1 and the LR requirements shown in Tables 3-2 and 3-3. The LRs within a given fiscal year were divided into four groups to spread the acquisition process over the four quarters of the fiscal year. The LRs are not listed in priority sequence and are therefore subject to rearrangement in accordance with priorities to be established and subject to funding. The TPPs for FY 1981

to FY 1987 are illustrated in Figures 3-2 through 3-8, respectively. The E/M number in the left-hand margin of each figure is related to the corresponding E/M number in Figure 3-1, as discussed in Subsection 3.2.4.1.

The figures are oriented to the "FY Buy Year," i.e., the fiscal year in which the Army is planning to buy the product specified in the LR. The plan for any given fiscal year requires approximately 18 quarters (54 months, or 4.5 years) to complete.

3.2.4.3 TPP Overview (OTS ETE NDI Acquisition Process)

By use of the data depicted in Figures 3-2 through 3-8, a TPP overview (Figure 3-9) was developed for the first five fiscal years currently planned for the TMP. The overview is oriented toward the "FY Buy Year" and is divided into four parts representing the four quarters in a fiscal year.

3.2.5 Implementation of the TPP

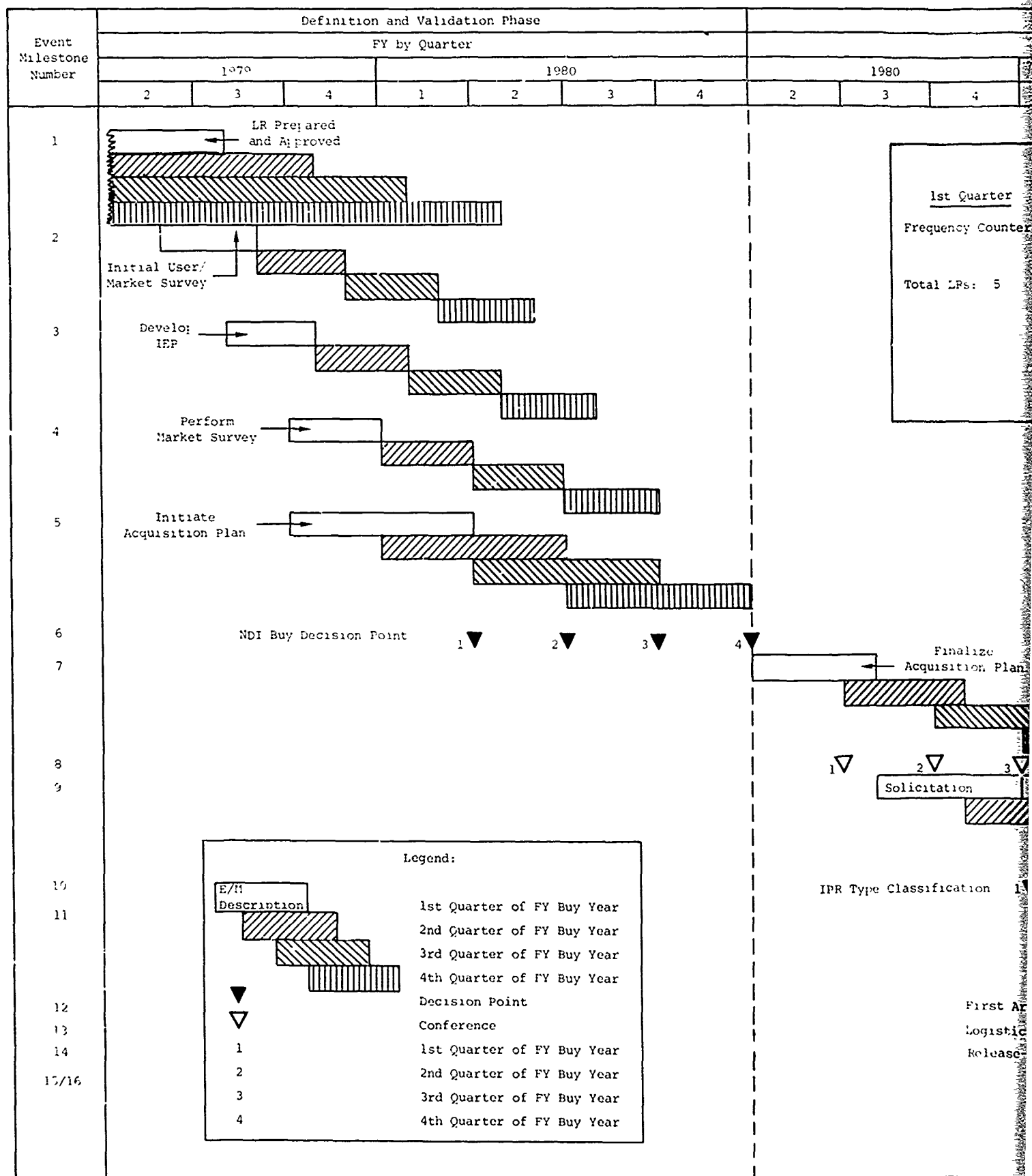
In accordance with the NDI Acquisition Management Model for OTS ETE, the acquisition process begins when the LR is in the final stages of approval. The LR triggers a chain of E/M that must be accomplished for each acquisition. The period depicted in the model for each event is an approximation; it can probably be reduced as experience is acquired in completing prescribed activities. In addition, a management chart that establishes dates for completing specific E/M can be developed for each LR to be satisfied. This will enable the program manager to monitor the progress for each acquisition and to position resources to overcome bottlenecks or delays.

It is too late to apply the NDI acquisition process to those procurements occurring in FY 1981. However, specific activities associated with those procurements (e.g., validating replacement requirements, E/M-5) can and should be implemented immediately. For those procurements planned for FY 1982 and FY 1983, those events described in the Definition and Validation Phase of the model should also be implemented immediately. Particular emphasis is required on the preparation or upgrading and validation of an OTS ETE FD for each applicable LR, the validation of replacement requirements, and the identification and preparation of those documents required for the Acquisition Plan. Sufficient resources must be allocated for these purposes if the TMP is to be successfully implemented.

3.3 RESULTS OF SUBTASK 4C: EVALUATE THE IMPACT OF NOT DELIVERING MODERNIZED TMDE ON SCHEDULE

3.3.1 Cost and Replacement Data

Cost and replacement data were not available for all 59 LRs. Data that were available for the LRs in FY 1981 and for 26 other LRs are shown in Tables 3-4 and 3-5, respectively. Table 3-4 presents the "investment cost" and "potential cost savings" for FY 1981. These data are currently being refined prior to contract award. Table 3-5 contains the most complete



Production Follow-On -- Evaluation and Development Phase

FY by Quarter

1980		1981				1982		1983	
3	4	1	2	3	4	1	2	3	4

FY Buy Year 1981: LR Requirements by FY Quarter

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Frequency Counter A	Frequency Counter B Frequency Counter C	Signal Generator B	Signal Generator I
Total LRs: 5			

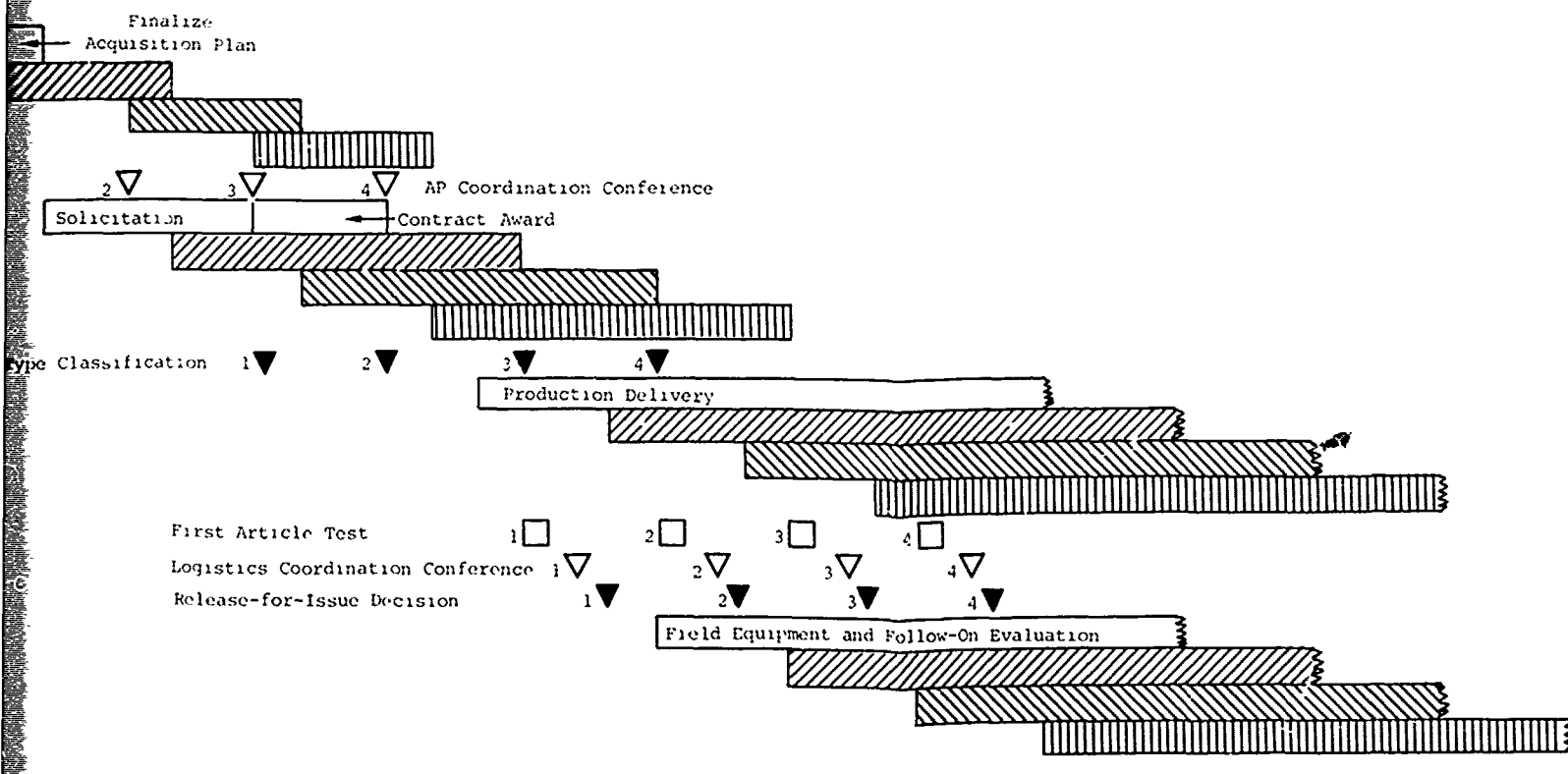
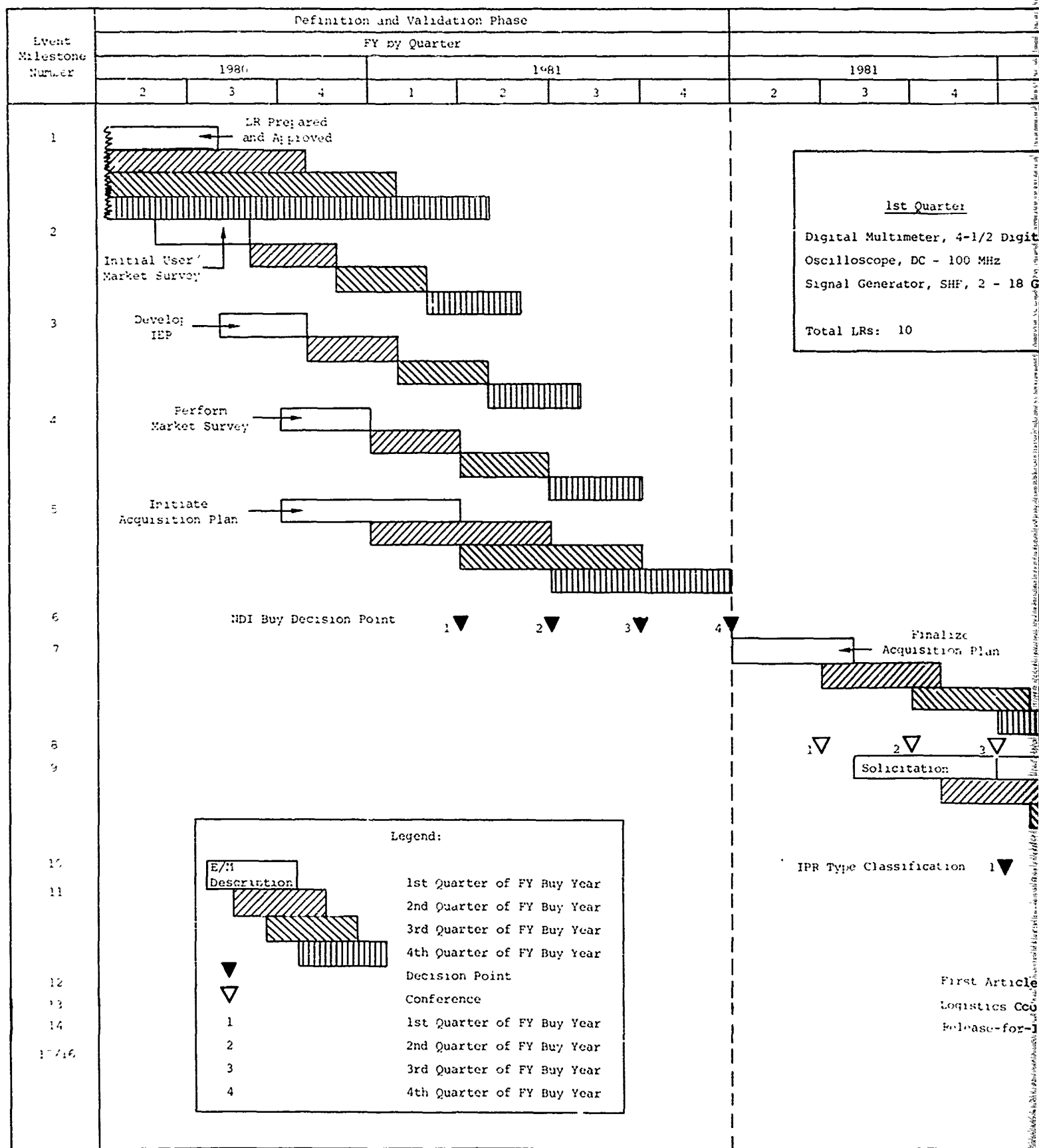


