R-446

APPLICATION OF THE HARDMAN METHODOLOGY TO THE SINGLE CHANNEL GROUND-AIRBORNE RADIO SYSTEM (SINCGARS)

TECHNICAL REPORT

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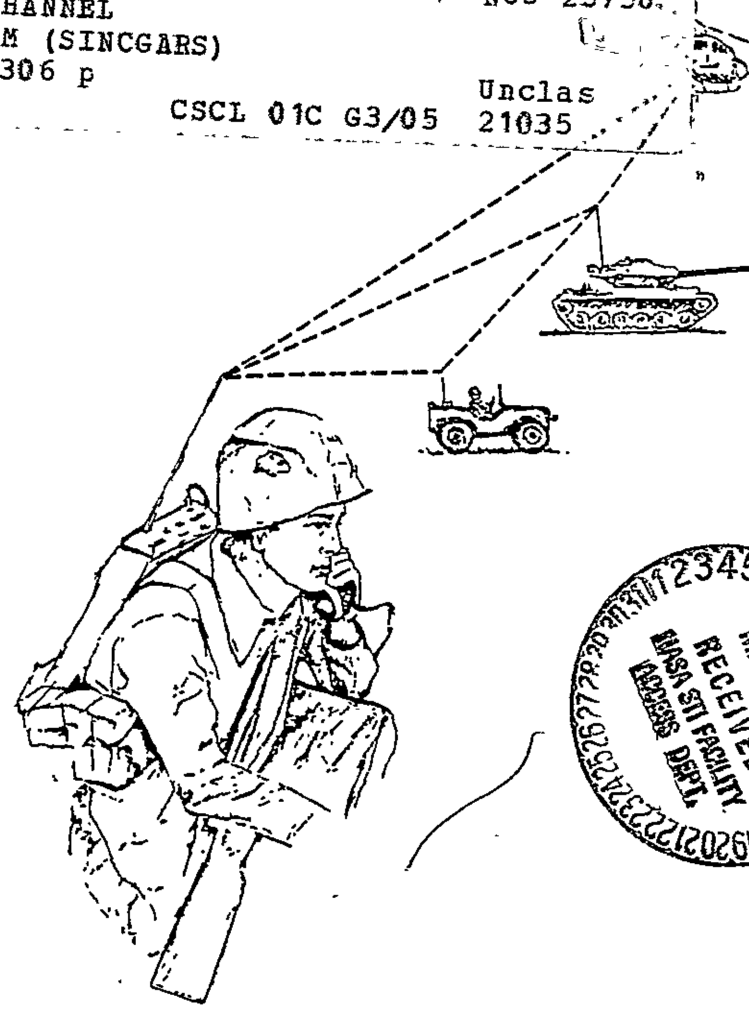

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May 3, 1985

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TECHNICAL REPORT

JANUARY 1984

Prepared For:

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PREFACE

This report describes the application of the HARDMAN methodology to the various configurations of employment for an emerging Army multipurpose communications system. The methodology was used to analyze the manpower, personnel and training (MPT) requirements and associated costs, of the system concepts responsive to the Army's requirement for the Single Channel Ground-Airborne Radio System (SINCGARS). The scope of the application includes the analysis of two conceptual designs (Cincinnati Electronics and ITT Aerospace/Optical Division) for operation and maintenance support addressed through the general support maintenance echelon.

The project effort was authorized under Contract number 956384, a fixed price contract with California Institute of Technology, Jet Propulsion Laboratory (JPL), Pasadena California in support of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) and the U.S. Army Soldier Support Center (SSC). The contract is task order number RE-182/256 of NASA subcontract NAS7-100. The contract monitor was Ms. Kathy O'Hara of JPL. Work on the project was performed by members of the Man-Machine Systems Department, Dynamics Research Corporation, Wilmington, Massachusetts. The contract Program Manager was Thomas E. Mannle, Jr. The report manager was John L. Balcom. Principle analysts and authors of the report were Kathryn Bisack, Robert Guptill, John Park, Ray Perry, John Snow, Linwood Toomer, and Cecil Wakelin. Adminstrative support was provided by Corinne Perkins, Donna Fentross and Dianna DiGregorio.

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SECTION 1 - EXECUTIVE SUMMARY

1.1 PURPOSE

In November 1982, Dynamics Research Corporation (DRC) was placed under contract by the Jet Propulsion Laboratory, Pasadena, California, in support of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) and the U.S. Army Soldier Support Center (SSC). The purpose of the contract was to apply the DRC-developed Military Manpower vs. Hardware Procurement (HARDMAN) methodology to the Single Channel Ground-Airborne Radio System (SINCGARS). The HARDMAN methodology was originally developed by DRC for the U.S. Navy to determine the manpower, personnel and training (MPT) requirements of emerging weapon systems. The methodology has been applied to several major Army weapon systems. The HARDMAN methodology is an integrated set of data base management techniques and analytic tools designed to assess the human resource implications of design decisions. The methodology identifies adverse MPT impacts of weapon system design early enough in the acquisition process to allow corrective actions and thereby improve system supportability.

1.2 SCOPE OF THE PROJECT

SINCGARS is an electronically tuned and controlled Very High Frequency - Frequency Modulated (VHF-FM) radio system. The SINCGARS family of radios consists of one manpack and six vehicular models, each with a different configuration of standard building block modules or components.

The SINCGARS acquisition program is approaching the Full Scale Development Phase of the Weapon System Acquisition Process (WSAP). At the time of the application of HARDMAN, the SINCGARS Milestone III review by the Army System Acquisition Review Council (ASARC) had not been accomplished. Two contractors were in competition for SINCGARS full-scale development: Cincinnati Electronics (CE) and International Telephone and Telegraph (ITT) Aerospace/ Optical Division. This project examined the proposed design of each of the two competitors. Because of the limited time available, the scope of the project was limited to the following:

(1) All six steps of the HARDMAN methodology were applied:

(2) All components of the receiver/transmitter (R/T) unit and the following optional components were analyzed:

Communications Security (COMSEC)
Electronic Counter - Countermeasures (ECCM) Unit
ECCM Fill Device
Digital Data Device
Securable Remote Control Unit (SRCU)
Intra-Vehicular Remote Control (IVRC) Unit
Net Control Unit

(3) Only SINCGARS-specific maintenance workload was computed.

(4) Manpower requirements for the crew, organizational, direct support and general support levels of maintenance were determined.

1.3 DESCRIPTION OF THE HARDMAN METHODOLOGY

The HARDMAN methodology is composed of six major interrelated steps. All six steps of the methodology were performed as part of the SINCGARS effort. A brief description of each step follows:

Step 1 - Establish a Consolidated Data Base (CDB)

During Step 1 two major functions are accomplished. First, the Baseline Comparison System (BCS), also called the reference system, and the proposed system configurations are developed and the design differences between them are evaluated. Secondly, all data required to support this and subsequent HARDMAN analyses are identified, collected, and formatted.

Step 2 - Determine Manpower Requirements

In the Manpower Requirements Analysis, the manpower requirement of the proposed system is estimated. Where appropriate, this requirement can include civil service and contractor as well as military manpower through all echelons of maintenance. This estimate is derived from workload generated by operational and maintenance task/event networks using the reference system as a point of departure. Changes in manpower requirements are functions of the design differences identified in Step 1.

Step 3 - Determine Training Resource Requirements

During the Training Resource Requirements Analysis (TRRA), training data are collected for the reference system and modified to reflect the design differences in the proposed design. Thus, changes are made in the operational and maintenance tasks to be performed, in individual courses (to account for the general task changes), and in course resources and cost. The impacts of these changes are aggregated to determine estimates of training, training resources, and cost for the proposed system.

Step 4 - Determine Personnel Requirements

The Personnel Requirements Analysis (PRA) determines the total personnel demand of the reference and proposed systems. This total requirement consists of (a) personnel required "on board" to operate and maintain the system, plus (b) the pipeline personnel who must be "grown" in the system to consistently meet the manpower requirements determined in Step 2. The Interactive Manpower-Personnel Assessment and Correlation Technology (IMPACT) model is used to determine the total personnel requirements of the proposed system.

Step 5 - Conduct Impact Analysis

The Impact Analysis determines the Army's supply of those manpower and training resources required by the proposed system and measures that supply projection against the MPT demand (determined in Steps 2 through 4). It identifies (a) new requirements for skills, training, and training resources; (b) design and other sources of high human resource demand; (c) requirements for scarce assets such as skills and training resources; and (d) high cost components of the manpower, personnel, and training requirements associated with the proposed system. These products include many of the data elements required in current Department of

Defense and Department of the Army documentation for program reviews.

Step 6 - Perform Tradeoff Analysis

The Tradeoff Analysis prioritizes the critical requirements (established in Step 5) according to their impacts on resource availability. A range of potential solutions to each requirement is determined and prioritized for analysis. The HARDMAN methodology is then iterated to develop the most effective response to each critical resource requirement. Both the data for and the findings of these analyses are included in the Consolidated Data Base (CDB), thereby insuring that a complete audit trail is generated.

1.4 RESULTS

Table 1.4-1 highlights the results of the effort with respect to the Baseline Comparison System and the two proposed systems analyzed for SINCGARS. Based upon the figures in this table, the design proposed by Cincinnati Electronics emerges as the preferred candidate. However, this alternative cannot be recommended, since the variances between CE and ITT, and between CE and the BCS are almost wholly accounted for by the differences in the degree of design coverage provided by the Logistics Support Analysis (LSA) data furnished by the two contractors (see 1.5 below). ITT provided less LSA for their design and DRC made relatively more analytic use of extrapolations from the BCS. Consequently, the MPT values obtained for ITT are closer to the BCS. CE had more coverage, and DRC accepted more of CE's estimates, which resulted in MPT estimates much further

Table 1.4-1 SINCGARS Results Summary

CATEGORY	REFERENCE BCS	PROPOSED CE	PROPOSED ITT
Manpower			
Crew	17,182	3,898	15,056
Organizational	54,218	1,863	2,809
Direct Support	25,380	1,629	9,153
General Support	20,600	1,303	6,391
Personnel			
Number of MOS	7	7	7
Personnel Requirements	285,096	20,982	93,440
Annual Recruits	137,514	10,824	46,539
Training (Annual)			
Training Man-Days (K)	10,661	502	2,382
Instructor Requirements 1/	10,242	524	2,206
Course Costs ($K) 1/	989,173	61,938	239,472
Impact			
Availability Ratios			
32G	.30	1.07	.38
35C	.05	.39	.09

1/ Does not include operator requirements.

from those of the BCS. Normally, the engineering analysts accept contractor projections of component reliability and maintainability as a starting point for their portion of a HARDMAN application. These projections are examined, clarified and normalized for consistency through discussions, sometimes extensive, with individual contractors. Because the SINCGARS program was close to source selection, this procedure was not followed. Thus the MPT results in Table 1-4 reflect a real number of resource requirements given the input data available. The results should serve as an analytical point of departure for further analysis and may be used to demonstrate sensitivities in design or doctrinal changes. Given the input data, all SINCGARS configurations have been analyzed to the best possible degree and the application of the methodology is consistent over each alternative. Results are discussed in more detail in the appropriate sections of this report.

1.5 FACTORS INFLUENCING RESULTS

Results of this analysis were influenced by a number of underlying assumptions and/or constraints. A brief summary of each is listed below.

General

- The competition sensitive nature of the data describing each design alternative constrained the depth to which the application of HARDMAN could be carried out. Data available to the SINCGARS Program Office were unable to be released for consideration in this project. When lower level of detail information is unavailable for the proposed systems, the analyst must rely on the reference system for evaluation of the missing components. Reference system equipments represent real field data on mature systems and, hence, are more low risk conservative projections. The ITT alternative shown in Table 1.4-1 illustrates how missing information and reliance on the reference system impact results. In contrast, information received on the CE alternative described innovative, technological advances in enough detail to evaluate and reflect very favorable MPT projections.

Functional Requirements

- The SINCGARS functional requirements were derived from analysis of the SINCGARS Operational and Organizational (O&O) Plan and other system description program documentation.

Engineering and Workload

- The Baseline Comparison System (BCS), also called the reference system, which was used as a benchmark for evaluating the two proposed designs, was selected to not only meet SINCGARS functional requirements but to represent technology similar to that of proposed system designs.

- For security reasons, the TSEC/KYV-4 VANDAL communications security (COMSEC) equipment being developed in parallel with SINCGARS and under the cognizance of the National Security Agency, was not analyzed. In its place, the existing TSEC/KY-57 VINSON COMSEC equipment, which will be compatible with SINCGARS, was included in the analysis.

- Contractor-generated Logistic Support Analysis (LSA) data differed in degree of coverage between the two design contractors. This deficiency accounted for the variance in the magnitude of the MPT discrepancies between the two proposed designs and hindered the comparability analyses of many sub-systems. This deficiency also partially accounts for the lack of a recommendation of a preferred candidate.

- BCS reliability, availability, maintainability (RAM) data were used in areas where actual, projected or test data of the proposed systems were unavailable. These BCS data were perturbed to reflect the projected impact from emerging technologies.

Manpower

- Mission profile and equipment populations for each of the seven SINCGARS configurations represented the best estimates available to DRC personnel. An official Mission Profile/Operational Mode Summary was not available for this analysis.

- The manpower requirements analysis considered SINCGARS-specific maintenance workload only. Operator manpower requirements for SINCGARS could not be quantified for this analysis because of the number of possible operational configurations for the system.

- Allowances and constraints for estimating manpower from the Army Manpower Authorization Criteria (MACRIT) process, contained in Army Regulation 570-2, were incorporated into the analysis.

- The capacity factor of the basic MACRIT equation was modified to provide a more realistic availability factor for individuals operating within the specified mission environment.

Personnel

- Personnel rates were not available for Automatic Test Equipment Repairer, MOS 35C, as a result of being a new MOS. Since it appeared that Fixed Cryptographic Equipment Repairer, MOS 32G, would have a similar career path, rates for MOS 32G were used to calculate annual recruits and to represent a personnel structure for MOS 35C. MOS 32G has the same low population density as 35C and provides a career path with a similar formal school training plan.

- Army Enlisted Master File (EMF) data proved to be unavailable. However, processed data from the Defense Manpower Data Center (DMDC) turned out to be as useful for the PRA. The analysis was affected positively as the DMDC processed data was in a more usable form.

Training

- Training associated with the operational test and evaluation of the proposed system and training associated with the initial fielding of the system (e.g., new equipment training) were not estimated.

- All existing training used for training estimation for the proposed system was assumed to be adequately meeting existing system performance requirements.

- Training resources to support supervised on-the-job training (SOJT), collective training, advan ed technical training, and training other than for entry level institutional training was not identified.

- MOS's chosen for operator analysis were assumed to operate the following SINCGARS radio configurations:

MOS	SINCGARS CONFIGURATION
11B	V1 Manpack and V5 Vehicular Long Range
13E	V6 Vehicular Short Range Dismountable and Long Range
19E	V5 Vehicular Long Range

- It was assumed that the automatic test equipment (ATE) AN/MSM-105 will only be available at the Specialized Repair Activity (SRA).

- All Army systems identified for comparison purposes did not include built-in-test (BIT) capabilities. It was estimated from comparison of CE and ITT alternatives that approximately 40% of the training in troubleshooting could be eliminated from existing training by using BIT and the proposed diagnostic test equipment. (See Table 3.5-6.)

1.6 CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis conducted thus far, neither proposed system design can be recommended. The choice facing a decision maker is between the two alternatives. CE had more information available predicting significant performance improvements, but hence has more risk if the improvements cannot be demonstrated; the ITT alternative had less information available, was thus evaluated more conservatively, hence, reflects fewer new capabilities but also at low risk. Between these two alternatives DRC cannot recommend a clear winner. Initial MPT resource projections could be improved and validated through the iterative process embedded in the HARDMAN methodology. Updated descriptive design information at a greater level of detail plus any DT/OT test results data would ensure a more thorough evaluation of the two proposed alternatives.

The results of the application do, however, demonstrate the consistent human resource cost sensitivity of engineering design improvements across the two SINCGARS alternatives. This sensitivity is illustrated in annual recruit requirements and training costs.

Further, DRC estimates affecting the results such as equipment populations, mission scenarios and reference system selections should be officially reviewed for accuracy by knowledgeable Army authorities. Modifications resulting from such estimates should form the basis of additional trade-off analyses. The results, additionally, provide the Project Manager with the capability to focus attention on SINCGARS components which contain technological risks and significantly impact MPT resources. These critical components should be looked at carefully during operational testing for realistic performance verification.

As this report illustrates, the HARDMAN methodology can provide a wealth of timely information to those concerned with system development and acquisition. This is true despite problems encountered in obtaining the basic data required for various HARDMAN analyses. The Impact Analysis section explains in more detail the problems encountered by DRC analysts who, due to non-accessability to the data, were unable to complete portions of the application. In these cases, the procedure to be applied is explained in Section 3. Nevertheless, the SINCGARS application of HARDMAN demonstrates the versatility and utility of the methodology in support of the Weapon Systems Acquisition Process.

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SECTION 2 - ANALYSIS PLAN

2.1 PURPOSE OF THE SINCGARS STUDY

The application of the Military Manpower vs. Hardware Procurement (HARDMAN) methodology to the Single Channel Ground-Airborne Radio System (SINCGARS) was to support objectives of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) and the U.S. Army Soldier Support Center (SSC). Among these objectives were (1) to analyze the manpower, personnel and training (MPT) implications of two proposed SINCGARS designs as the acquisition program nears the Milestone III review by the Army System Acquisition Review Council (ASARC) and (2) to continue analysis of the applicability and utility of the HARDMAN methodology in providing supportability assessments of Army weapon systems.

The SINCGARS system is an electronically tuned and controlled Very High Frequency - Frequency Modulated (VHF-FM) radio system. The SINCGARS family of radios consists of one manpack and six vehicular models, each a different configuration of standard building block modules or components. Two proposed designs were analyzed, one each from the two contractors who were in competition for SINCGARS full-scale development: Cincinnati Electronics (CE) and International Telephone and Telegraph (ITT) Aerospace/Optical Division. The scope of the study was limited to the following:

(1) All six steps of the HARDMAN methodology were performed.

(2) All components of the receiver/transmitter (R/T) basic unit and the following optional components were analyzed:

Communications Security (COMSEC)
Electronics Counter - Countermeasures (ECCM) Unit
ECCM Fill Device
Digital Data Device
Securable Remote Control Unit (SRCU)
Intra-Vehicular Remote Control (IVRC) Unit
Net Control Unit (NCU)

(3) Only SINCGARS-specific maintenance workload was computed.

(4) Manpower requirements for the crew, organizational, direct support and general support levels of maintenance were determined.