Figure 3-2. TIME-PHASED PLAN FOR FISCAL YEAR 1981



Production Follow-On -- Evaluation and Development Phase

FY by Quarter

1981		1982				1983				1984	
3	4	1	2	3	4	1	2	3	4	1	2

FY Buy Year 1982: LR Requirements By FY Quarter

1st Quarter

2nd Quarter

3rd Quarter

4th Quarter

Digital Multimeter, 4-1/2 Digits
Oscilloscope, DC - 100 MHz
Signal Generator, SHF, 2 - 18 GHz

Digital Multimeter, 3-1/2 Digits
Signal Generator, VHF-UHF,
450 KHz - 2.4 GHz
Signal Generator, Pulse

Signal Generator, Sweep,
100 KHz - 40 GHz
Signal Generator, Function

Oscilloscope, DC - 200 MHz
Transmission Test Set
(Telephone)

1 LRs: 10

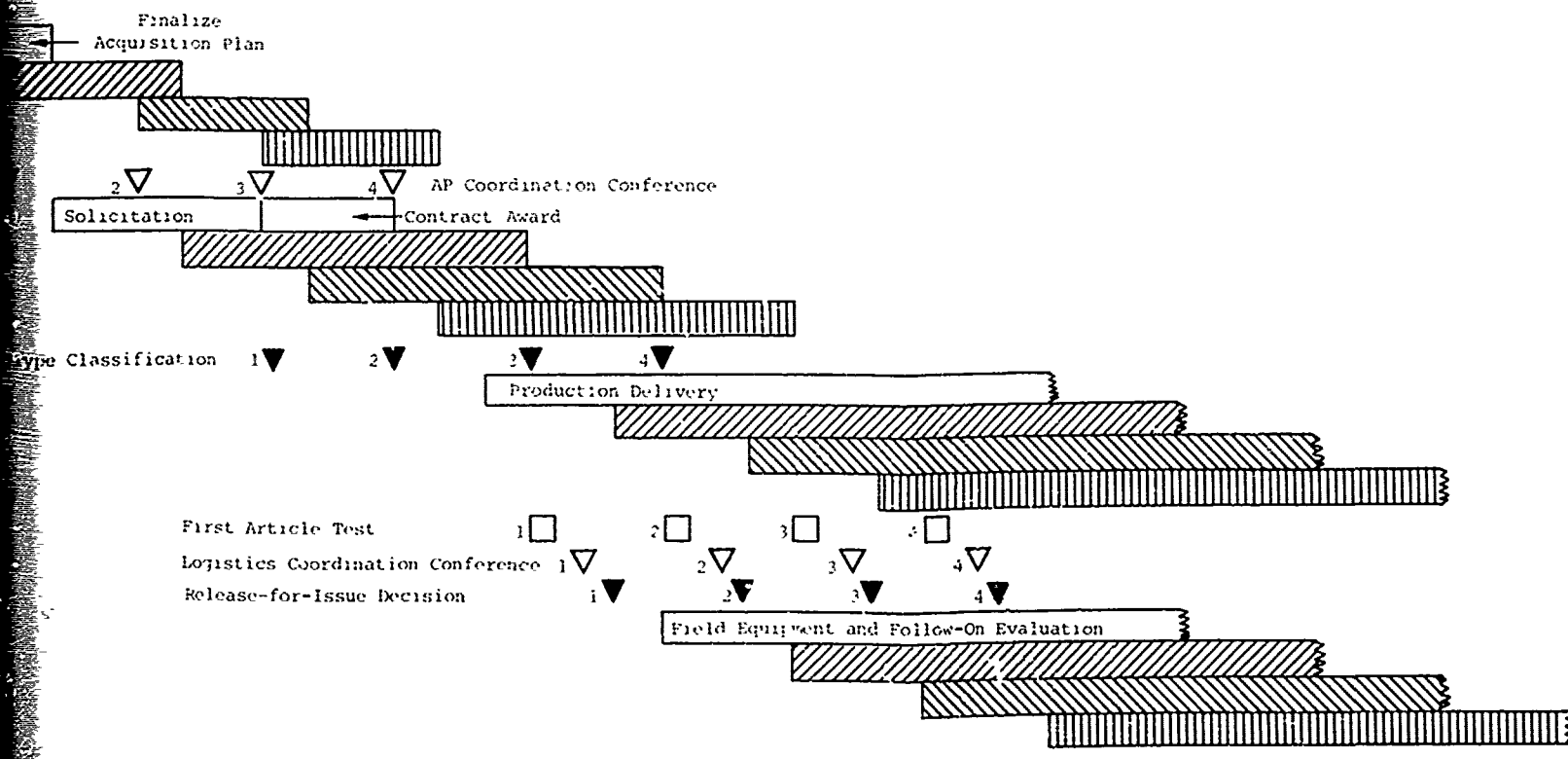
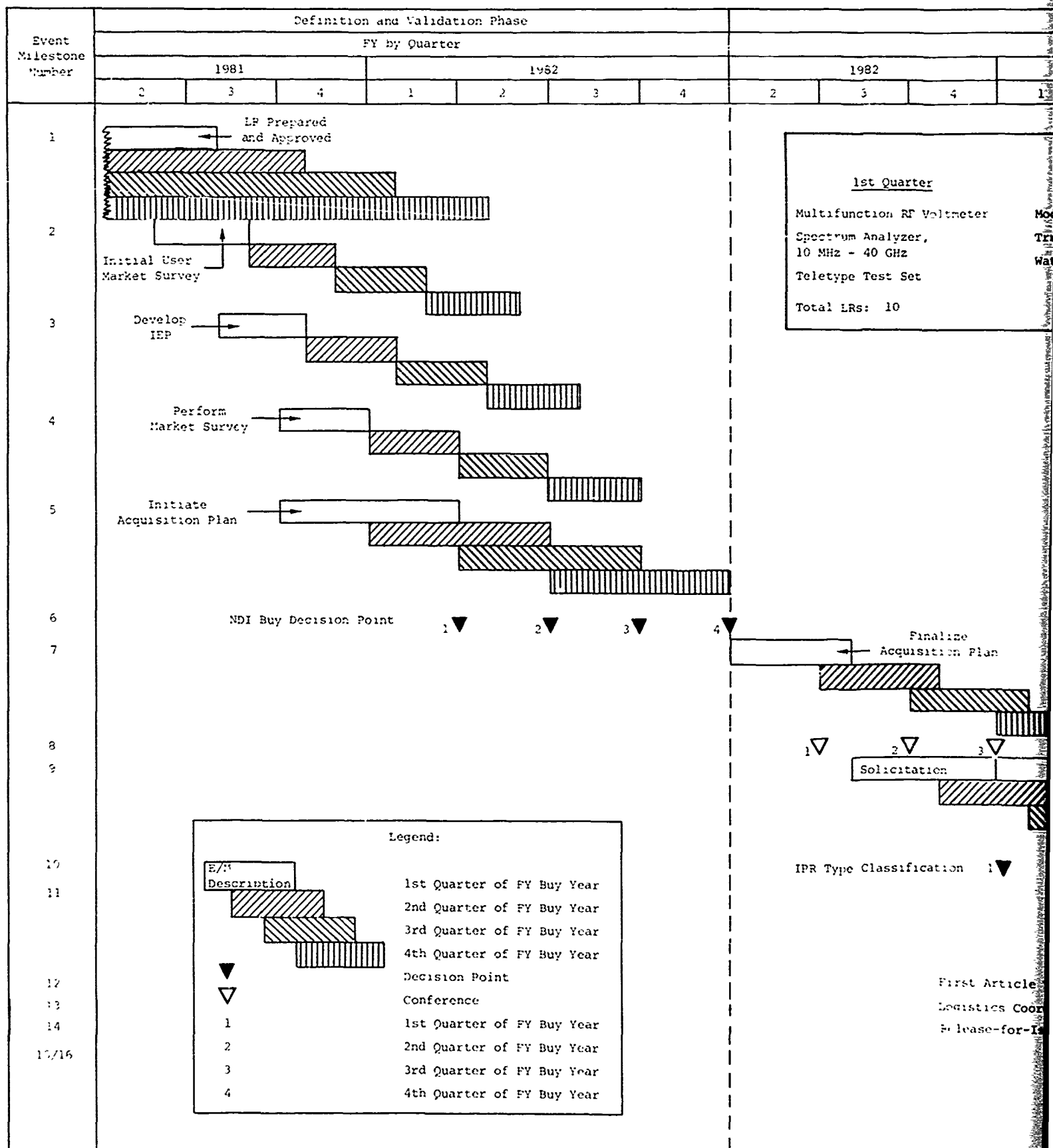