2.2 DATA COLLECTION

The HARDMAN methodology has the capability to provide a range of information on emerging system and other supportability requirements which may provide valuable information to program managers, system developers and logistics planners. To fulfill the capability, however, HARDMAN is necessarily data intensive. HARDMAN's validity is based on its utilization of historical operator, maintainer and other workload data on mature, fielded equipments.

Therefore, any plan for a HARDMAN analysis must have adequate data collection as its foundation.

There were two major concerns with respect to data collection and utilization in the SINCGARS study, both driven, to a large extent, by data availability. The first concern was timeliness. Despite the fact that the individual analysis steps of HARDMAN can proceed independently in the early stages of an application, they become increasingly interdependent as time goes on. In most situations, delays in dta collection actions pose the greatest risk to the smooth progress of each analysis step and ultimately, to the collective analysis. If the HARDMAN analysis were PERT-charted, the critical path would include data collection tasks.

The second concern was data adequacy. Of primary importance was the collection of adequate data to support analysis procedures and validate judgments during the SINCGARS study. Identifying data requirements early, therefore, became a prime concern. Data source, content and format, procurement procedures and procurement time had to be assessed. The data were then requested through proper channels. The data request was closely followed up until receipt. Whenever data collection problems were anticipated, a second source of the data was contacted or other types of data were considered.

Planning and coordinating the SINCGARS data collection was the initial effort in the study. Data requirements were first projected for each of the major analysis areas: general program information, functional requirements, equipment characteristics, manpower, personnel, and training. Within these categories, there are standard documents available for most acquisition programs. The following are examples of the initial documents that were obtained in support of the SINCGARS study:

- o General/Functional Requirements
  - Required Operational Capability (ROC)
  - Operational and Organizational (O&O) Plan
  - Acquisition Plan

- o Equipment Characteristics
  - Of system being replaced - operation and maintenance manuals, historical workload data
  - Of new system - preliminary hardware contractor proposals and other documents

- o Manpower - Army Manpower Determination criteria (MACRIT)

- o Personnel - for relevant MOS
  - Personnel Statistics

- o Training - for relevant MOS
  - Programs of Instruction
  - Trainer's Guides
  - Soldier's Manuals

A more comprehensive list of required data evolved as the SINCGARS analysis progressed. More detailed lists of data inputs and sources are included in discussions of specific analyses in Section 3.

2.3 PROCEDURAL STEPS AND JUDGMENTS

The HARDMAN methodology consists of a series of procedural steps and judgments that project the MPT requirements of an emerging system. Judgments are made based upon historical data gathered on comparable existing systems. As previously discussed, data had to be available to support these processes; indeed, the quality of the results was only as good as the quality of input data. Additionally, whether a process was merely a procedure or involved a judgment depended upon the availability of data.

Procedural steps and judgments performed during the HARDMAN application to SINCGARS included the following:

Procedural Steps	Judgments
analyses of contractor proposed designs	best selection of existing equipment comparable to SINCGARS for BCS
data manipulations	projections of new system characteristics data extrapolations
impact measurements	impact assessments

The completeness of data collected determined whether a process would be a procedural step or would require a judgment, for example in the case of a data manipulation or a data extrapolation. In the case of reference system equipment selection, there was no procedural step to avoid judgments required in selecting existing equipments to compare functionally with projected SINCGARS. The impact measurement procedural step involves a mere comparison of reference and contractor-projected system parameters, whereas the impact assessment judgment requires an estimate of the impact of reference-to-proposed system design differences of a particular system parameter. Since SINCGARS judgments were less precise than data driven procedural steps, analysts attempted to minimize the number of judgments required and reduce the breadth of those judgments which could not be eliminated. This effort improved the precision of the overall analysis. Considering the hard data vs. judgment question, judgment minimization was accomplished by executing a well-organized data collection plan.

2.4 SINCGARS ANALYSIS PLAN

Estimation of the MPT requirements for the two SINCGARS proposed designs was planned in two phases. Phase I analyzed SINCGARS program requirements, developed the data collection plan, determined SINCGARS functional requirements, analyzed the two contractor proposals with respect to comparable existing systems, and determined manpower requirements. Phase II determined personnel and training requirements and conducted impact and tradeoff analyses. The Phase I and II planning schedules are shown in Figures 2-1 and 2-2 respectively.

2.5 ANALYSIS OF THE RESULTS

The SINCGARS analysis specified plans for study result content and format. The data had to support identifying MPT requirements for the two proposed SINCGARS designs. Data had to provide the SINCGARS Program Manager, logistics specialists and other analysts with the ability to appraise the sensitivity of SINCGARS MPT requirements over a wide variety of factors.

Due to the modular concept of the SINCGARS design and the existence of seven unique manpack and vehicular configurations, key engineering and manpower parameters were organized into a matrix format. Mission profile/operating scenarios (usage rates) and equipment populations were factored into the two design proposals and integrated across the seven SINCGARS cofigurations. These factors, and the results they influenced, would then be able to be revised as system parameters evolved or as tradeoffs were identified and analyzed.

The restricted availability of data for each SINCGARS alternative impacted the results of the study. The "competition sensitive" nature of the two proposed systems data constrained the depth and currency of the data available for consideration in the analysis. For example, the DT/OT test results for each alternative could not be released by the SINCGARS Program Office. Additionally, security requirements caused information on the KYV-4 VANDAL COMSEC equipment to be unavailable for the analysis.

Also of significance were the disparities between the equipment coverage of the Logistic Support Analysis Records (LSAR) received from the two contractors. These disparities were a major contributor to the magnitude of the MPT discrepancies between the two proposed designs and hindered comparability analyses of many sub-systems.

The mission scenario and equipment population input data used for each of the seven SINCGARS configurations could also measurably affect the analysis results. These parameters were analyzed independently by DRC and, therefore, generated MPT results which may differ from an Army approved alternative. Other assumptions made, such as the individual manpower capacity factor, may affect the results similarly. In summary, when assessing the accuracy of the SINCGARS analysis results, the data quality upon which the analyses were dependent must be carefully weighed.

3

SECTION 3 - ANALYSIS PROCEDURES AND RESULTS

3.1 FUNCTIONAL REQUIREMENTS ANALYSIS

3.1.1 General

Functional Requirements Analysis determines the range (what) and depth (to what extent/or how well) of all of the functions that the system is required to perform on the battlefield. It is necessary to do this analysis because typically this information is not specified for a new or emerging system. In this application the Required Operational Capability (ROC) and the Operational and Organizational (O&O) plan documents were available for SINCGARS. These were used as the starting point for this analysis.

The SINCGARS functional requirements analysis was accomplished in four steps:

1. The mission requirements of SINCGARS were defined. A mission, stated in or derived from program initiation documents, is a primary function or activity which the system is required to perform.

2. System operating functions necessary to meet these missions were delineated next. These were analyzed in the context of conditions likely to be present on the battlefield and the performance desired. Performance standards relating to particular functions were defined by program initiation documents as measures of performance

capabilities. System functional requirements, i.e., inherent characteristics of the system or those dictated by its presence on the battlefield were thus defined.

3. The functional requirements were allocated for performance by humans, generic equipment information, or a combination. The SINCGARS functional requirements analysis was the first analysis conducted using the DRC-developed System Description Technology (SDT), which facilitates this process.

4. A generic task taxonomy, or list, was developed based on the assignment of functions to humans and generic equipment. The result was a complete list of human tasks.

3.1.2 Data Inputs and Sources

The data required to support this analysis are of three types:

1. Requirements Documents: These are doctrinal and program-specific documents which discuss or establish the mission need for the system and specify the functions that have been identified for the system. The source for these is the program office.

2. Functional Description Documents: These are documents which describe existing or proposed equipment and the use of this equipment. These include Technical Manuals, Field Manuals, and contractor developed system descriptions. These documents are useful in providing detail to the proposed system description in the requirements documents. The

sources for these include the program office, TRADOC libraries and schools, and other services.

3. Task Description Documents: These are used to develop the generic task taxonomy for the system. These documents include Trainer's Guides and LSAR documents for the proposed systems. A complete list of the references for the SINCGARS functional requirements analysis is located in section 3.1.4 of this report.

3.1.3 Analytic Procedures

Mission Requirements

The requirements documents for the SINCGARS system, additional mission analysis documents, and recent articles and publications which identify the enemy threat and define future Army doctrine were reviewed. The contents of these documents were then summarized. The purpose of this process was to define the activities and events which the SINCGARS system must perform on the battlefield. This information provided the focus for the functional requirements analysis.

Functions and Performance Standards

The requirements documents were again examined to develop a list of supporting functions the SINCGARS system must perform to accomplish each of its missions. This initial list was augmented with functional descriptions of equipment and systems.

The requirements documents also provided the performance standards for the SINCGARS system. These were grouped under four broad categories.

1. Range
2. Volume of Information
3. Survivability
4. Availability

Range measures specified the distances communications must travel; volume measures affect the amounts of different information the system can accommodate at any given point in time; survivability measures specify the requirements for system performance conditions; and availability measures affect the number of different SINCGARS systems available and the length of time SINCGARS will be available on the battlefield.

All functions and performance requirements which are identified for the system are the basis for generating a generic equipment list which will aid in the identification of the specific baseline comparison equipment. The generic equipment list contains the possible types of equipment which may satisfy the functional requirements (e.g., receiver/transmitter). This selection process is interactive with the engineering analysis. From the generic equipment list, a generic task list is developed. The development of the generic equipment and task lists is the first step in performing a functional allocation and defines the overall structure of the functions, equipment and people which make up the system. This structure provides a common point of departure for the engineering, manpower, personnel, and training analysis, and can be used to make quality control checks during these subsequent steps in the analysis.

Functional Requirements

Once the system functions, system performance standards, and equipment which comprise the SINCGARS were identified, these were documented as functional requirements for the system. This was done for SINCGARS by relating the following categories of information.

1. Function - The system activity necessary to accomplish the mission.

2. Measure - The unit of measure for assessing system activity.

3. Improvement - The change in the measure e.g., increase, reduce.

4. Performance Standard - The degree or objective of the change in measure.

5. Functional Assignment - The system element (equipment and/or people) which performs the function.

Generic Task Taxonomy

The functional requirements documentation along with the task description documents were used to develop a generic task taxonomy. The objective of the taxonomy is to provide a starting point for development of task descriptions in the reference and proposed system. It serves a vital purpose for workload aggregation during the manpower analysis and for subsequent training requirements analysis. This starting point facilitates task comparisons between reference and proposed systems, and provides continuity between the manpower and training task analyses, permits the rapid recovery of task and equipment information from the data base, and facilitates the analysis of design impacts on manpower and training requirements.

3.1.4 Results

Mission Requirements

SINCGARS mission requirements were defined in response to the anticipated characteristics of the enemy and the new tactical strategies required to overcome this threat on the battlefield.

Air/land battle tactics have been under intensive evaluation and extensive modification over the past decade. The results of this process were a series of studies and documents which defined the battlefield tactical requirements for overcoming this threat. These documents and studies include The Battlefield Development Plan (BDP), the Division 86 studies, and most recently the Air Land Battle 2000.

The battlefield task of the SINCGARS is communications. The SINCGARS will convey the information which feeds the tactical decision making and planning process and the information which results in the implementation of the tactical plan on the battlefield. Without the effectiveness of SINCGARS, command and control of the battlefield cannot be accomplished. SINCGARS will perform this mission in a broad diversity of weapon and command and control systems. It must also be capable of accepting a broad spectrum of information formats to include the spoken word and digital inputs of different types such as teletype and facsimile.

SINCGARS Performance Standards for the measures of system performance are contained in the SINCGARS Organizational and Operational (O&O) Concept and the required Operational Capability (ROC). These measures and standards have been listed under the four broad categories of (1) Range, (2) Volume of Information, (3) Survivability and (4) Availability.

SINCGARS Generic Equipment List

The SINCGARS Generic Equipment List is divided into three sections. Table 3.1-1 lists the seven (7) configurations which are included in the SINCGARS. Table 3.1-2 lists the common components which are arranged in different combinations for each configuration and Table 3.1-3 lists the optional components which may be added to a configuration based on the mission requirements and condition present in a specific operational environment. The number column in these two tables contain the Equipment Configuration Identification Codes which were assigned to each component during the equipment analysis. Table 3.1-4 shows which common components are assigned to the basic receiver/ transmitter (R/T) unit in each of the seven (7) configurations.

Table 3.1-1 SINCGARS Configurations

NUMBER	EQUIPMENT
1	CONFIGURATIONS V1-V7
1.1	V1 MANPACK
1.2	V2 VEHICULAR SHORT RANGE RADIO
1.3	V3 VEHICULAR SHORT RANGE/MANPACK
1.4	V4 VEHICULAR SHORT RANGE & LONG RANGE
1.5	V5 VEHICULAR LONG RANGE RADIO
1.6	V6 VEHICULAR SR DISMOUNTABLE AND LR
1.7	V7 DUAL LONG RANGE

Table 3.1-2 SINCGARS Common Components

SINCGARS GENERIC EQUIPMENT

NUMBER	EQUIPMENT
2.1	RECEIVER TRANSMITTER
2.1.1	R/T CONTROL & DISPLAY PANEL
2.1.2	SYNTHESIZER
2.1.3	TUNER MIXER
2.1.4	RF AMPLIFIER
2.1.5	AUDIO AMPLIFIER
2.1.6	SQUELCH CIRCUIT
2.1.7	DETECTOR/DEMODULATOR
2.1.8	MODULATOR
2.1.9	POWER SUPPLY
2.1.10	IF AMPLIFIER
2.1.11	MEMORY
2.1.12	ANTENNA COUPLER
2.2	ANTENNA
2.2.1	ANTENNA WHIP
2.2.2	ANTENNA VEHICULAR
2.3	MOUNTING SUBSYSTEMS
2.3.1	VEHICULAR APPLIQUE
2.3.1.1	MOUNTS
2.3.1.2	INTERCONNECTING CABLES
2.3 2	MANPACK APPLIQUE
2.3.2.1	BACKPACK
2.3.2.2	BATTERY
2.4	RF POWER AMPLIFIER
2.5	HEADSET/HANDSET

Table 3.1-3 SINCGARS Optional Components

NUMBER	EQUIPMENT
3.1	ECCM UNIT
3.2	REMOTE FILL DEVICE
3.3	DIGITAL DATA DEVICE
3.4	SECURABLE REMOTE CONTROL UNIT (SRCU)
3.4.1	SRCU CONTROL & DISPLAY PANEL
3.4.2	BATTERY
3.5	INTRA-VEHICULAR REMOTE CONTROL (IVRCU)
3.5.1	IVRCU CONTROL & DISPLAY PANEL
3.6	NET CONTROL UNIT (NCU)
3.6.1	NCU CONTROL & DISPLAY PANEL
3.7	COMSEC UNIT
3.7.1	COMSEC CONTROL & DISPLAY PANEL
3.7.2	COMSEC FILL DEVICE

Table 3.1- 4 SINCGARS Configuration Composition (Basic Unit)

	V1	V2	V3	V4	V5	V6	V7
R/T	1	1	1	2	1	2	2
Manpack Antenna	1		1			1	
Vehicular Antenna		1	1	2	1	2	2
Power Amp				1	1	1	2
Vehicular Applique		1	1	1	1	1	1
Manpack Applique	1		1			1	

SINCGARS Functional Requirements

Table 3.1-5 lists the functions performed by the men and equipment in the system and relates these to the measures of system performance, the standard for the measure, and shows the assignment of function to generic equipment or people. The functioning of the system is divided into the categories of "Operate SINCGARS" and "Be Supportable". The emphasis is placed on system operation because the support requirements for the system follow from the operation of the system. By summarizing the relationship between functions, equipment, and people, it establishes a common organization for these system elements which assists in the subsequent analyses. The standard column on this table refers to the specific standard for the measure which is listed in Table 3.1-6.

The SINCGARS functions are listed to the fourth level of indenture. The horizontal lines on the table separate the first, second and third levels of indenture. At the third level of indenture, generic and optional components from the generic equipment list are designated and system operators are indicated in the equipment task assignment column of the worksheet, by the entry "people", if humans are needed to perform the function. At the fourth level of indenture, for common and optional components other than control heads and panels, functions are assigned to subcomponents or at the card level.

For control heads and panels, functions are listed and assigned to the generic control at the third level of indenture. Function and sub-component assignment at this level does not match a single proposed system as the final assignment at this level is a function of the design for a