Figure 3-3. TIME-PHASED PLAN FOR FISCAL YEAR 1982



Production Follow-On -- Evaluation and Development Phase

FY by Quarter

1982		1983				1984				1985	
3	4	1	2	3	4	1	2	3	4	1	2

FY Buy Year 1983: LR Requirements by FY Quarter

1st Quarter

2nd Quarter

3rd Quarter

4th Quarter

Function RF Voltmeter

Modulation Meter

Wattmeter (10 mW), 1 MHz - 18 GHz

Oscilloscope, DC - 500 MHz

Spectrum Analyzer,
12 - 40 GHz

True RMS Voltmeter and DB Meter

Wattmeter (500 W), 30 MHz - 50 MHz

Oscilloscope, Storage,
DC - 100 MHz

Type Test Set

Wattmeter (10 kW), 2 MHz - 2.3 GHz

LRs: 10

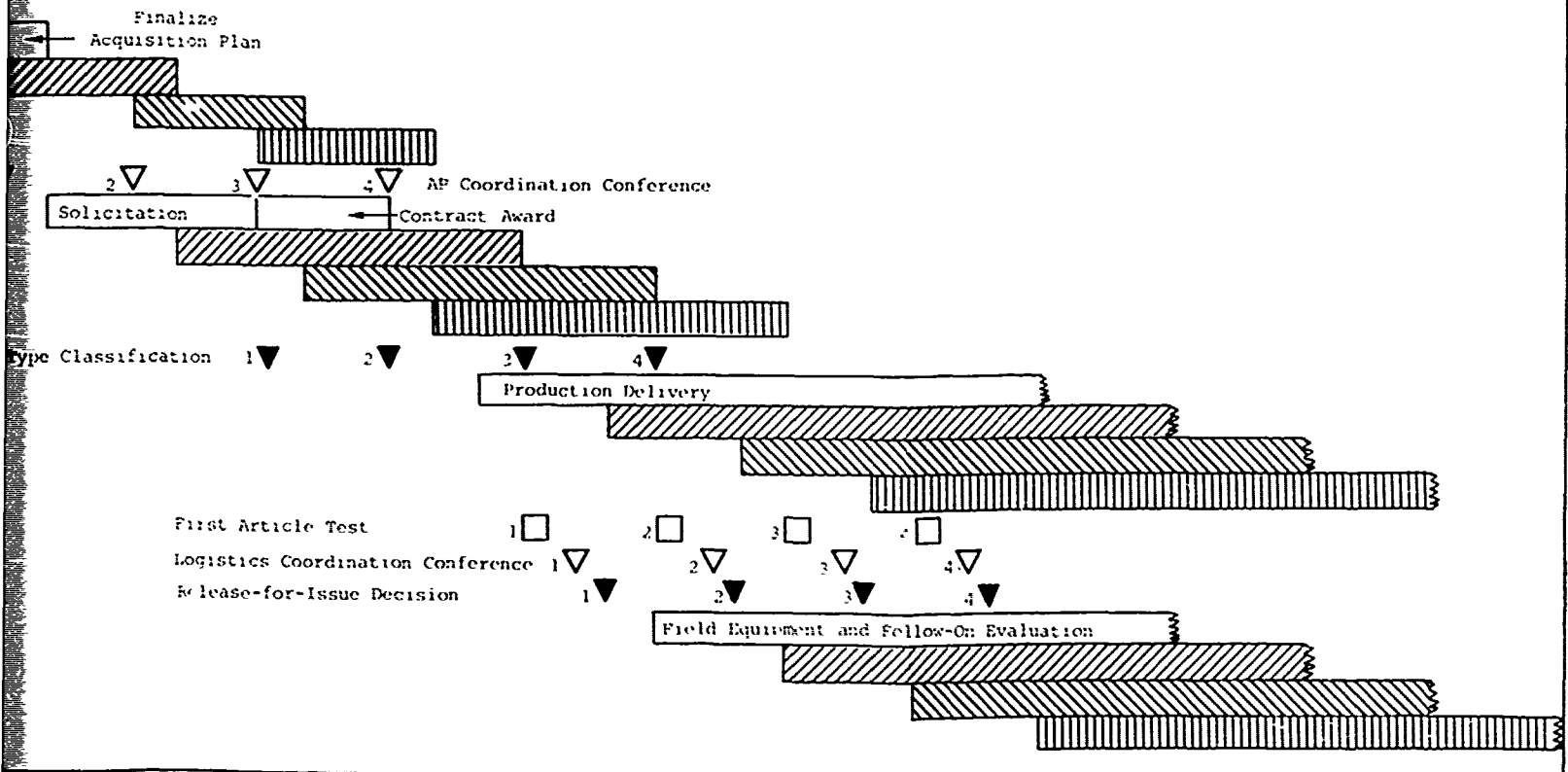
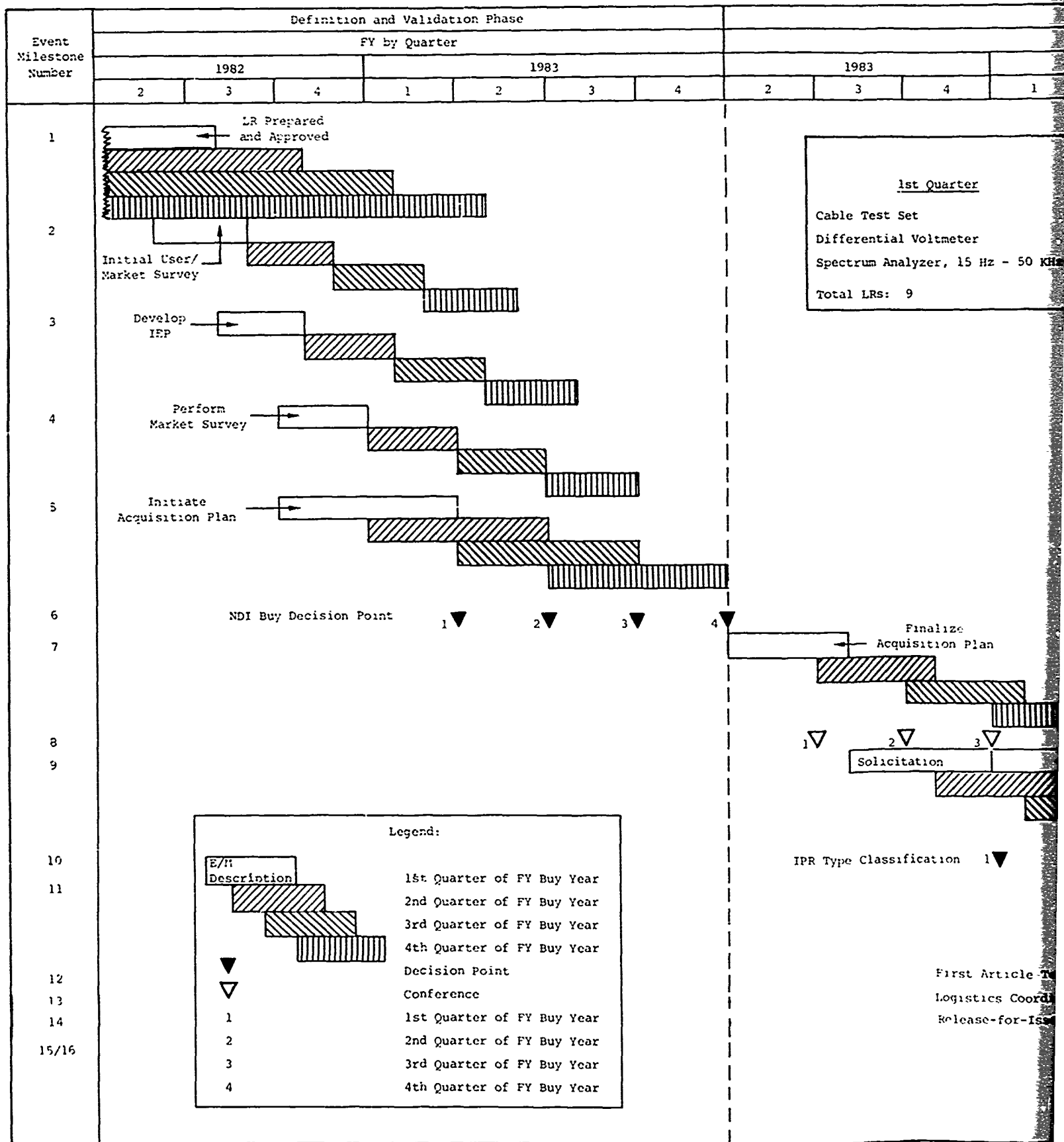


Figure 3-4. TIME-PHASED PLAN FOR FISCAL YEAR 1983



Production Follow-On -- Evaluation and Development Phase

FY by Quarter

1983		1984				1985				1986	
3	4	1	2	3	4	1	2	3	4	1	2

FY Buy Year 1984: LR Requirements by FY Quarter

1st Quarter

2nd Quarter

3rd Quarter

4th Quarter

Cable Test Set

Spectrum Analyzer, 4 KHz - 9.1 MHz

Dial Equipment Test Set

Impulse Noise Test Set

Differential Voltmeter

Frequency Selective Voltmeter

Distortion Analyzer

Spectrum Analyzer, 15 Hz - 50 KHz

Signal Generator, Tracking

Total LRs: 9

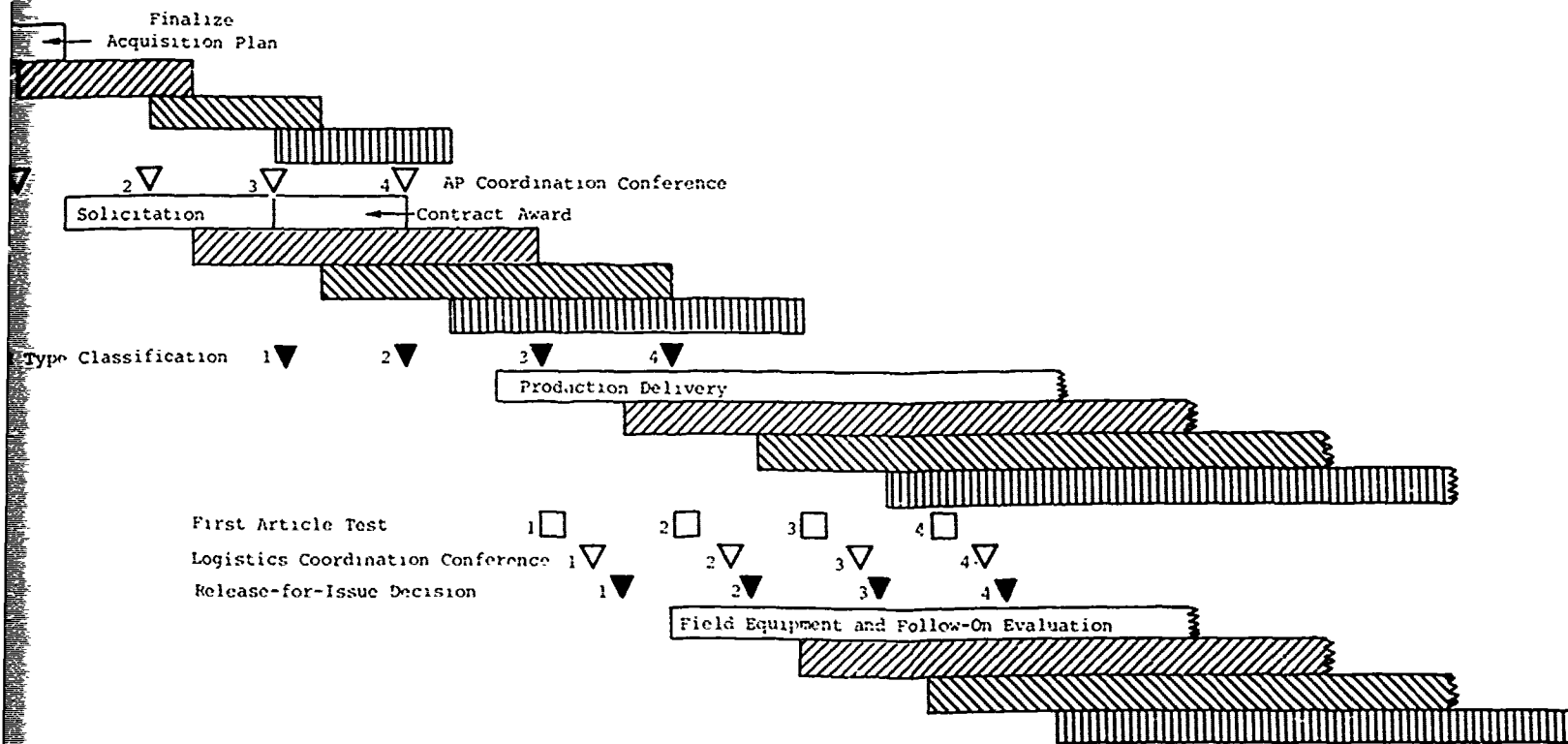
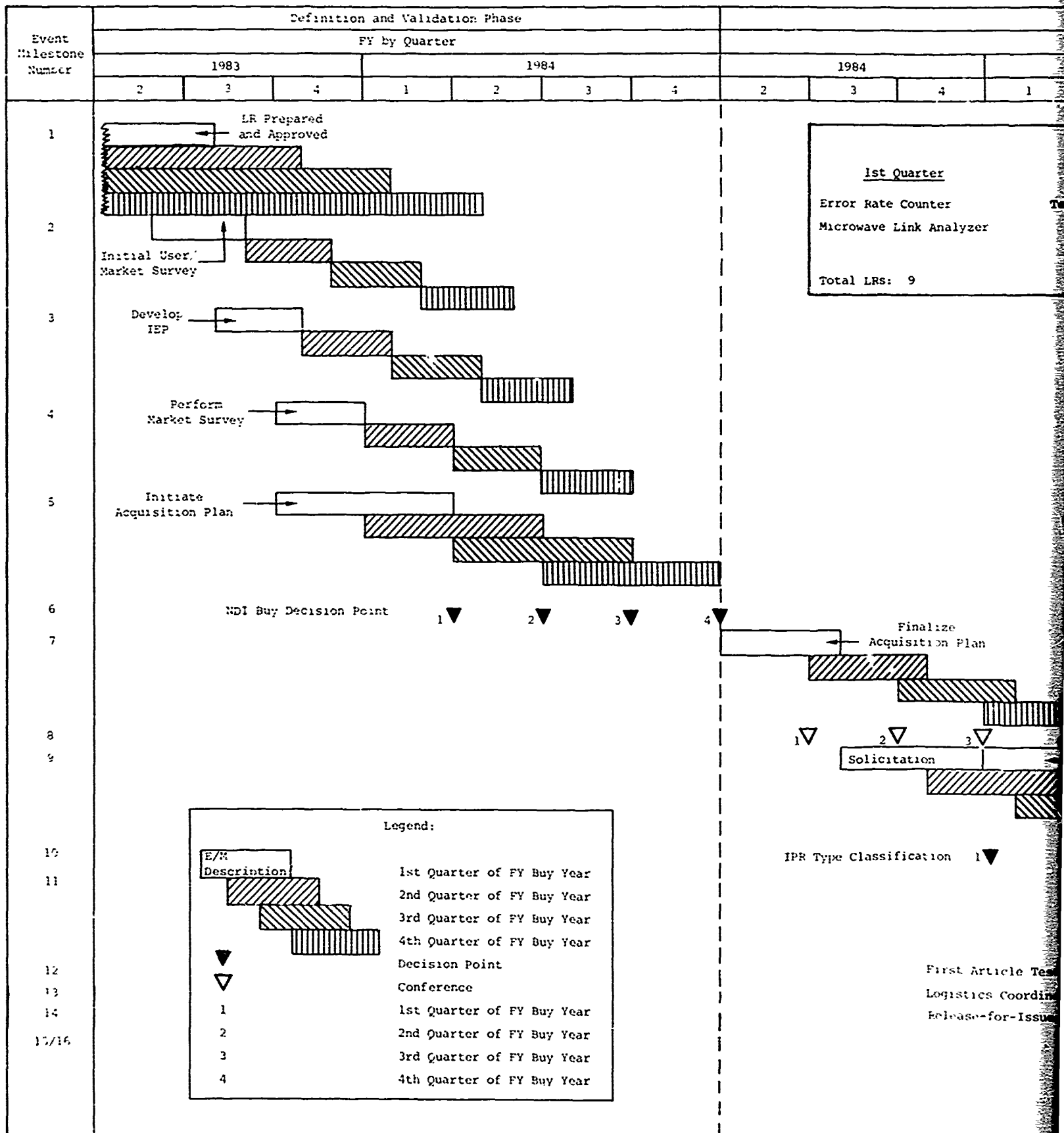


Figure 3-5. TIME-PHASED PLAN FOR FISCAL YEAR 1984



Production Follow-On -- Evaluation and Development Phase											
FY by Quarter											
1984		1985				1986				1987	
3	4	1	2	3	4	1	2	3	4	1	2

FY Buy Year 1985: LR Requirements by FY Quarter			
<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
Error Rate Counter	Test Set Semiconductor	Insulation Test Set	X-Y Recorder
Microwave Link Analyzer		Megohmmeter	Oscillographic Recorder (2 Channel)
		Null Balance Earth Tester	Oscillographic Recorder (8 Channel)
Total LRs: 9			