Table 3.1-5 System Functional Requirements

NUMBER	FUNCTION	MEASURE	STANDARD	EQUIPMENT/PEOPLE ASSIGNMENT
1	OPERATE SINCGARS	RANGE	1 0	CONFIGURATIONS V1-V7
		VOL OF INFO· INCREASE	2.0	COMMON COMPONENTS
		SURVIVABILITY INCREASE	3.0	OPTIONAL COMPONENTS
		AVAILABILITY	4.0	PEOPLE
1.1	COMMUNICATE	RANGE:	1 0	RECEIVER TRANSMITTER
		VOL OF INFO INCREASE	2 0	ANTENNA
		AVAILABILITY	4.0	RF POWER AMPLIFIER
				HEADSET/HANDSET
				DIGITAL DATA DEVICE
				PEOPLE
	FORMAT. VOICE,DIGITAL	DIG DATA INPUT RATE INCREASE	2 2	HEADSET/HANDSET
		DIG CONVERSION RATE. INCREASE	2 3	DIGITAL DATA DEVICE
				NCU CONTROL & DISPLAY PANEL
				PEOPLE
	CONTENT N/A			PEOPLE
	MEDIUM· FM			RECEIVER TRANSMITTER
				DETECTOR/DEMODULATOR
1 1 1	TRANSMIT INFORMATION	RANGE	1.0	RECEIVER TRANSMITTER
		DIG DATA INPUT RATE INCREASE	2.2	ANTENNA COUPLER
		DIG. CONVERSION RATE INCREASE	2.3	ANTENNA
		# OF CHANNELS. INCREASE	2.4	RF POWER AMPLIFIER
		# OF PRESET CHANNELS INCREASE	2.5	DIGITAL DATA DEVICE
		VSWR TOLERANCE	4.2	
1 1 1 1	TUNE FREQUENCY			SYNTHESIZER
				TUNER MIXER
				ANTENNA COUPLER
				MEMORY
1 1 1.2	CONVERT DIGITAL DATA			
1 1 1.3	AMPLIFY INPUT			AUDIO AMPLIFIER
1 1.1 4	GENERATE MIXER FREQUENCY			SYNTHESIZER
				TUNER MIXER
1 1 1 5	STABILIZE MIXER FREQUENCY			PEOPLE
1.1 1 6	MIX FREQUENCIES			SYNTHESIZER
				TUNER MIXER
1 1 1 7	GENERATE RF			SYNTHESIZER
				TUNER MIXER
1 1 1 8	MODULATE RF			MODULATOR
1 1 1 9	STABILIZE RF			SYNTHESIZER
				TUNER MIXER
1 1 1 10	AMPLIFY RF			RF AMPLIFIER
				RF POWER AMPLIFIER
1 1 1 11	FILTER HARMONICS			SYNTHESIZER
				TUNER MIXER
				RF AMPLIFIER
1 1 1 12	DETECT SIDETONE			DETECTOR/DEMODULATOR
1.1 1 13	AMPLIFY AUDIO			AUDIO AMPLIFIER
1 1 1 14	MINIMIZE POWER LOSS			ANTENNA COUPLER
				ANTENNA
1 1 1 15	PROTECT AGAINST REFLECTED POWER			RF AMPLIFIER
				RF POWER AMPLIFIER
1 1 1 16	RADIATE RF			ANTENNA
1 1 1 17	PROTECT RECEIVER CIRCUITS			RF AMPLIFIER
1.1 2	RECEIVE INFORMATION	DIG DATA INPUT RATE INCREASE	2 2	RECEIVER TRANSMITTER
		DIG CONVERSION RATE· INCREASE	2 3	ANTENNA COUPLER
		# OF CHANNELS INCREASE	2 4	ANTENNA
		# OF PRESET CHANNELS· INCREASE	2 5	HEADSET/HANDSET
				DIGITAL DATA DEVICE
1.1.2.1	TUNE FREQUENCY			SYNTHESIZER
				TUNER MIXER
				ANTENNA COUPLER
				MEMORY
1 1 2 2	COLLECT RF			ANTENNA
1 1 2 3	MINIMIZE POWER LOSS			ANTENNA COUPLER
				ANTENNA
1 1.2 4	AMPLIFY RF			RF AMPLIFIER
1 1 2 5	GENERATE MIXER FREQUENCY			SYNTHESIZER
				TUNER MIXER
1 1 2 6	STABILIZE MIXER FREQUENCY			SYNTHESIZER
				TUNER MIXER
1 1 2.7	AMPLIFY IF			IF AMPLIFIER
1 1 2 8	FILTER HARMONICS			SYNTHESIZER
				TUNER MIXER
				IF AMPLIFIER
1 1.2.9	DETECT INFORMATION			DETECTOR/DEMODULATOR
1 1.2 10	SQUELCH NOISE			SQUELCH CIRCUIT
1 1 2 11	AMPLIFY OUTPUT			AUDIO AMPLIFIER
1 1.2 12	CONVERT DIGITAL DATA			DIGITAL DATA DEVICE
1 1 3	RETRANSMIT INFORMATION			RECEIVER TRANSMITTER
1 1 3.1	INTERCONNECT R/T UNITS			CABLE ASSEMBLY
1 1.3 2	SAME AS 1 1 2			
1 1.3 3	SAME AS 1 1 1			

Table 3.1-5 System Functional Requirements (Con't).

1 2	COMMAND CONTROL	VOLUME OF INFO. INCREASE SURVIVABILITY	2.0 3.0	RECEIVER TRANSMITTER HEADSET/HANDSET REMOTE FILL DEVICE SECURABLE REMOTE CONTROL UNIT (SRCU) INTRA-VEHICULAR REMOTE CONTROL (IVRCU) NET CONTROL UNIT (NCU) COMSEC FILL DEVICE PEOPLE
1 2 1	CONTROL COMMUNICATIONS LOCALLY	# OF CHANNELS: INCREASE # OF PRESET CHANNELS: INCREASE # OF POWER SETTINGS KHZ OF FREQUENCY OFFSET INCREASE	2.4 2.5 3.1 3.2	RECEIVER TRANSMITTER PEOPLE
1 2 1.1	SET POWER			R/T CONTROL & DISPLAY PANEL
1 2 1 2	SELECT FREQUENCY			
1.2.1 2.1	PRESET FREQUENCY			MEMORY
1 2 1 2 2	SET FREQUENCY			
1.2 1.3	SET RECEIVE TRANSMIT			HEADSET/HANDSET
1 2 1 4	SET VOLUME			R/T CONTROL & DISPLAY PANEL
1 2.1 5	SET SQUELCH			
1 2 1 6	SELECT VOICE DATA			
1 2 1 7	SELECT SECURE OPERATION			R/T CONTROL & DISPLAY PANEL COMSEC CONTROL & DISPLAY PANEL
1 2 1 8	SELECT ECCM			R/T CONTROL & DISPLAY PANEL
1 2 1 8	SELECT FREQUENCY HOPPING			
1 2 1 8 2	CUE NET ENTRY			
1 2 1 8 3	SELECT FREQUENCY OFFSET			
1 2 1 8 4	SELECT RF POWER LEVEL			
1.2 1 9	SELECT BUILT IN TEST			
1 2 2	CONTROL COMMUNICATIONS REMOTELY	# OF RADIOS CONTROLLED INCREASE # OF CHANNELS: INCREASE # OF PRESET CHANNELS. INCREASE # OF POWER SETTINGS INCREASE KHZ OF FREQUENCY OFFSET INCREASE	2.1 2.4 2.5 3.1 3.2	HEADSET/HANDSET SECURABLE REMOTE CONTROL UNIT (SRCU) INTRA-VEHICULAR REMOTE CONTROL (IVRCU) PEOPLE
1 2 2.1	SET POWER			SRCU CONTROL & DISPLAY PANEL IVRCU CONTROL & DISPLAY PANEL
1 2 2 2	SELECT FREQUENCY, SAME AS 1 2 1 2			SRCU CONTROL & DISPLAY PANEL IVRCU CONTROL & DISPLAY PANEL
1.2 2 3	SET RECEIVE TRANSMIT			HEADSET/HANDSET SRCU CONTROL & DISPLAY PANEL
1 2 2 4	SET VOLUME			SRCU CONTROL & DISPLAY PANEL IVRCU CONTROL & DISPLAY PANEL
1 2 2 5	SET SQUELCH			SRCU CONTROL & DISPLAY PANEL
1.2 2 6	SELECT VOICE/DATA			SRCU CONTROL & DISPLAY PANEL
1 2 2 7	SELECT SECURE OPERATIONS (COMSEC)			IVRCU CONTROL & DISPLAY PANEL COMSEC CONTROL & DISPLAY PANEL
1 2 2 8	SELECT ECCM, SAME AS 1 2.1 8			SRCU CONTROL & DISPLAY PANEL IVRCU CONTROL & DISPLAY PANEL
1 2 2 9	SELECT BUILT IN TEST			
1 2 2 10	SELECT RADIOS			INTRA-VEHICULAR REMOTE CONTROL (IVRCU)
1.2 2 11	SELECT VEHICLE INTERCOM			INTRA-VEHICULAR REMOTE CONTROL (IVRCU)
1 2 2 12	SELECT RETRANSMISSION			R/T CONTROL & DISPLAY PANEL IVRCU CONTROL & DISPLAY PANEL
1 2 3	ESTABLISH RADIO NET	# OF RADIOS INCREASE # OF CHANNELS: INCREASE # OF PRESET CHANNELS INCREASE	2.1 2.4 2.5	RECEIVER TRANSMITTER REMOTE FILL DEVICE SECURABLE REMOTE CONTROL UNIT (SRCU) INTRA-VEHICULAR REMOTE CONTROL (IVRCU) NET CONTROL UNIT (NCU) COMSEC FILL DEVICE PEOPLE
1 2 3 1	SET NET FREQUENCY			R/T CONTROL & DISPLAY PANEL SRCU CONTROL & DISPLAY PANEL IVRCU CONTROL & DISPLAY PANEL
1 2 3 2	SYNCHRONIZE FREQUENCY HOPPING			R/T CONTROL & DISPLAY PANEL REMOTE FILL DEVICE NCU CONTROL & DISPLAY PANEL
1 2.3 2.1	SYNCHRONIZE TIME			
1 2 3.2.2	SYNCHRONIZE FREQUENCY			
1 2 3.3	SET COMSEC CODE			COMSEC FILL DEVICE
1 2 4	CONTROL RADIO NET			RECEIVER TRANSMITTER SECURABLE REMOTE CONTROL UNIT (SRCU) INTRA-VEHICULAR REMOTE CONTROL (IVRCU) NET CONTROL UNIT (NCU) PEOPLE
1 2 4 1	CONTROL NET ACCESS			
1 2 4 2	CONTROL MESSAGE TRAFFIC			
1 2 4 2.1	ENTER MESSAGES			
1 2 4 2 2	EDIT/CHANGE MESSAGES			
1 2 4 2 3	ROUTE MESSAGES			

Table 3.1-5 System Functional Requirements (Con't).

1 3	ACCOMMODATE MOBILITY	SURVIVABILITY. AVAILABILITY	3 0 4.0	ANTENNA MOUNTING SUBSYSTEMS INTRA-VEHICULAR REMOTE CONTROL (IVRCU)
1 3 1	ACCOMMODATE MOVEMENT BY MAN	ANTENNA VISIBILITY WEIGHT. BATTERY LIFE	ANTENNA 3 5 4 5	RECEIVER TRANSMITTER ANTENNA WHIP BACK PACK BATTERY PEOPLE
1.3 1 1	GENERATE ELECTRICAL POWER			BATTERY
1 3 1.2	RADIATE/COLLECT RF			ANTENNA WHIP
1 3 2	ACCOMMODATE VEHICULAR MOVEMENT	ANTENNA VISIBILITY WEIGHT· BATTERY LIFE	3 4 3 5 4.5	RECEIVER TRANSMITTER VEHICULAR APPLIQUE INTRA-VEHICULAR REMOTE CONTROL (IVRCU)
1 3.2.1	SUPPLY ELECTRICAL POWER			CABLE ASSEMBLY
1 3 2 2	REGULATE ELECTRICAL POWER			POWER SUPPLY
1.3 2.3	RADIATE/COLLECT RF			ANTENNA VEHICULAR
1 3 2 4	ACCOMMODATE CREW INTERCOMMUNICATION			
1 4	SURVIVE THREAT ENVIRONMENT	SURVIVABILITY:	3.0	RECEIVER TRANSMITTER ECCM UNIT COMSEC UNIT PEOPLE
1 4 1	SECURE COMMUNICATIONS (COMSEC)			RECEIVER TRANSMITTER COMSEC UNIT
1 4 1 1	ENCRYPT INFORMATION			COMSEC UNIT
1 4 1 2	DECRYPT INFORMATION			COMSEC UNIT
1 4 2	PROTECT AGAINST ECCM	KHZ OF FREQUENCY OFFSET: INCREASE RATE OF FREQUENCY HOP: INCREASE	3 2 3.3	RECEIVER TRANSMITTER ECCM UNIT
1 4 2 1	HOP FREQUENCY			SYNTHESIZER TUNER MIXER ECCM UNIT
1 4 2 1 1	SYNCHRONIZE HOP			
1 4 2 2	OFFSET FREQUENCY			
1 4 2 3	CHANGE FREQUENCY			
2 0	BE SUPPORTABLE	AVAILABILITY MTBF VSWR TOLERANCE MTTR MAINTENANCE RATIO % OF BITE SCHEDULED ORG MAINT TIME BATTERY LIFE	4.0 4.1 4.2 4 3 4 4 4 5 4 6 4.7	CONFIGURATIONS V1-V7 COMMON COMPONENTS OPTIONAL COMPONENTS PEOPLE

Table 3.1-6

SINCGARS PERFORMANCE STANDARDS (CAPABILITY)

#	Measure	ROC Standard	O&O Standard
1.0	Range (V1, V2) Manpack VSR		Voice 8km Digital 4.5km
	(V5) VLR		Voice 35km Digital 17km
	Securable Remote (RWI)		4km
2.0	Volume of Information		
2.1	Number of Radios Controlled		3
2.2	Digital Data Input Rates		75 (bps) 150 300 600 1200 2400 4800
2.3	Digital Conversion Rate		16 kb
2.4	Number of Channels	920	2320
2.5	Number of Preset Crypto Net Channels	4	4

Table 3.1-6 (con't).

SINCGARS PERFORMANCE STANDARDS (CAPABILITY)

#	Measure	ROC Standard	O&O Standard
3.0	Survivability		
3.1	Number of Power Settings		
3.2	KHZ of Frequency Offset		$\pm$ 5 kc $\pm$ 10 kc
3.3	Rate of Frequency Hopping During ECCM Operations		
3.4	Antenna Visibility Manpack (V1)		200 meters
	Vehicular		500 meters
3.5	Weight Manpack (V1)	20 lb	
	Battery		2.5 lb 1.1 kg
	COMSEC Unit		2.5 lb 1.1 kg

Table 3.1-6 (Con't).

SINCGARS PERFORMANCE STANDARDS (CAPABILITY)

#	Measure	ROC Standard		O&O Standard	
4.0	Availability				
4.1	MTBF	MAV	1250 hours	Radio	1300 hours
				With ECCM	950 hours
		BOC	3300 hours	With COMSEC	950 hours
				With COMSEC + ECCM	746 hours
	Securable Remote (RWI)	MAC	1250 hours		
		BOC	3300 hours		
	VSR* (V2)			Radio	1250 hours
				With ECCM	920 hours
				With COMSEC	920 hours
				With ECCM + COMSEC	730 hours
	VLR* (V5)			Radio	1250 hours
				With ECCM	920 hours
				With COMSEC	920 hours
				With ECCM + COMSEC	730 hours
	VLR with * Auxiliary Receiver (V7)			Radio	1250 hours
				With ECCM	920 hours
				With COMSEC	920 hours
				With ECCM + COMSEC	730 hours

* Includes securable remote equipment

Table 3.1-6 (Con't).

SINCGARS PERFORMANCE STANDARDS (CAPABILITY)

#	Measure	ROC Standard	O&O Standard
4.2	VSWR Tolerance	Infinite	
4.3	MTTR		
	Manpack (V1)	ORG 15 minutes	ORG 15 minutes
		DS	DS 45 minutes
		GS	GS 2.5 hours
	RWI Device	ORG 15 minutes	
4.4	Maintenance Ratio Manpack	.022	
	RWI Device	.022	
	System		2.2
4.5	BITE - % of Failure Isolated to LRU		
4.6	Scheduled Organizational Maintenance Time	30 minutes per week	
4.7	Battery Life Manpack (V1)	24 hour continuous operation with a normal duty cycle	24 hour continuous operation with a 9 to 1 receive transmit duty cycle

specific system. This same principle applies to the assignment of functions to system operator controls.

SINCGARS Generic Tasks

Table 3.1-7 contains the generic task list for the SINCGARS system. It contains the tasks SINCGARS operators and maintainers will perform during a complete operational cycle of a specific configuration. "Operate SINCGARS", and the action verbs which will be assigned to identify the maintenance actions performed by system maintainers, "Maintain SINCGARS", correlate with the functions identified in the functional hierarchy. However, they are not identical. This difference is a result of the emphasis and purpose of functional requirements and the generic task list. The primary purpose of functional requirements is to allocate functions equipment and people while the primary purpose of the generic task list is to identify the human tasks required to be performed to operate and maintain the system to specifications.

For operators three general types of tasks occur. Figure 3.1-1 displays these generic operator tasks.

1. Tasks which involve preparing the configuration for operation and removing the configuration from operation. (1.1 and 1.3)

2. Tasks involving communicating within the configuration (1.2)

3. Tasks involving the maintaining of the system (2).

Table 3.1-7

SINCGARS GENERIC TASK LIST

1.0	Operate SINCGARS
1.1	Prepare for Operation
1.1.1	Change Mission Profile
1.1.1.1	Install Vehicular Configuration
1.1.1.2	Assemble/Disassemble Configuration
1.1.1.3	Install/Remove Components
1.1.2	Perform Preoperational Inspection
1.1.3	Initialize Configurations/Component
1.2	Communicate
1.2.1	Send and Receive a Message
1.2.2	Operate Configurations/Components
1.2.3	Establish and Control Radio Net
1.2.4	Operate Radio Net
1.3	Remove from Operation
1.3.1	Shutdown Configurations/Component
1.3.2	Perform Post Operational Checks
2.0	Maintain SINCGARS
2.1	Perform Preventive Maintenance
2.1.1	Inspect
2.1.2	Test
2.1.3	Service

Table 3.1-7 (Continued)

2.2	Perform Corrective Maintenance
2.2.1	Inspect
2.2.2	Test
2.2.3	Adjust
2.2.4	Align
2.2.5	Fault Isolate
2.2.6	Remove and Replace
2.2.7	Repair
2.2.8	Overhaul

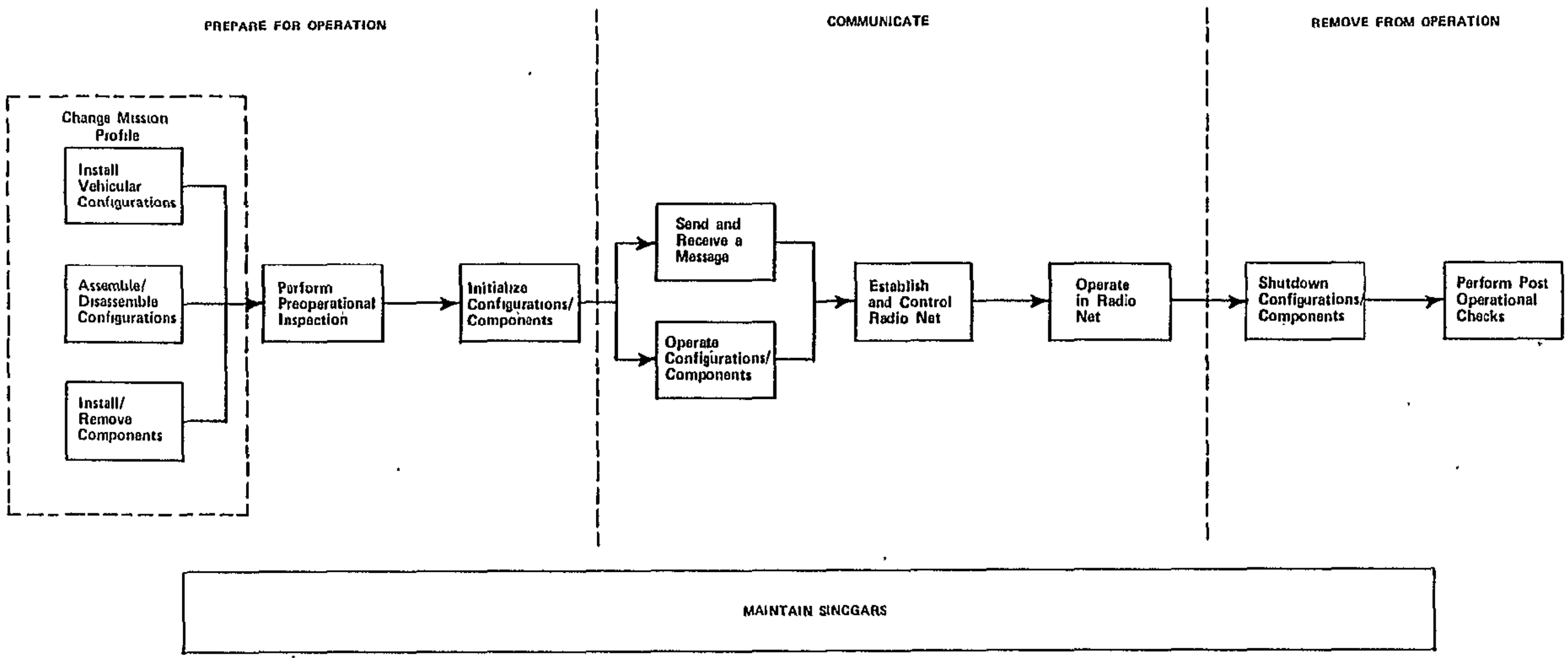

Figure 3.1-1 Operator Generic Tasks

Preparing a system for, and removing a system from operation involves the disassembly and assembly of configurations by removing and replacing components from configurations (1.1), inspecting components for proper condition, insuring proper system operation (1.1.2), and initializing the system by establishing the operating parameters (frequency, ECCM, and COMSEC codes), (1.1.3).