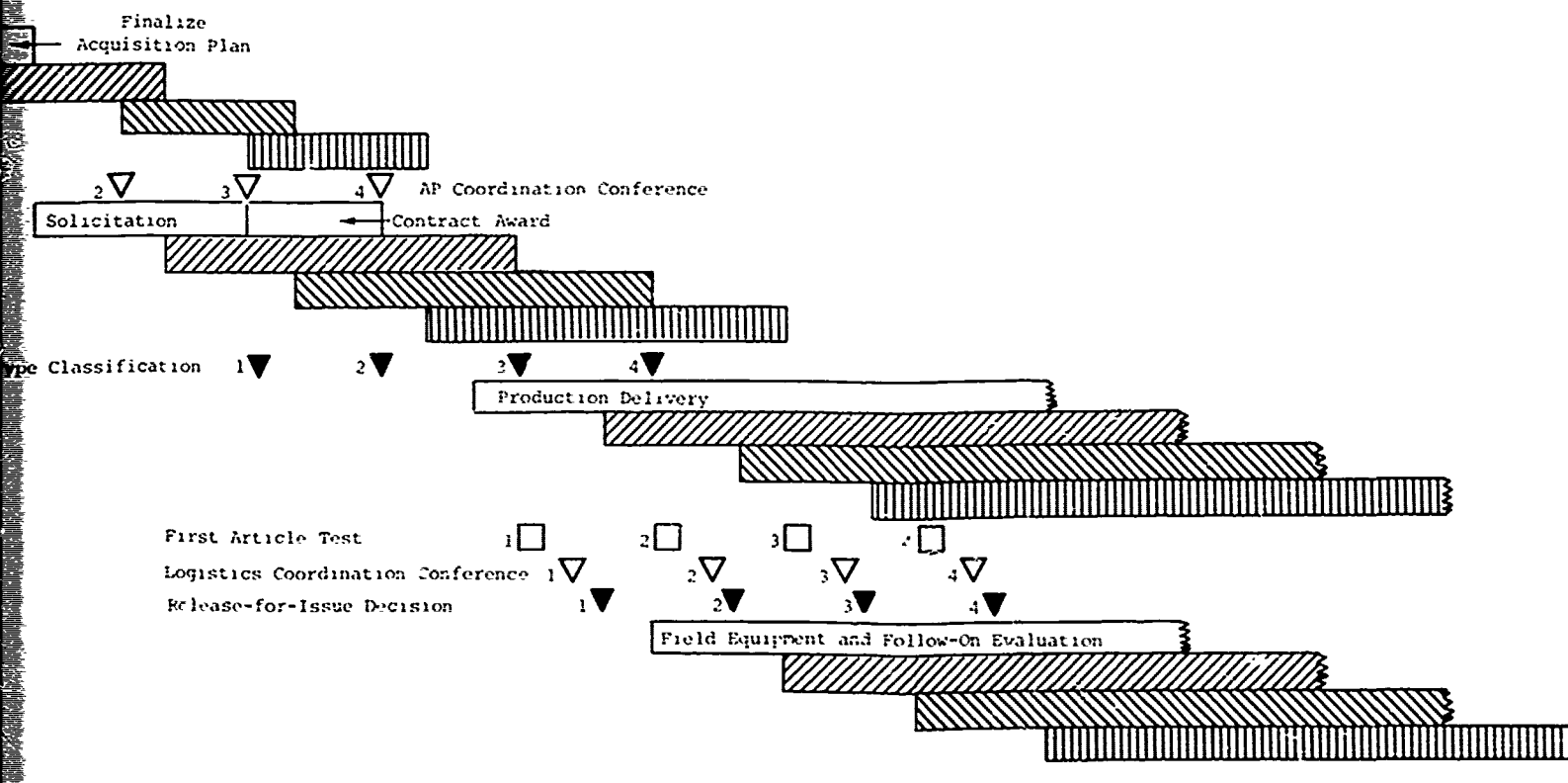
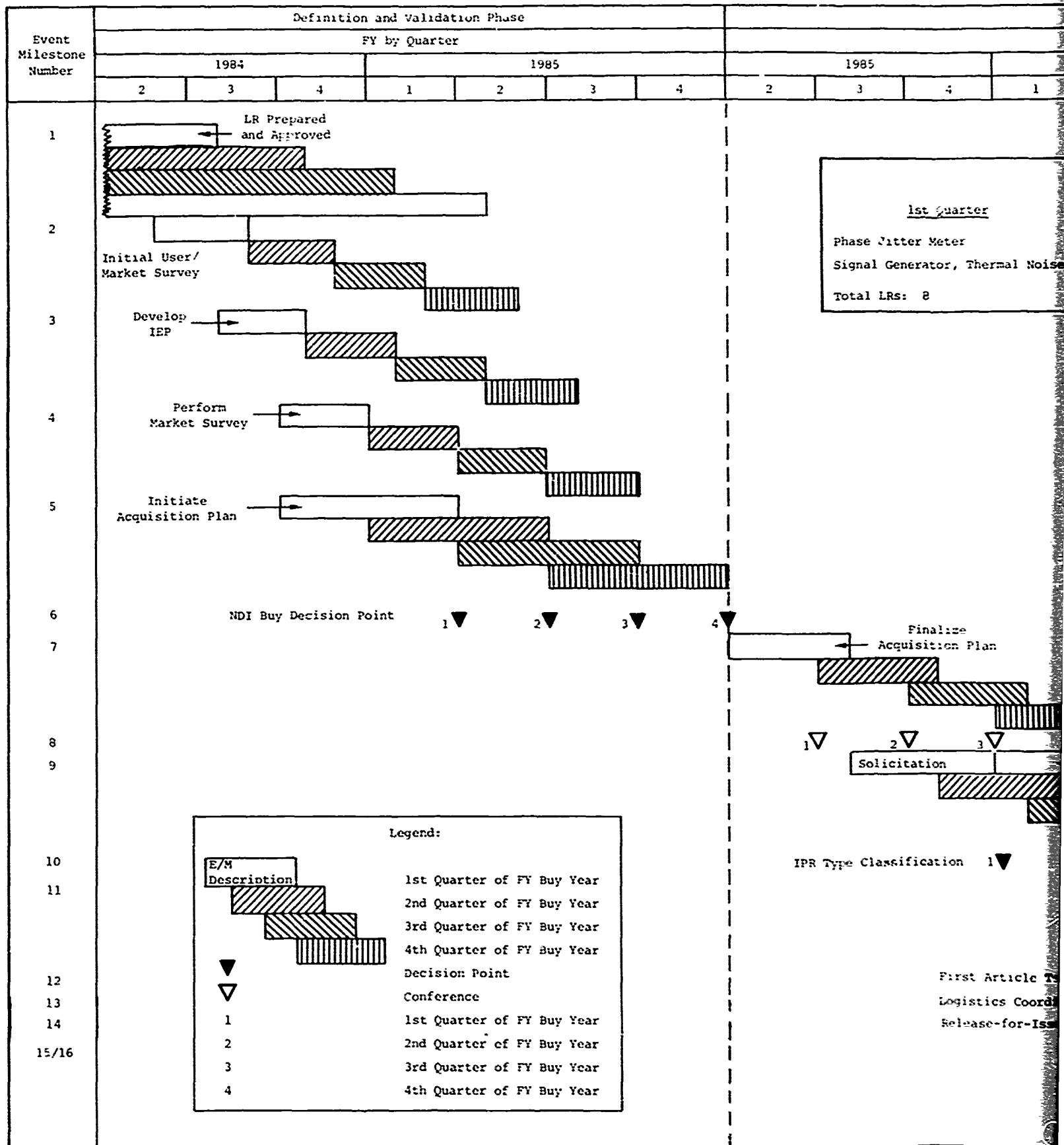


Figure 3-6. TIME-PHASED PLAN FOR FISCAL YEAR 1985



Production Follow-On -- Evaluation and Development Phase											
FY by quarter											
1985		1986				1987				1988	
3	4	1	2	3	4	1	2	3	4	1	2
FY Buy Year 1986: LR Requirements by FY Quarter											
<u>1st Quarter</u>			<u>2nd Quarter</u>			<u>3rd Quarter</u>			<u>4th Quarter</u>		
Phase Jitter Meter			Transmission Test Set			Universal Bridge			Noise Loading Test Set A		
Signal Generator, Thermal Noise			Envelope Delay Test Set			Stroboscope			Noise Loading Test Set B		
Total LRs: 8											

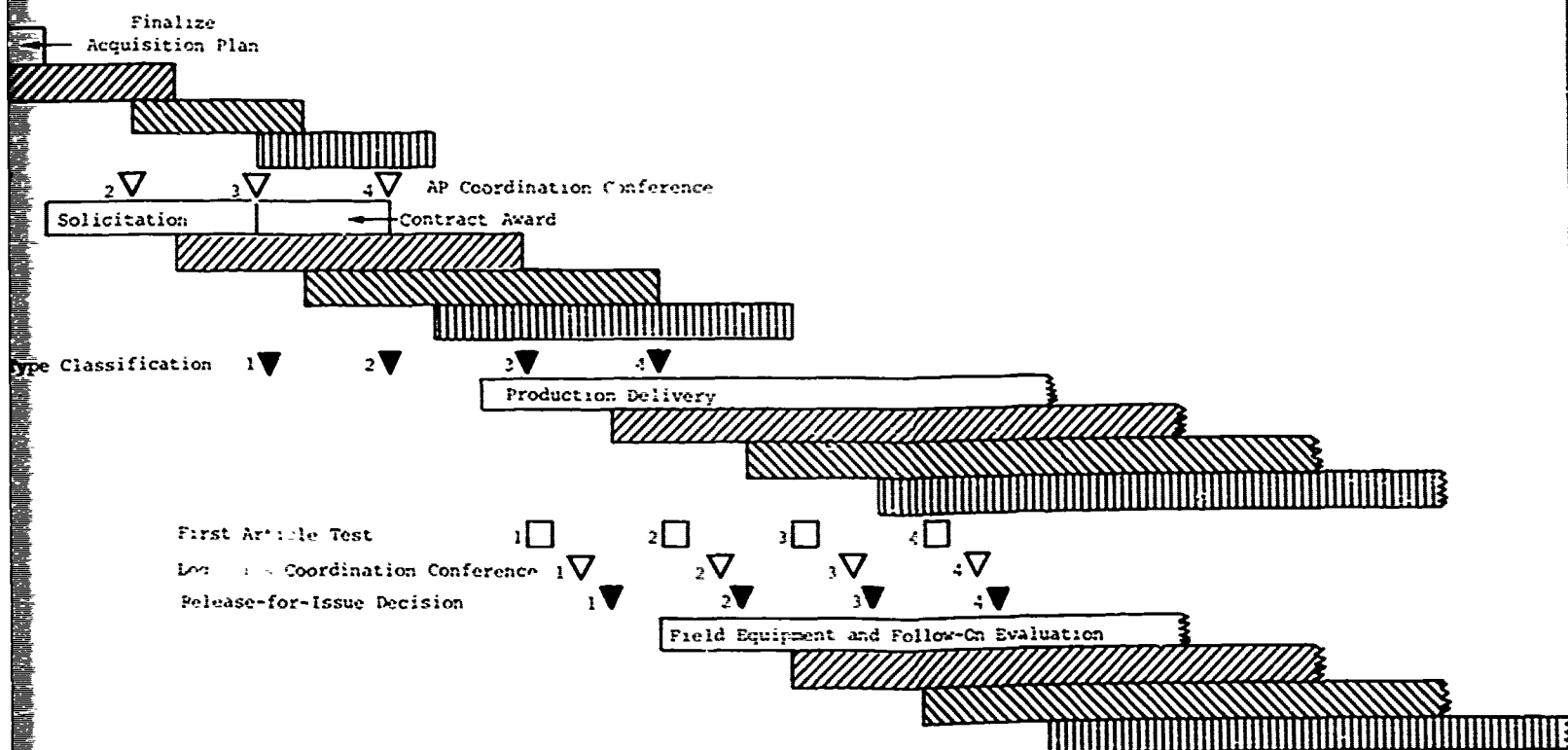
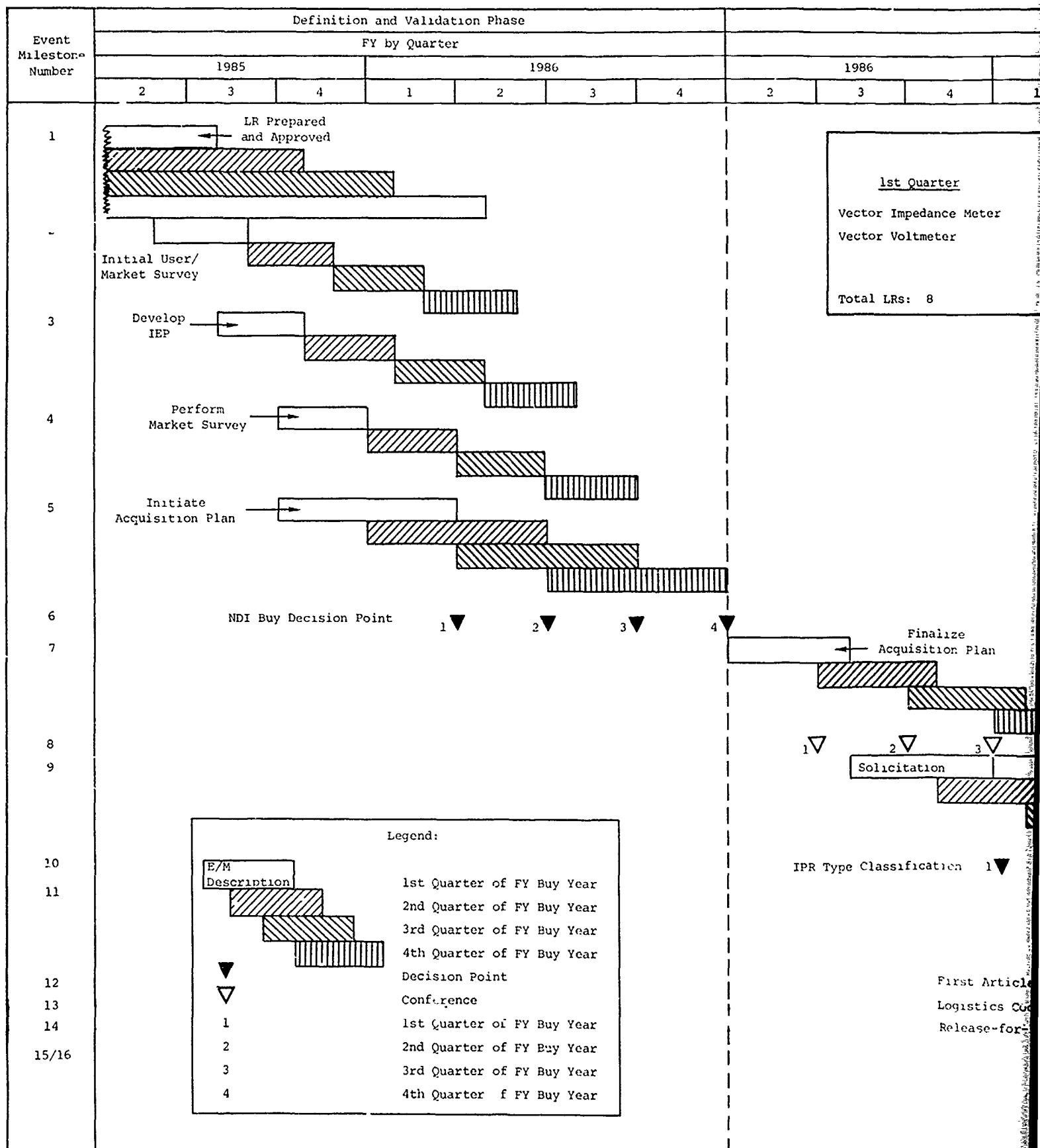