Communicating, using a specific configuration, involves performing the duties of a net controller and a radio operator (1.2.2). The radio operator may communicate in or out of a radio net. These differences in operational requirements and conditions results in the need for these different operator sets of behaviors during task performance. Maintenance tasks are of three general types; system isolation and removal, preventative maintenance and corrective maintenance. Preventative maintenance is scheduled and required at periodic intervals, this type of maintenance tends to overlap for operators with the tasks of preparing a system for operation and taking a system out of operation. Corrective maintenance tasks which are performed when the system is operating improperly. The action verbs used to describe both types of maintenance overlap have little meaning until they are assigned to specific equipment and a level of maintenance. For the SINCGARS these assignments were made on the LSAR. These assignments are examined during training analysis. The generic task list, combined with functional requirements, provides the general framework for structuring the function, equipment and task data, which was used or developed in the subsequent steps of the SINCGARS analysis.

3.2 ENGINEERING ANALYSIS

3.2.1 General

Engineering analysis is the bridge between knowing what the system must do (functional requirements) and what equipment configurations can do to it. The outputs are key elements of the HARDMAN application: the reference, or Baseline Comparison System (BCS), and the proposed system designs. All other HARDMAN analyses are dependent upon these design configurations.

All reference and proposed system configurations must meet or nearly meet the functional requirements determined in Section 3.1. While the reference system will perform all basic functions of the new system, it may not meet all the performance standards required of the new system. If it did, there probably would be no need for the new system. The reference system is used for comparability analysis only and is not intended to be considered an integrated system in itself.

The SINCGARS predecessor systems, i.e., the radio systems it will replace in the field, are the AN/PRC-77 and AN/VRC-12 series radio systems. Information on the predecessor systems contributed to the functional requirements analysis and the generic task identification as described in Section 3.1. While a predecessor system could contribute many of the sub-systems to the reference system configuration, this was not the case with SINCGARS. First, the AN/PRC-77 and AN/VRC-12 predecessor designs were not as technologically advanced as other candidate reference subsystems. Secondly, historical workload data (operation time, maintenance, etc.)

and/or workload parameters (reliability, maintainability, etc.) were not sufficiently available to support an analysis of the requirements for the projected SINCGARS designs. The reference system selection process is discussed further in section 3.2.3 and as it was applied to specific SINCGARS subsystems in section 3.2.4.

The status of the SINCGARS acquisition program meant that considerable design, descriptive, and workload data were available from the two SINCGARS contractors, Cincinnati Electronics and ITT. These data established the two proposed system configurations. The contractor-generated workload data facilitated the determination of proposed system MPT requirements.

3.2.2 Data Inputs & Sources

No one data source contains all the information needed to determine workload for the reference and proposed systems. It is for this reason several documents may be required to determine workload for must one sub-system. These documents may duplicate data information which may or may not be conflicting. All data is reviewed for accuracy and completeness and judgments must be made when values seem inadequate. Table 3.2-1 is an example of data sources available.

Other documentation listed on Table 3.2-1 will provide a means to match the functions of the proposed system equipment to candidate reference system equipment. Documents contain operation, maintenance and technological makeup of individual equipment structures. These documents

Table 3.2-1 Data Sources

SOURCE / Nomenclature	Design Description Sources: Jane's Military Communications	Design Description Sources: FM 24-24 Radio and Radar Reference Data	Design Description Sources: Operator Technical Manuals	Design Description Sources: Maintenance Technical Manuals	Design Description Sources: Marketing Brochure	Design Description Sources: Manufacture's Description	Design Description Sources: Independent Evaluation Reports	R/M Sources: 3M RAM-D	R/M Sources: PMCS	R/M Sources: Maintenance Allocation Chart	R/M Sources: MACRIT
Receiver-Transmitter											
AN/VRC-12	X	X	X	X					X	X	X
AN/ARC-131	X		X					X	X	X	X
AN/ARC-114	X		X	X	X			X	X	X	X
AN/PRC-77	X	X	X	X					X	X	X
AN/PRC-68	X	X			X		X				
AN/PRC-117 (Harris RF-3090P)	X				X						
AN/PRC-116 AN/VRC-84 (Jaguar-V)					X	X					
AN/ARC-164	X				X	X					

are used throughout the study to complete the other steps of the HARDMAN methodology.

3.2.3 Analytic Procedures

The primary goals of the SINCGARS engineering analysis were to analyze, define, and determine the impacts of proposed SINCGARS design alternatives and to support subsequent manpower, personnel and training (MPT) analyses. These goals were achieved through three major tasks:

1. Define a SINCGARS reference system of mature equipments and subsystems.

2. Define the two proposed systems.

3. Identify and quantify the impacts of reference-to-proposed system improvements and design differences.

Reference System Selection

The reference system is design configured to approximate the functional requirements for a projected system. The reference system is a composite of systems and subsystems. If available, the predecessor system may form the source for selection of many of the reference sub-systems/equipments. Supplemental equipments are included in the reference system to overcome functional deficiencies of the predecessor.

The reference system is not intended to be a fully integrated design but rather as an analytic tool in comparability analysis. In this sense it satisfies the requirement for a Baseline Comparison System (BCS) as stipulated in MIL-STD-1388-A, Logistic Support Analysis.

For the SINCGARS study, the criteria for selecting reference system equipments were the following:

(1) Selected equipment had to meet required system functions and approach required system performance levels.

(2) Selected equipment had to have available mature reliability/maintainability (R/M), workload and other data.

(3) Where design information for the proposed system existed, the technology of the selected reference equipment was to be as close as possible to that of the proposed design.

The third criterion was particularly important in the study of SINCGARS due to the advanced stage of the contractor designs. For both contractors, descriptions of the designs were available for the majority of proposed SINCGARS subsystems.

The reference system selected met all of the SINCGARS functional requirements, reflected mature, existing technology, and had verifiable reliability/maintainability and workload data available for analysis. A detailed discussion of reference equipment selections is included in Section 3.2.4.

Determination of Proposed Systems

The next step of the engineering analysis focused on the development of the two SINCGARS proposed systems. The proposed system is defined as the best estimate of new system design, incorporating modified or improved design features, technological advances, new operating and support concepts and changes to other system elements. As with the reference system, each proposed system must fulfill all functional requirements. Unlike the reference system, however, the proposed systems are expected to meet all standards with respect to system performance criteria. An acquisition program with multiple proposed systems, such as SINCGARS, reflects a variety of potential design solutions that can be analyzed concurrently.

Considerable SINCGARS contractor design data were available for analysis. The data were first evaluated for weapon system mission fulfillment. One of the following two situations applied to the contractor - proposed designs:

(a) A proposed system component met a SINCGARS functional requirement and directly corresponded to a reference system component, or

(b) The proposed system did not fulfill all SINCGARS functional requirements and for that reason, was incomplete.

In the first situation, contractor components were automatically included in the respective proposed system configuration. This was the case for all but two of the equipments in each of the contractor - proposed designs. In the second situation, equipment assigned to perform some functional requirements was missing and additions to the proposed system had to be generated. The two components for which this was required were the communications security (COMSEC) unit and the Securable Remote Control Unit (SRCU).

The proposed systems for both the Cincinnati Electronics and ITT configurations are discussed in greater detail in section 3.2.4. Next, the Design Difference Index, a detailed list of reference-to-proposed system design differences, needed to be generated for subsequent analysis of design impacts on system workload. The analysis worksheet for this procedure is termed the Design Difference Index (DDI). Table 3.2-2 illustrates the DDI data sheet format. Delineation of all reference-to-proposed design differences was conducted in one of two ways:

(a) If a proposed system equipment design description was available, potential design improvement areas and new technologies were determined from an examination of the contractor's description.

(b) If a proposed system equipment design description was not available, potential design improvements and new technologies were analyzed and estimated by engineering judgment.

The design differences of greatest concern were those with potential workload impacts. Differences were related to the areas of technology, reliability/maintainability, task allocation, operating and support concepts and operating environment. For situation (b) above, two major sources of information on potential design improvements and new

Table 3.2-2. Design Difference Index Data Sheet Format.