Figure 3-7. TIME-PHASED PLAN FOR FISCAL YEAR 1986



Production Follow-On -- Evaluation and Development Phase											
FY by Quarter											
1986		1987				1988				1989	
3	4	1	2	3	4	1	2	3	4	1	2

FY Buy Year 1987: LR Requirements by FY Quarter			
<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
Vector Impedance Meter	Logic Analyzer	Signal Generator,	Signal Generator, SHF,
Vector Voltmeter	Phase Meter	Color Television	18 - 26.5 GHz
		Television Generator,	Signal Generator, SHF,
		Sweep and Marker	26.5 - 40 GHz
Total LRs: 8			

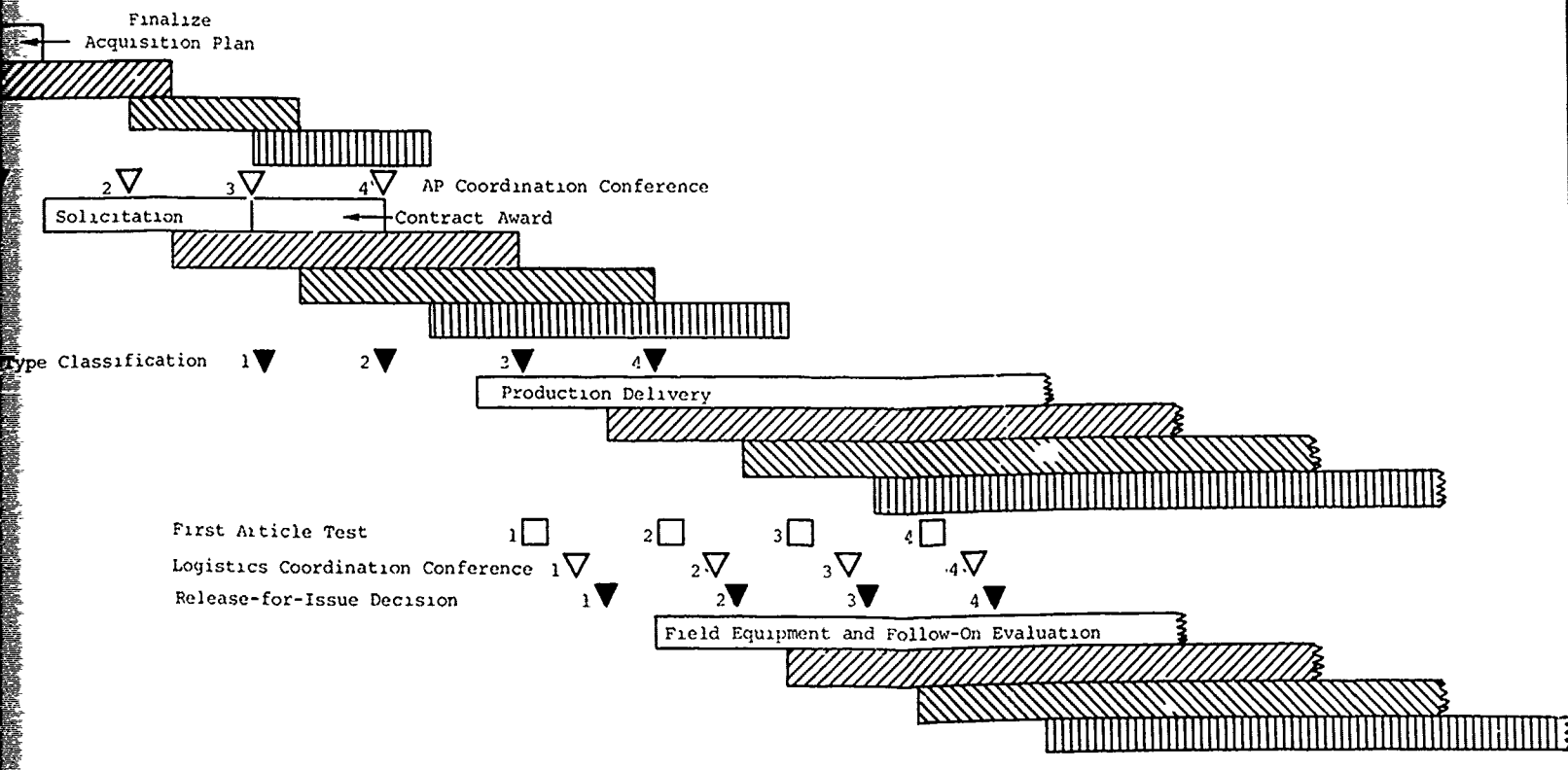


Figure 3-8. TIME-PHASED PLAN FOR FISCAL YEAR 1987

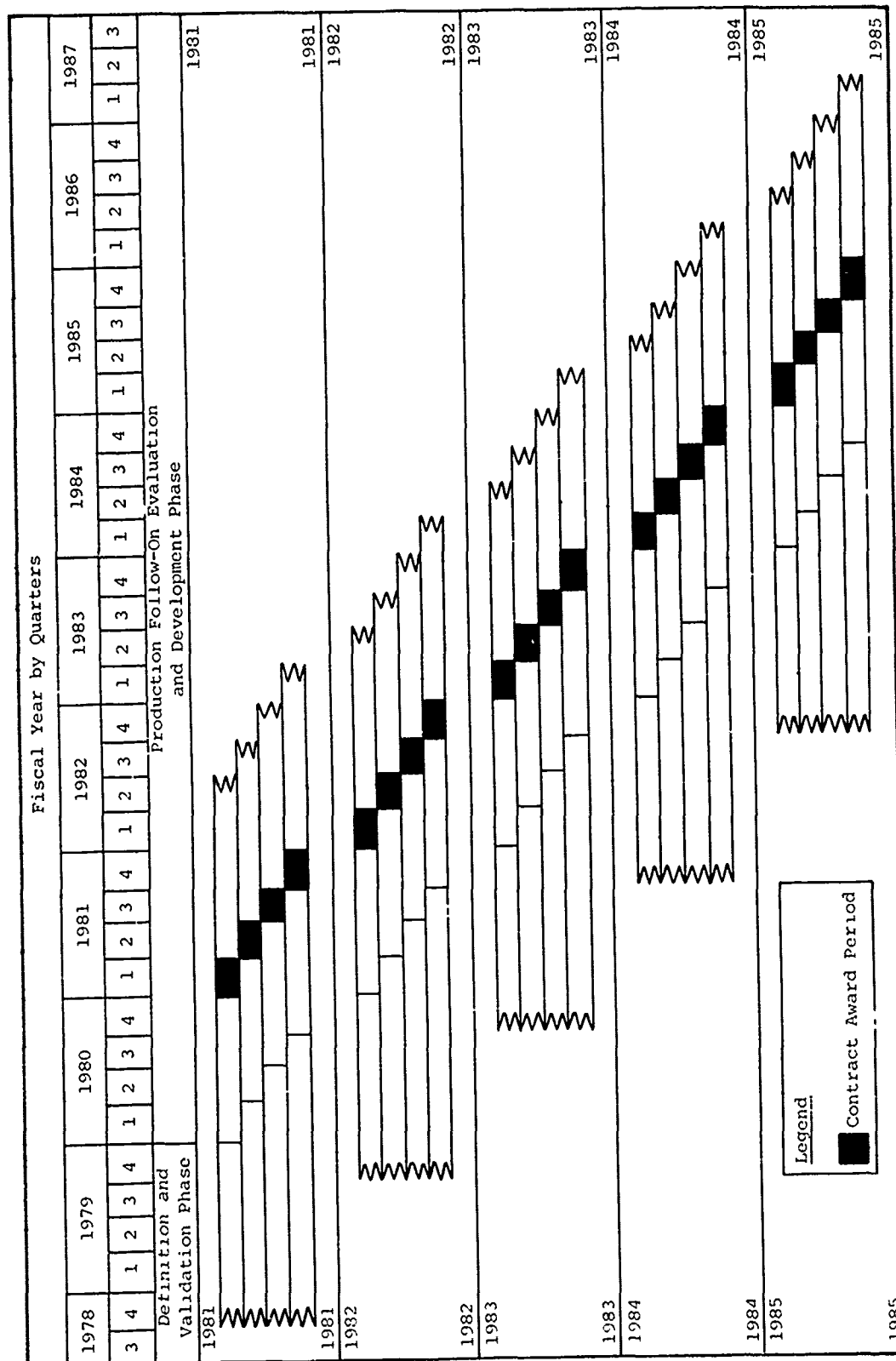


Figure 3-9. OVERVIEW OF TIME-PHASED PLAN (TPP) (OTS ETE NDI ACQUISITION PROCESS)

Table 3-4. COST AND REPLACEMENT DATA FOR FISCAL YEAR 1981					
Draft LR Name	Number of M/M Replaced by LR	Investment Cost	20-Year Cost to Retain Inventory	20-Year Cost of Preferred Item	Potential Cost Savings (+ or -)
Frequency Counter A 0 - 500 MHz	8	\$ 4,332,858	\$29,801,904	\$12,179,760	\$17,622,144
Frequency Counter B 10 Hz - 18 GHz	5	10,099,892	New Item	--	New Item
Frequency Counter C 300 kHz - 18 GHz w/RF Pulse	0	4,779,941	New Item	--	New Item
Signal Generator B 50 kHz - 80 MHz	Unknown	1,682,100	Unknown	--	Unknown
Signal Generator I 7.0 - 11.0 GHz	4	1,038,200	3,404,338	2,474,746	929,592

data, including 20-year investment, operation and support, and total cost data. The TMDE life-cycle-cost model used to develop the cost data in Table 3-5 is described in Appendix C.

In FY 1981 two of the five items of ETE are new to the inventory and consequently would not yield any cost savings. Because of the limited number of items to be purchased and the fact that two-fifths of the items are new, it was decided to exclude the FY 1981 data from the overall projection. As a result, it was considered appropriate and necessary to treat the cost data in Table 3-5 as a baseline from which to project the cost and potential savings for the TMP from FY 1982 through FY 1987. (Note: All cost data are reflected in inflated dollars based on the "Inflation Indices" provided by CERCOM.) This initial projection resulted in an average (mean) cost and a median cost within each of the cost categories per LR, which is presented in Table 3-6.

In December 1980 the DARCOM/TRADOC JWG structured the 59 activity LRs into the TMP, as shown in Tables 3-2 and 3-3. These data and the data in Tables 3-5 and 3-6 were used to develop the cost requirements for a fully funded TMP based on the baseline means cost* data. (Using the baseline median cost data would result in lower overall projected costs and savings.) These cost requirements are shown in Table 3-7, which lists the actual funds required in a given fiscal year and the funded and unfunded elements of the current CERCOM TMP budget line. As shown in Table 3-8, these data were further extrapolated to demonstrate the impact of a fully funded TMP (100 percent), a partially funded TMP (50 percent), and a nonfunded TMP (0 percent). Table 3-8 lists the expected savings the Army could realize over a 20-year period by the procurement of the preferred TMDE and the corresponding cost, to the Army, if the current TMDE inventory is retained or only partially replaced. It is estimated that the total investment cost for a

*Mean cost data were used to develop the projected cost of the TMP, because that data corresponded more closely to the cost experiences gained as a result of the FY 1981 TMP acquisitions.

Table 3-5. TMP COST AND REPLACEMENT DATA

Table 3-5. TMP COST AND REPLACEMENT DATA								
LR Number and Functional Description Number	TMDE Family Code	Draft LR Name	20-Year Cost					
			Investment Cost					Fielded TMDE Total
			Preferred TMDE by Fiscal Year					
			1982	1989	1996	Total		
LR16	032	Electronic Analog Multimeter	3.42	5.20	7.87	16.49	29.58	
LR17*28	032	Digital Multimeter, 3-1/2 Digits (A)	4.38	6.66	10.07	21.11	22.45	
LR18*29	032	Digital Multimeter, 4-1/2 Digits (B)	0.88	1.33	2.02	4.23	6.41	
LR70	078	Digital Multimeter	3.51	5.34	8.08	16.93	18.64	
LR72*40	079	Multifunction RF Voltmeter	2.73	4.18	6.37	13.28	4.61	
LR23*91	036	Oscillographic Recorder (2 Channels)	1.78	2.73	4.16	8.67	2.06	
LR24*S1	089	Oscilloscope, DC - 15 MHz (A)	3.59	5.50	8.38	17.47	41.55	
LR25*S2	091	Oscilloscope, DC - 100 MHz (B)	23.44	35.90	54.70	114.04	131.41	
LR26*S3	094	Oscilloscope, Storage, DC - 100 MHz (C)	1.08	1.66	2.52	5.26	4.53	
LR27*S4	090	Oscilloscope, DC - 200 MHz (D)	1.87	2.87	4.37	9.11	9.59	
LR28*S5	080	Oscilloscope, DC - 400 MHz (E)	1.13	1.73	2.64	5.50	1.60	
LR29*S6	085	Oscilloscope, DC - 500 MHz (F)	2.08	3.18	4.84	10.10	8.03	
LR47*19	081	Signal Generator, Function	0.91	1.38	2.09	4.38	4.04	
LR33*01	006	Signal Generator, Low Frequency, Audio Oscillator (A)	7.20	10.95	16.58	34.73	13.74	
LR48*04	050	Signal Generator, Pulse	1.04	1.59	2.40	5.03	12.11	
LR39*05	053	Signal Generator, SHF, 1.8 - 4 GHz (G)	2.34	3.58	5.46	11.38	18.80	
LR40*06	053	Signal Generator, SHF, 3.8 - 7 GHz (H)	4.21	6.40	9.69	20.30	8.91	
LR42*08	053	Signal Generator, SHF, 10 - 15 GHz (J)	0.18	0.28	0.42	0.88	0.10	
LR43*12	053	Signal Generator, SHF, 2 - 18 GHz (K)	0.99	1.51	2.29	4.79	0.89	
LR49*20	052	Signal Generator, Sweep, 100 KHz - 110 MHz (A)	0.69	1.05	1.60	3.34	2.90	
LR50*22	109	Signal Generator, Sweep, 10 MHz - 1 GHz (B)	2.07	3.16	4.82	10.05	3.42	
LR51*21	049	Signal Generator, Sweep, 1 - 40 GHz (C)	7.61	11.66	17.76	37.03	6.91	
LR35*18	106	Signal Generator, VHF, 450 KHz - 512 MHz (C)	7.21	10.97	16.60	34.78	31.74	
LR37*15	107	Signal Generator, UHF, 500 MHz - 1.2 GHz (E)	0.60	0.93	1.41	2.94	4.44	
LR38*16	107	Signal Generator, UHF, 800 MHz - 2.4 GHz (F)	5.75	8.75	13.24	27.74	8.79	
LR63*93	045	Test Set, Semiconductor	1.52	2.33	3.56	7.41	8.09	
Total			92.21	140.82	213.94	446.97	405.34	

COST AND REPLACEMENT DATA FOR FISCAL YEAR 1982

20-Year Cost Data (In Millions of Dollars, Inflated)

Investment Cost				Operation and Support Cost			Total Cost			Replacement Data			
	Total	Fielded TMDE Total	Cost Difference (+/-)	Preferred TMDE	Fielded TMDE	Cost Difference (+/-)	Preferred TMDE	Fielded TMDE	Cost Difference (+/-)	Number of M/M Replaced			Density of M/M Used in EA
										TCRL	LR	EA	
	16.49	29.58	13.09	23.93	247.44	223.51	40.42	277.02	236.60	0	6	6	44,155
	21.11	22.45	1.34	21.11	94.60	73.49	42.22	117.05	74.83	57	19	14	15,608
	4.23	6.41	2.18	4.00	6.41	2.41	8.23	12.82	4.59	127	9	9	1,592
	16.93	18.64	1.71	8.97	22.06	13.09	25.90	40.70	14.80	--	7	--	--
	13.28	4.61	-8.67	8.28	33.60	25.32	21.56	38.21	16.65	12	5	8	784
	8.67	2.06	-6.61	5.92	28.42	22.50	14.59	30.48	15.89	11	12	8	244
	17.47	41.55	24.08	13.39	162.38	148.99	30.86	203.93	173.07	122	63	17	2,632
	114.04	131.41	17.37	32.93	335.30	302.37	146.97	466.71	319.74	80	43	18	6,679
	5.26	4.53	-0.73	9.09	49.57	40.48	14.35	54.10	39.75	8	7	7	114
	9.11	9.59	0.48	11.21	40.09	28.88	20.32	49.68	29.36	12	6	5	289
	5.50	1.60	-3.90	9.58	28.18	18.60	15.08	29.78	14.70	10	5	4	43
	10.10	8.03	-2.07	10.56	37.35	26.79	20.66	45.38	24.72	19	5	5	111
	4.38	4.04	-0.34	6.25	46.6	40.31	10.63	50.60	39.97	36	15	13	601
	34.73	13.74	-20.99	19.95	85.91	65.96	54.68	99.65	44.97	59	42	15	7,472
	5.03	12.11	7.08	7.43	41.34	33.91	12.46	53.45	40.99	34	16	10	893
	11.38	18.80	7.42	7.57	19.56	11.99	18.95	38.36	19.41	5	3	3	265
	20.30	8.91	-11.39	8.37	18.02	9.65	28.67	26.93	-1.74	6	6	4	457
	0.88	0.10	-0.78	4.48	3.97	-0.51	5.36	4.07	-1.29	1	1	1	1
	4.79	0.89	-3.90	5.22	4.25	-0.97	10.01	5.14	-4.87	6	5	1	21
	3.34	2.90	-0.44	5.34	15.57	10.23	8.68	18.47	9.79	11	6	4	101
	10.05	3.42	-6.63	6.68	18.96	12.28	16.73	22.38	5.65	10	6	5	162
	37.03	6.91	-30.12	10.56	67.27	56.71	47.59	74.18	26.59	39	11	19	281
	34.78	31.74	-3.04	17.31	76.16	58.85	52.09	107.90	55.81	51	24	16	2,872
	2.94	4.44	1.50	5.54	10.36	4.82	8.48	14.80	6.32	--	1	1	14
	27.74	8.79	-18.95	9.82	33.34	23.52	37.56	42.13	4.57	13	8	7	791
	7.41	8.09	0.68	3.60	24.60	21.00	11.01	32.69	21.68	24	15	11	2,682
	446.97	405.34	-41.63	277.09	1551.27	1274.18	724.06	1956.61	1232.55	753	346	211	88,864

Table 3-6. BASELINE COST DATA BY LR (\$ MILLIONS)		
Cost Category*	Mean Cost per LR	Median Cost per LR
Investment Cost**	3.55	2.08
20-Year Life Savings**	47.41	20.55
20-Year Cost to Retain Army Inventory**	75.25	41.42
*See Appendix C. **Investment Cost: Estimated funds required to procure the preferred TMDE and to meet ILS requirements. 20-Year Life Savings: Estimated savings expected from procuring and maintaining preferred TMDE as opposed to retaining current Army inventory TMDE. 20-Year Cost to Retain Army Inventory: Estimated cost to retain current Army inventory TMDE.		

Table 3-7. ESTIMATED TMP FUNDING REQUIREMENTS (\$ MILLIONS)								
Fund Status	Fiscal Year							Total
	1981	1982	1983	1984	1985	1986	1987	
Actual Funds Required	22.80	65.30	26.99	25.79	23.04	26.85	28.40	219.18
CERCOM Budget								
Funded	22.80	15.00	19.50	17.90	17.40	18.30	19.40	130.30
Unfunded	--	17.73	12.23	14.83	15.33	14.43	13.33	88.88
Total	22.80	32.73	32.73	32.73	32.73	32.73	32.73	219.18

fully funded TMP over a 20-year period would yield a 3:1 return on investment. Further, while a partially funded TMP (50 percent) would result in a saving of \$1,398.60 million, there would still be a cost requirement of \$2,219.99 million to maintain those inventory TMDE which could not be replaced. As shown in Table 3-7, the TMP unfunded requirements are estimated at \$88.88 million, which is more than 45 percent of the total funding requirements for the FY 1982 through FY 1987 portions of the TMP.

Table 3-8. ESTIMATED COST AND SAVINGS (\$ MILLIONS)			
Cost Category	TMP Funding Levels		
	Fully Funded (100 Percent)	Partially Funded (50 Percent)	Unfunded (0 Percent)
20-Year Life Savings	2,797.20	1,398.60	0
20-Year Cost to Retain Army Inventory	0	2,219.88	4,439.75

From a review of the data presented, it can be determined that modernized TMDE will not be available to the Army in the field, in accordance with the planned schedule, unless programmed funds are significantly increased. At present, an estimated shortfall of approximately \$88.68 million exists between the actual funds required and the programmed funds.

ARINC Research Corporation believes that the actual funding requirements for the first seven-year cycle of the TMP will be approximately \$200 to \$225 million. TMP cost requirements will continue to rise or fall as additional cost and replacement data are developed, or existing data refined, and as new LRs are added. It is important to continue developing cost data for all of the activity LRs in order to define the cost and context of the TMP.

3.3.2 Other Factors

From the discussion of Section 3.3.1 and from a purely economic standpoint, the choice of the appropriate course of action is a clear one, i.e., to fully fund the TMP. The choice is even clearer when other factors are considered. It has been recognized in numerous documents that the present inventory of TMDE is inadequate to support current and future weapon systems. These new systems require advanced state-of-the-art technology that does not exist in most of the fielded TMDE inventory; i.e., Standard A TMDE are for the most part technically obsolete. In addition to this technical inadequacy, the TMDE problem is further compounded by inherent obsolescence, which has created the need for more frequent repairs and increased difficulty in accomplishing these repairs due to lack of spare parts. Many repair parts are difficult to find and procure, because in most cases the manufacturers are no longer producing the ETE. Logistic support, in terms of maintenance, spare parts, and calibration, requires budgetary resources far exceeding the limits of cost-effective operations. This condition is slowly being documented by the LCC economic analyses for each LR.

In a recent report, published in January 1980 by the Radio Technical Commission for Aeronautics (RTCA), a distinguished panel of experts in the ETE field addressed the issue of obsolescence by stating:

"The obsolescence of existing ETE can be determined by judging technological, economic, and readiness factors. Newer, more advanced systems may require higher measurement speeds, ranges, or accuracies than available on current ETE. Quite often new technology in the operating systems demands new ETE. Economic factors require the comparison of cost of ownership between existing and new ETE. Such tangible factors as maintenance costs, measurement capability, software requirements, or training time may be substantially lower for new ETE, especially if the old ETE is faced with a new-technology application. Cases have been documented where new item purchases have been amortized in one year or less, and five-year ownership costs cut as much as 50 percent.

"Operational readiness can be jeopardized by obsolescent ETE through higher failure rates or diminished availability. Comparative factors in determining obsolescence are (a) technology, (b) cost of ownership, and (c) operational readiness.

"ETE users have had difficulty in providing cost-effective logistics support for older ETE. Since there is usually a lack of funds for its replacement, older ETE that is no longer cost-effective to maintain and use tends to remain in the active inventory, creating unnecessary costs. Existing ETE may be deemed obsolescent if:

- (a) It does not economically meet new measurement requirements demanded by new technologies, and if it is not otherwise fully utilized.
- (b) A high cost of ownership results from maintenance, repair, training, software, or other operating costs which exceed corresponding costs for new ETE.
- (c) It cannot meet readiness requirements owing to diminished performance, reliability, or availability."

In addition to technical inadequacy and obsolescence, the current inventory of TMDE is plagued with proliferation. The difficulties in managing the swollen inventory present serious planning problems. Further, proliferation affects logistic support by requiring a greater range of spare parts, a larger number (by type) of technical publications, a wider variety of training programs for both operators and maintainers, and a larger number of hardware and software support packages.

To stop proliferation and improve the technical adequacy of the ETE inventory to meet advancing technological requirements, the systematic, orderly acquisition plan proposed by the TRADOC/DARCOM JWG and documented

in the TPP should be fully supported and funded. A less than total commitment to the TMP would result in a serious loss in technological capability to meet existing and future requirements, considerable degradation in operational readiness and mission capability, and a waste of budgetary resources through the continuous support of obsolete, inefficient, and ineffective items of ETE.

If it is decided to support the TMP fully and make a maximum effort to program and budget the required funds for FY 1982 and beyond, a significant cost saving can be realized. In addition, technological leadership will be fostered through the acquisition of the latest state-of-the-art equipment, and combat readiness will be improved through a greater mission capability. The availability of modern OTS ETE will also make it unnecessary to rely on the weapon systems contractor for TMDE during operational and developmental testing and will significantly reduce the development of SP TMDE.

CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

ARINC Research Corporation reached the following conclusions from this project on the basis of the source documents listed in Appendix A and review and analysis of the draft LRs prepared by the DARCOM/TRADOC JWG:

- The use of groups of multipurpose GP TMDE in place of SP TMDE may result in a significant cost saving (or avoidance). Further study will be required to substantiate this conclusion.
- A total of 88 LRs were reviewed by the DARCOM/TRADOC JWG. As a result, 59 LRs were structured into the TMP for FYs 1981 through 1987. An additional five LRs were set aside pending further review. Finally, there are nine FDs that describe other families of GP TMDE that could potentially require the development of LRs.
- Most of the LR/FD combinations shown in Table 3-1 are compatible, indicating that the LR can be satisfied with an OTS ETE. Disparities between LR/FD combinations must be resolved to ensure the availability of OTS ETE to satisfy the LR. Further, OTS ETE FDs that will be more than one year old in the intended "FY Buy Year" should be reviewed, updated, and validated to determine their compatibility with the ETE state of the art.
- The replacement data in the LRs and the TCRL, which specified the M/M that will be replaced, are not compatible. The difference between these two source documents should be resolved so that it will be possible to identify the TMDE that will be replaced by an LR, the intended application of each item being replaced, and the number of replacement units required.
- The minimum number of M/M required to replace the U.S. Army GP TMDE inventory is 73. This number will increase if each main frame and plug-in combination required to satisfy an LR is nomenclatured separately. The 73 M/M have the potential for replacing 2,222 individual M/M of GP TMDE in the Army inventory.

- CERCOM should establish an OTS ETE technology base that will consist of data and trends applicable to the ETE industry. In addition, CERCOM should promote an open-door policy, act as an interface between the Army and the ETE industry, and continuously monitor TMDE requirements from the field and from new systems being developed.
- There are several existing OTS ETE FDs for which LRs have not been developed. These FDs should be reviewed and LRs should be developed as needed to further define the potential benefits of the TMP/TPP.
- The NDI acquisition process, which was used to develop the TPP, is applicable to OTS ETE and hence the TMP. Application of this process to the TMP should produce significant cost savings by eliminating the need for RDT&E funds and by compressing the overall acquisition cycle. However, the NDI acquisition process is different from that normally used by the Army to acquire materiel. It must therefore be studied and understood by members of commands participating in the TMP/TPP. Further, detailed policies and procedures must be developed to define the various roles of each participant and the means of carrying out their responsibilities.
- The TPP should be coordinated with all participating commands as soon as possible and put in final form. In addition, LRs within a given year should be arranged in priority sequence so that available resources can be focused accordingly.
- The TPP by fiscal year provides sufficient guidance for implementing the TMP and determining initial resource requirements. It must, however, be refined further by LR priority in a given fiscal year, and exact dates must be determined for the completion of required events and milestones.
- There were insufficient cost and replacement data for all 59 activity LRs. The cost and replacement data for 26 LRs were therefore used as the baseline for projecting funding requirements and for determining the impact of various TMP funding levels on the Army. Tables 3-7 and 3-8 depict these data and show that funding for the TMP is short by approximately \$88.88 million. This will result in a cost to the Government to retain obsolete TMDE in the inventory over a 20-year period. The following additional problems will be experienced by the Army if the TMP is not fully funded:
 - There will be continued proliferation of M/M and associated increases in logistics costs, e.g., training, spare parts inventory, and publications.
 - A full complement of state-of-the-art TMDE will not be available to support developmental and operational testing for new systems. This will make the program manager dependent on the end-item manufacturer for TMDE and will promote the development of SP TMDE, further complicating the Army's logistics system.

- A serious loss in technology capability will be experienced, and this will affect materiel readiness and the ability of the Army to respond to changing requirements.

4.2 RECOMMENDATIONS

On the basis of the foregoing conclusions, ARINC Research Corporation offers the following recommendations:

- CERCOM should continue exploring the potential cost savings that could be realized through the replacement of SP TMDE with GP TMDE.
- The DARCOM/TRADOC JWG should further evaluate the five LRs identified in Table 3-1 for further review and the nine FDs identified in Section 3.1.4.
- Inconsistencies in replacement data between the LRs and the TCRL should be resolved so that requirements for OTS ETE can be more accurately defined.
- CERCOM should establish an open-door policy with the ETE industry and develop procedures for merging ETE innovations with Army TMDE requirements.
- Out-of-date OTS ETE FDs should be reviewed, upgraded, and validated on a scheduled basis or in accordance with the priorities established by requirements documents.
- The DARCOM/TRADOC JWG should review the identified GP TMDE families that do not have LRs and determine the need for such a document.
- The TPP should be coordinated and implemented. In addition, efforts should be made to create an awareness of the NDI acquisition strategy and to develop policies and procedures needed for completion of specific events and milestones of that strategy.
- LCC economic analyses should be completed for each LR as soon as possible so that cost and replacement data applicable to the TMP can be further defined.
- The benefits of the TMP should be reported to DARCOM, TRADOC, DA, and DoD. This can be accomplished through a series of briefings to key personnel outlining the TMP/TPP, the resources required, the potential cost savings, and the expected improvement in materiel readiness.

APPENDIX A

SOURCE DOCUMENTS

The documents used in the OTS ETE analysis are listed in this appendix in three parts:

- Part I - ARINC Research Corporation Publications
- Part II - Unofficial Documents
- Part III - Official Documents

Part I - ARINC Research Corporation Publications

Title	Contract	Date	Publication Number
Phase I Final Report - Economic Analysis of Selected TMDE from the USACC PIL	DAEA 18-72-A-0005 Delivery Order 0006	August 1974	1072-01-1-1316
Phase II Final Report - Economic Analysis of Selected TMDE from the USACC PIL	DAEA 18-72-A-0005 Delivery Order 0006	November 1974	1072-01-2-1333
Phase III Final Report - Economic Analysis of Selected TMDE from the USACC PIL	DAEA 18-72-A-0005 Delivery Order 0006	May 1975	1072-02-4-1405 (Volume I) 1072-02-3-1403 (Volume II)
Engineering Review of Field Assets to Iden- tify Families of TMDE, Task 1	DAEA 18-72-A-0005 Delivery Order 0007	July 1976	1073-01-1-1504
Determination of an Analysis Sequence for the TMDE Families, Task 2	DAEA 18-72-A-0005 Delivery Order 0007	August 1976	1073-01-2-1517
Determination of the Set of Characteristics of TMDE Families (Groups A through E), Task 3	DAEA 18-72-A-0005 Delivery Order 0007	September 1976	1073-01-3-1534 4-1540, 5-1549 8-1559, and 9-1567

Part I (continued)

<u>Title</u>	<u>Contract</u>	<u>Date</u>	<u>Publication Number</u>
Determination of Best Mix, Technological Forecast, and Availability of Existing TMDE Families (Groups A through E), Tasks 4 and 5	DAEA 18-72-A-0005 Delivery Order 0007	November 1976	1073-01-6-1554R, 7-1553, 10-1568, 12-1573, and 15-1604
TMDE Family Specifications	DAEA 18-72-A-0005 Delivery Order 0007	January 1977	1073-01-11-1571, 13-1583, 16-1611, 17-1625, and 18-1629
Engineering Analysis and Determination of U.S. Army TMDE Requirements (Final Summary Report)	DAEA 18-72-A-0005 Delivery Order 0007	July 1977	1073-01-19-1633
Establish Project Data Base Structure for the Definitization of Specifications for Families of OTS ETE, Task 1	DAEA 18-72-A-0005 Delivery Order BG-02	December 1977	1076-01-1-1693
Review and Analysis of Technical Characteristics for the Definitization, Subtask 2B	DAEA 18-72-A-0005 Delivery Order BG-02	March 1978	1076-01-2-1720
Definitize and Prepare OTS ETE Specifications	DAEA 18-72-A-0005 Delivery Order BG-02	July 1978	1076-01-3-1770
Determination of a Life-Cycle-Cost Procurement Approach in the Selection of OTS ETE	DAEA 18-72-A-0005 Delivery Order 0011	April 1978	1078-02-1-1730
Validation of the CERCOM Life-Cycle-Cost Model	DAAB07-78-A-6606/06	November 1979	1534-01-TR-2091
Definitize Specifications for Families of Off-the-Shelf Electronic Test Equipment	DAAB07-78-A-6606/ 0001	December 1979	1574-01-1-2076

Part I (continued)

<u>Title</u>	<u>Contract</u>	<u>Date</u>	<u>Publication Number</u>
Fourteen (14) Military (OTS ETE) Specifications	DAAB07-78-A-6606/ 0001	December 1979	1574-01-1-2077 to 2090
Determine the Feasi- bility of Replacing Special Purpose TMDE With Off-the-Shelf Electronic Test Equipment	DAAB07-78-A-6606/03	April 1980	1581-01-1-2173 Volumes I and II
Life-Cycle-Cost Analysis of Selected TMDE Families	DAAB07-78-A-6606/06	February 1980	1584-01-1 to 25-2128
Optimize the Quantity and Types of TMDE Required to Support U.S.A. Electronic Systems at the General Support Level	DAAB07-78-A-6606/02	November 1980	To Be Determined

Part II - Unofficial Documents

- Letter, DAMA-PPM-A, Subject: Nondevelopment Items (NDI) dated 1 May 1980.*
- APRO 803 - Acquisition Strategies for Nondevelopment Items (NDI), May 1979.
- Commercial by Design - Proceedings of the Workshop on Commercial Commodity Acquisition, January 17-19, 1978
- Draft AR 70-1, 14 December 1978
- DARCOM Letter of Instruction, Communications and Electronics Materiel Readiness Command (CERCOM), 23 December 1977
- DARCOM Letter of Instruction, Electronics Research and Development Command (ERADCOM), 23 December 1977
- CERCOM Regulation: Equipment Transition Processing, Coordination and Approval, June 1979
- Memorandum of Agreement: Uniform System for Materiel Acquisition Management (Project Control Board) between AVRADCOM, CERCOM, CORADCOM, and ERADCOM, 11 March 1979

*Draft Chapter 6 of AR 70-1.

- Memorandum of Agreement: General Purpose TMDE, between DARCOM and TRADOC, 27 December 1976
- Master Plan for Modernization of Manual Electronic TMDE, prepared by USASCH&PG, 3 March 1980
- Recommendations on Policies and Procedures for OTS ETE Acquisition and Support, Document NQ RTCA/DO-171, January 1980

Part III - Official Documents

- Army Pamphlets

DAPAM 11-25	May 1975
DAPAM 700-127	April 1979

- Army Regulations

AR 70-1	1 May 1975
AR 71-2	19 April 1976
AR 71-3	8 March 1977
AR 71-6	13 July 1973
AR 310-3	26 August 1977
AR 700-127	11 April 1975
AR 750-1	1 April 1978
AR 750-43	22 September 1976

- DARCOM Supplements

Supplement 1 to AR 700-127	20 June 1977
Supplement 1 to AR 750-43	18 February 1976

- DARCOM Circular

DARCOM-C 20-3	21 August 1979
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- DARCOM Regulation

DARCOM-R 700-34	15 June 1978
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- CERCOM Supplements

Supplement 1 to AR 750-43	8 October 1976
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- CERCOM Regulation

CERCOM-R 10-1	19 June 1978
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- Supply Bulletin

SB 700-20	January 1979
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APPENDIX B

DESCRIPTION OF TMDE CROSS-REFERENCE LIST (TCRL)

The TMDE Cross-Reference List (TCRL) is intended as a guide for initially identifying those OTS ETE functional descriptions (FDs) which are "functionally compatible" or "partially compatible" with U.S. Army GP TMDE inventory. Under earlier contracts, ARINC Research Corporation compared the technical parameters for each item, as described in the DA TMDE Register, with the technical parameters of the OTS ETE FDs or LR developed by DARCOM/TRADOC JWG (considered a specification) and determined whether the TMDE parameters were "functionally compatible" or "partially compatible" with a particular FD. Applicable data were then encoded. The two types of compatibility are described as follows:

- "Functionally compatible" implies that the technical parameters of the TMDE are within the range of the technical parameters of the identified OTS ETE FD.
- "Partially compatible" implies that the technical parameters of the TMDE are only partially within the range of the technical parameters of the identified OTS ETE FD(s) and that more than one specification is required to provide full compatibility.

The analysis and subsequent encoding resulted in the following listings for a two-part TCRL:

- Part I - OTS ETE Functional Description to U.S. Army General Purpose TMDE. Part I is an alphabetical listing of OTS ETE FDs correlated with the U.S. Army GP TMDE inventory that are either functionally compatible or partially compatible with each FD.
- Part II - U.S. Army General Purpose TMDE to OTS ETE Functional Description(s). Part II is an alphanumeric listing, by type designator or manufacturer's model number, of each U.S. Army GP TMDE considered in the analysis; it indicates by OTS ETE FD number(s) whether the TMDE is functionally or partially compatible.

The data displayed in the TCRL should be considered as representative of the potential of each OTS ETE FD for replacing GP TMDE in the Army. It is intended to serve as the starting point for estimating cost savings that can be realized from the TMP.

The original TCRL was upgraded in July 1978 and December 1979 for 7 and 18 TMDE families, respectively. GP TMDE added to the DA TMDE Register since July 1976, as listed in the April 1979 Register, were included in the TCRL as part of the SP TMDE study described in Section 2.1.3 of this report. However, the DA TMDE Register does not include all TMDE being used by the Army. The U.S. Army Central TMDE Activity (CTA) continues to identify TMDE that has not been incorporated into the register as required by AR 750-43. On the basis of the data ARINC Research Corporation has accumulated in support of the TMP, it can be reasonably estimated that there are approximately 1,000 separate M/M of Army TMDE not listed in the register. The TCRL must be considered in that light.

ARINC Research Corporation believes that the data in the TCRL are reasonably accurate. However, the TCRL is not intended to be a vehicle for "final" Army decisions. It is a starting point for determining which TMDE can be "functionally" or "partially" replaced by the acquisition of a new TMDE that conforms to the OTS ETE FD shown. In fact, it may not be desirable or possible to replace the item. Therefore, before a final decision to replace an item is made, a detailed analysis of that item is required. The TCRL could be upgraded by performing a detailed analysis of each TMDE listed and incorporating the results in the TCRL, i.e., reviewing each individual end system and TMDE technical manuals; however, we believe that this would only marginally improve the usefulness of the document. Further, as part of the acquisition process for each new TMDE, the data in the TCRL would have to be verified against the actual FD used in the solicitation to provide assurance to all concerned that the items designated for replacement should in fact be replaced. Finally, the TMDE state of the art at the time of acquisition might dictate the consolidation of families of TMDE. For example, the Sweep Generator Audio might be combined with the Generator, Signal Function. Therefore, ARINC Research Corporation does not consider it advisable to conclude the acquisition process for a new TMDE without first performing a detailed analysis and verification of the TMDE to be replaced.

APPENDIX C

LIFE-CYCLE-COST MODEL

1. DISCUSSION

In the following documentation, each life-cycle-cost element variable is indexed with an "I," e.g., HDWC(I). With this addition the variable represents an OTS ETE preferred item when "I" equals 1, and a fielded item when "I" is greater than 1.

The cost elements vary over the CERCOM-specified 20-year cycle from 1982 through 2001. The computer program will compute and list each life-cycle-cost element first in constant 1980 dollars and then in inflated dollars.

2. GENERAL LIFE-CYCLE-COST EXPRESSION

The general life-cycle-cost expression is as follows:

$$\begin{array}{lcl} \text{LCC}_{\text{TMDE}} = & \text{Hardware Cost} & \\ & + \text{Engineering Cost} & \\ & + \text{Initial Training Cost} & \\ & + \text{Transportation Cost} & \\ & + \text{Documentation Cost} & \\ & + \text{Initial Provisioning Cost*} & \left. \begin{array}{l} \\ \\ \\ \\ \end{array} \right\} \begin{array}{l} \text{Investment} \\ \text{Cost} \\ \text{Elements**} \end{array} \\ & + \text{Inventory Management Cost} & \\ & + \text{Replacement Training Cost} & \\ & + \text{Maintenance Labor Cost} & \\ & + \text{Consumables Cost} & \\ & + \text{Holding Cost} & \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \begin{array}{l} \text{Recurring} \\ \text{Cost} \\ \text{Elements**} \end{array} \end{array}$$

The algorithms for the individual cost elements are presented in the following subsections.

*Spares.

**Details are provided in each algorithm.

2.1 Hardware Cost Algorithm

$$\text{HDWC}(I) = \text{NEQB}(I) \times \text{UPRC}(I)$$

where

HDWC(I) = Hardware Cost of Ith TMDE Item

NEQB(I) = Quantity Purchased of Ith TMDE Item

UPRC(I) = Unit Price of Ith TMDE Item

TMDE equipment is as follows:

- Alternative A (Preferred Item) for $I = 1$
- Alternative B (Fielded Item) for $I > 1$

2.2 Engineering Cost Algorithm

$$\text{ENGCSST}(I) = [\text{HDWC}(I) \times (\text{ECO} + \text{PEPA}(I))] + \text{GEC}(I)$$

where

ENGCSST(I) = Engineering Cost of Ith TMDE Item

HDWC(I) = Hardware Cost of Ith TMDE Item

ECO = Engineering Change Orders. Source is CERCOM Logistics Engineering Directorate (LED).

0.02

PEPA(I) = Production Engineering/Product Assurance. Source is CERCOM LED.

Zero for Alternative A

0.08 for Alternative B

GEC(I) = Government Engineering Cost. Source is CERCOM LED.

24,700 for Alternative A

Zero for Alternative B

TMDE equipment is as follows:

- Alternative A (Preferred Item) for $I = 1$
- Alternative B (Fielded Item) for $I > 1$

2.3 Initial Training Cost Algorithm

INIT(I) = INITA for Alternate A
= 0 for Alternate B

where

INIT(I) = Initial Training Cost for Ith TMDE Item
INITA = $\begin{cases} 5,000 \text{ for } C = 1 \\ 22,000 \text{ for } C = 2 \\ 39,000 \text{ for } C = 3 \end{cases}$
C = Complexity Factor (1, 2, or 3)

This algorithm is based on the following information supplied by DRSEL-PL-SA:

- Factory Training Cost = \$12,000 per week
- Training Film Cost = \$ 1,000 per minute

TMDE Complexity (C)	Factory Training Time	Training Film Length	Cost
1 - Below Average	--	5 minutes	\$ 5,000
2 - Average	1 week	10 minutes	\$22,000
3 - Above Average	2 weeks	15 minutes	\$39,000

TMDE equipment is as follows:

- Alternative A (Preferred Item) for I = 1
- Alternative B (Fielded Item) for I > 1

2.4 Transportation Cost Algorithms

$$\text{FDTRC}(I) = 0.015^* \times \text{HDWC}(I)$$

$$\text{SDTRC}(I) = 0.05^{**} \times \text{HDWC}(I)$$

where

FDTRC(I) = First Destination Transportation Cost for Ith
TMDE Item

SDTRC(I) = Second Destination Transportation Cost for Ith
TMDE Item

HDWC(I) = Hardware Cost of Ith TMDE Item

TMDE equipment is as follows:

- Alternative A (Preferred Item) for $I = 1$
- Alternative B (Fielded Item) for $I > 1$

*Source is U.S. Army Communications Research and Development Command
(CORADCOM) "Cost Estimating Handbook," p. V-10.

**Source is U.S. Army Electronics Command Pamphlet (ECOMP) 11-4, Volume 7,
"Cost Estimating Handbook," p. VI-13.

2.5 Documentation Cost Algorithm

$$\begin{aligned} \text{DMTC}(I) &= \text{NPC}(C) \times 250^* \times \text{REBY}(I) + [\text{PLC}(C) + \text{RLC}(C)] \times 35^{**} \\ &\quad \text{for Alternative A} \\ &= \text{NPC}(C) \times 250^* \times \text{REBY}(I) \text{ for Alternate B} \end{aligned}$$

where

DMTC(I) = Documentation Cost for Ith TMDE Item

NPC(C) = Narrative Section Page Count as a Function of TMDE Complexity, C = 1, 2, or 3

PLC(C) = Provisioning Section Line Count as a Function of TMDE Complexity, C = 1, 2, or 3

RLC(C) = Repair Parts and Special Tool List (RPSTL) Section Line Count as a Function of TMDE Complexity, C = 1, 2, or 3

REBY(I) = Rebuy Factor for Narrative Section: 0.2 if a Rebuy or 1 Otherwise. (Source is DRSEL-PL-SA.)

The documentation information listed below was provided by ManTech of New Jersey Corporation under Contract DAAB07-77-D-6136:

C	Typical TMDE	Narrative Pages (NPC)	Provisioning Pages (PLC)	RPSTL Lines (RLC)
1	Multimeter	80	500	125
2	Signal Generator	150	1,000	250
3	Spectrum Analyzer	250	2,000	500

TMDE equipment is as follows:

- Alternative A (Preferred Item) for I = 1
- Alternative B (Fielded Item) for I > 1

*Cost per Narrative Page, supplied by Maintenance Engineering Directorate, DRSEL-ME-PCF.

**Cost per RPSTL (Repair Parts and Special Tool List) Line, supplied by Maintenance Engineering Directorate, DRSEL-ME-PCF.

2.6 Initial Provisioning Cost Algorithm

$$\begin{aligned}\text{IPRO}(I) &= \text{PIPCT}(I) \times \text{HDWC}(I) \text{ for Alternative A} \\ &= 0 \text{ for Alternative B}\end{aligned}$$

where

$\text{IPRO}(I)$ = Initial Provisioning Cost for Ith TMDE Item

$\text{PIPCT}(I)$ = Initial Provisioning Percentage for Alternative A (based on algorithm provided by ManTech of New Jersey Corporation under Contract DAAB07-77-D-6136)

$$= \frac{11 + \frac{500}{\text{MTBF}(1)}}{100} \quad \text{MTBF}(1) < 500 \text{ Hours}$$

$$= \frac{13 - \frac{\text{MTBF}(1)}{500}}{100} \quad 500 \text{ Hours} \leq \text{MTBF}(1) \leq 2500 \text{ Hours}$$

$$= 0.08 \quad \text{MTBF}(1) \geq 2500 \text{ Hours}$$

$\text{HDWC}(I)$ = Hardware Cost of Ith TMDE Item

$\text{MTBF}(1)$ = Mean Time Between Failures (in Hours) for Preferred Item

The condition of zero initial provisioning for Alternative B was supplied by DRSEL-PL-SA.

TMDE equipment is as follows:

- Alternative A (Preferred Item) for $I = 1$
- Alternative B (Fielded Item) for $I > 1$

2.7 Inventory Management Cost Algorithm

$$\begin{aligned}\text{IMC(I)} &= 668^* \times \text{RLC(C)} \text{ for a First Buy} \\ &= 291^{**} \times \text{RLC(C)} \text{ for a Catalogued Item}\end{aligned}$$

where

$$\begin{aligned}\text{IMC(I)} &= \text{Inventory Management Cost of Ith TMDE Item} \\ \text{RLC(C)} &= \text{RPSTL (Repair Parts and Special Tool List) Section Line} \\ &\quad \text{Count as a Function of Complexity, C = 1, 2, or 3}\end{aligned}$$

Costs attributable to inventory management include item identification, description, inclusion in supply catalog and maintenance catalog, establishment of inventory level and replacement rate, provisioning, requisitioning and rebuild instructions, supply studies, provisioning studies, requisitioning costs, and costs of holding inventory.

TMDE equipment is as follows:

- Alternative A (Preferred Item) for $I = 1$
- Alternative B (Fielded Item) for $I > 1$

*Cost of entering an item into the inventory system. Source is CORADCOM "Cost Estimating Handbook," p. VI-12. Cost is inflated to FY 1980 dollars with factor provided by DARCOM Comptroller.

**Cost of maintaining an item in the inventory system. Source is CORADCOM "Cost Estimating Handbook," p. VI-12. Cost is inflated to FY 1980 dollars with factor provided by DARCOM Comptroller.

2.8 Replacement Training Cost Algorithm

$$\text{TRNC} = 0.01* \times (\text{TRN35B} + \text{TRN35H})$$

where

TRNC = Training Cost

TRN35B = Total Cost of Training Military Occupational Specialty (MOS) 35B (Repairmen Classification)

= Number of 35Bs Trained Annually Multiplied by Course Cost per Individual

TRN35H = Total Cost of Training MOS 35H (Calibrator Classification)

= Number of 35Hs Trained Annually Multiplied by Course Cost per Individual

MOS	Number Trained Annually	Course Cost per Individual**
35B10	95	\$ 8,191
35B20	61	\$ 5,818
35H30	38	\$10,359

* Source: ManTech of New Jersey Corporation under Contract DAAB07-77-D-6136.

**Cost-of-training data provided by Comptroller of Army, DACA-CAF.

2.9 Maintenance Labor Cost Algorithm

$$\text{LBRCSST}(I) = \text{CALCST}(I) + \text{RPRCSST}(I)$$

$$\text{RPRCSST}(I) = \text{NOEQ}(I) \times \frac{\text{OPHY}(I)}{\text{MTBF}(I)} \times \text{MTTR}(I) \times 9.52^*$$

$$\text{CALCST}(I) = \text{NOEQ}(I) \times \frac{365^{**}}{\text{CAL}(I)} \times \text{MTTC}(I) \times 9.52^*$$

where

$\text{LBRCSST}(I)$ = Maintenance Labor Cost of Ith TMDE Item

$\text{CALCST}(I)$ = Cost of Calibration of Ith TMDE Item

$\text{RPRCSST}(I)$ = Cost of Repair of Ith TMDE Item

$\text{NOEQ}(I)$ = Quantity of Ith TMDE Item Purchased for the Next Seven Years

$\text{OPHY}(I)$ = Yearly Operating Hours of Ith TMDE Item

= $260 \times \text{Daily Use}$

$\text{MTBF}(I)$ = Mean Time Between Failures (hours) for Ith TMDE Item

$\text{MTTR}(I)$ = Mean Time To Repair (hours) for Ith TMDE Item

$\text{MTTC}(I)$ = Mean Time To Calibrate (hours) for Ith TMDE Item

$\text{CAL}(I)$ = Calibration Interval (days) for Ith TMDE Item

TMDE equipment is as follows:

- Alternative A (Preferred Item) for $I = 1$
- Alternative B (Fielded Item) for $I > 1$

* Cost per active maintenance man-hour for Communications-Electronics (C-E) equipment. Source is CORADCOM "Cost Estimating Handbook," p. VI-3 (value then inflated by 7 percent cost-of-living allowance).

**Scaling factor: days in one year.

2.10 Cost of Consumables Algorithm

$$\begin{aligned}\text{CONCST}(I) &= 0.25^* \times \text{IPRO}(1) \text{ for Alternative A} \\ &= 0.05^{**} \times \text{CUMHDW} \text{ for Alternative B}\end{aligned}$$

where

$\text{CONCST}(I)$ = Cost of Consumables for Ith TMDE Item
 $\text{IPRO}(1)$ = Initial Provisioning for Alternative A
 CUMHDW = Seven-Year Cumulative Hardware Totals for Fielded Items
Up To and Including Current Year

TMDE equipment is as follows:

- Alternative A (Preferred Item) for $I = 1$
- Alternative B (Fielded Item) for $I > 1$

* Supplied by DRSEL-PL-SA.

**Cost of Repairs Parts is typically five percent of the Total Hardware Cost. Source is CORADCOM "Cost Estimating Handbook," p. VI-5.

2.11 Holding Cost Algorithm

$$\begin{aligned}\text{HLDCST(I)} &= 0.03* \times \text{IPRO(I)} \text{ for Alternative A} \\ &= 0.0036** \times \text{CUMHDW} \text{ for Alternative B}\end{aligned}$$

where

$$\begin{aligned}\text{HLDCST(I)} &= \text{Holding Cost for Ith TMDE Item} \\ \text{IPRO(I)} &= \text{Provisioning Cost for Ith TMDE} \\ \text{CUMHDW} &= \text{Seven-Year Cumulative Hardware Totals for Fielded} \\ &\quad \text{Items Up To and Including Current Year}\end{aligned}$$

Holding costs apply to TMDE in the Supply System. Since no TMDE will be bought for float, holding cost will apply to consumables held in the supply system.

TMDE equipment is as follows:

- Alternative A (Preferred Item) for $I = 1$
- Alternative B (Fielded Item) for $I > 1$

*Repair Parts Holding Cost factor is based on a percentage of the cost of the item being stored. The cost of the item being stored is assumed to be equal to the Initial Provisioning Cost for the Ith TMDE. The percentages used are from CORADCOM "Cost Estimating Handbook," p. VI-6, and are as follows:

<u>Cost Factor</u>	<u>Percentage</u>
Storage Costs	1
Other Losses	<u>2</u>
Total	3

**Supplied by DRSEL-PL-SA.