Code	Reference	Proposed	Difference	Source	Impact	PV	Remarks
Functional Group Code,[1] Locally Assigned Code, etc.	Reference System Component	Proposed System Component	Reference to Proposed Design Differences: Technology R/M Task Allocation Operating and Support Concepts Operating Equipment	Pertinent technical documents and historical data	MPT Impacts (if any) of each design difference	Assign Perturbation value(s) (PV) to quantify each impact	Application of the perturbation values Additional miscellaneous information

[1] Functional Group Code, U.S. Army Technical Bulletin 750-93-1

Functional Group Code – A standardized system to index material for ready identification. The basic or two-digit code identifies the major assembly, and the next two digits identify the subassembly, and/or part within the major assembly.

Example: Code 01 identifies an engine assembly and Code 0102 identifies the crankshaft and related parts within the engine assembly. Similar to Work Unit Code or Work Breakdown Structure.

technologies were used: system equipment-related literature and documents, and interviews with subject matter experts. An example of one expert was Mr. Walter T. Ayer of the Harris Corporation who assisted with the engineering analysis of the AN/PRC-117, and ECCM equipment similar to SINCGARS. The information from all sources was used to assist judgments made for design differences. All design differences were cataloged on the DDI worksheets.

Reference system workload data, reference-to-proposed design differences and, when available, contractor-predicted proposed system workload data were the bases for SINCGARS proposed system workload estimates. Since by definition, the proposed system lacked mature data, determining the proposed system's workload parameters involved an estimate based on engineering judgment rather than a calculation (as with the reference system). Minimizing the errors of the estimates was a major concern and was accomplished by compatibility analysis between the reference and proposed systems. Impacts of each design difference on reference system mature workload data were carefully assessed and estimated. These estimated impacts were stated in terms of changes in requirements for tasks, task times, task frequencies, MOS/skill level requirements for tasks and task assignments to maintenance levels.

The impacts of system design differences are described in the "IMPACT" column of the Design Difference Index (DDI) begun in the previous step. The impacts are quantified in the "PV" (perturbation value) and qualified in the "REMARKS" columns respectively.

Reference system workload data were then modified to reflect the estimated impacts. SINCGARS MPT requirements were projected from the modified data. As the proposed system becomes defined during the course of the acquisition process, refinements to proposed system estimates may be performed by revising the initial assumptions made affecting the analysis.

In those instances when the contractor proposed system designs were available, they facilitated selection of the reference system equipments and generation of design difference information. When contractor proposed system workload estimates were available, those estimates were utilized to determine system MPT requirements in place of modified reference system data. Accuracy of the proposed system MPT estimates was, therefore dependent upon the following three factors:

(1) Validity of reference system design and workload data.

(2) Validity of the engineering judgments made during comparability analysis in modifying reference system data.

(3) Validity of contractor estimates of proposed system workload.

3.2.4 Results

General

Selections of reference system components were greatly facilitated by the availability of contractor design descriptions. The SINCGARS engineering analyst attempted to match the characteristics of candidate reference systems to those of the projected systems.

Due to the availability of contractor proposed system design descriptions, generation of the two proposed system equipment configurations was not so much an extrapolation from the reference system as extraction from the contractor-provided documents. Of greatest challenge in the generation of the two proposed systems was the Securable Remote Control Unit (SRCU), which was not addressed by the contractor designs. Design differences between the reference and proposed systems were derived through an item by item comparison.

Similarly, the impacts of design differences on SINCGARS system workload were for several subsystems, quantified and qualified by the contractor - predicted R/M data contained in various Logistic Support Analysis Records (LSARs). For subsystems not covered by the LSAR, estimates of workload impacts were projected through comparability analysis.

Reference system supporting equipment was selected from DoD/NATO inventory based on its ability to meet required functional requirements. Table 3.2-3 lists the final reference system components selected associated with generic equipment. Table 3.2-4 list the number of units for configurations 1-7.

Reference System

Basic Unit

Receiver/Transmitter

The receiver/transmitter (R/T) selected for the reference system was the AN/ARC-114. The selection of this major subsystem was the most important in the study. Its selection followed an examination of a variety of candidate R/Ts.

Each candidate R/T had similarities to the proposed SINCGARS R/Ts. The AN/PRC-77 and AN/VRC-12 were discarded due to dated technology while the AN/PRC-68, AN/PRC-117, AN/PRC-116, AN/VRC-84 and AN/ARC-164 were eliminated due to lack of usable R/M data. The AN/ARC-114 R/T was selected over the AN/ARC-131 based upon its technological proximity to the proposed SINCGARS R/Ts and the availability of historical R/M data. The AN/ARC-114 is a state-of-the-art R/T unit utilizing large scale integration (LSI) in its network circuits.

Additionally mature R/M data for the unit were available from the Navy Maintenance Material Management (3-M) System data base. The R/M values associated with the AN/ARC-114 were compiled from historical Navy aircraft maintenance actions and were adequate to support a SINCGARS R/T analysis. The 3-M data included induced as well as inherent failures of the R/T. Preventive maintenance tasks were derived from the PMCS and MAC charts contained in AN/ARC-114 operator and maintainer technical manuals (TM's). Finally, the assignment of corrective maintenance workload across maintenance levels was accomplished from MACRIT data.

Antenna Coupler

The CU2051/VR antenna coupler was taken from the E-2 aircraft. This VHF antenna coupler performs the same functions as the proposed systems. The workload for ITT was included in the R/T unit although CE singled out the antenna coupler. The reference system used the CU 2041/VR for CM workload and the PM was from the VRC-12 series radio.

TABLE 3.2-3
Reference System

Generic Equipment	Reference Equipment
Receiver/Transmitter	AN/ARC-114
Whip Antenna	AT-892/PRC-25
Vehicular Antenna	AT-1095/VRC
Antenna Coupler	CU2041/AR
RF Amplifier	AM6176/URC
Battery	BA-4386/u
ECCM	SN416()/APX-76
COMSEC	KY-57/TSEC
ECCM Fill Device	KYK-13/TSEC
Digital Data Device	CV2837/ARN 84(V)
SRCU	C-2328/GRA-39
IVRC	C416(V)/AIC-22(V)
Net Control	KYK-15/TSEC

Table 3.2-4 SINCGARS Reference System

Basic Unit	V1	V2	V3	V4	V5	V6	V7
Receiver/Transmitter	1	1	1	2	1	2	2
Antenna Coupler	1		1		1		
Whip Antenna	1		1		1		
Vehicular Antenna		1	1	2	1	2	2
Battery	1		1		1		
RF Amplifier				1	1	1	2
Optional							
ECCM	0	0	0	0(2)	0	0(2)	0(2)
COMSEC	0	0	0	0	0	0	0
ECCM FILL	0	0	0	0	0	0	0
Digital Data Device	0	0	0	0	0	0	0
SRCU	0	0	0	0	0	0	0
IVRC	0	0	0	0	0	0	0
Net Control	0	0	0	0	0	0	0

0 - 1 unit, optional
0(2) - 2 units, optional

Antenna

There were two antennas used in the study because of their applications in two different uses. The AT-892/PRC-25 from the AN/PRC-77 was used for descriptive data and both PM&CM and R/M data. This unit was used in the manpack system. In the vehicular system, the AS-1729/VRC was used also for the same data. Both units are used with the predecessor and will fulfill most of the functional requirements. This component will not drive the workload because other than the potential for the antenna being broken off there is no other CM workload.

RF Amplifier

This unit was difficult to define because of the lack of R/M data on these units. It was for this reason that we chose the AM 6176/URC RF amplifier for the reference system. Both CM&PM were taken from this unit. Functionally, it is the same as the proposed system's although its technology is not as advanced.

Battery

The reference system battery, BA-4386/U from the AN/PRC-77 was used because it was a fielded battery used in the same environment and has the same functional requirements as the proposed systems. The maintenance will be generally similar to those of the proposed systems. The major difference will be in the reliability but in this case reliability will be reflected in the useful life of the battery. Proposed system batteries have shown improvement in the useful life of the battery.

Optional Units

Electronic Counter-Countermeasure (ECCM)

The synchronizer from the AN/APX-76 interrogator set was chosen for the electronic counter-countermeasure (ECCM) system. The selection of this sub-system was based on similar circuitry to that required for frequency-hopping and the availability of R/M data. Tuned digital pulses will initiate and control each frequency hop. Although the synchronizer in the AN/APX-76 interrogator is functionally very different than the SINCGARS ECCM device, the circuits in both systems are state-of-the-art and comprised of similar components.

The R/M availability of the unit was a deciding factor for choosing the AN/APX-76. Of all the synchronizers examined the AN/APX-76 was the only system where R/M data was readily available.

Communications Security (COMSEC)

Security considertions precluded DRC from obtaining data on the KYV-4/TSEC (VANDAL), which is being developed under the direction of the National Security Agency. In its place the KY-57/TSEC (VINSON) was selected as the SINCGARS reference system COMSEC device. VINSON as well as VANDAL will interface with the SINCGARS radios. Descriptive data for operation and maintenance of VINSON was available in similar sources such as Operator and Maintenance Technical Manuals. These manuals identified the preventive maintenance (PM) workload. For application of corrective maintenance (CM) workload the KY-28 encoder was used.

ECCM Fill Device

The KYK-13/TSEC was chosen for the reference system based on its functional use. The proposed systems had vague descriptions of the ECCM Fill Device operation and maintenance. Workload data for the reference fill device were generated from the KY-57 MAC chart. The ITT LSA did not cover the ECCM Fill Device. LSA data were provided by Cincinatti Electronics.

Securable Remote Control Unit (SRCU)

The SRCU was not addressed by the two contractors so there was no design information or workload data. The only insight as to the purpose of the SRCU was the functional requirements generated from the O&O plan. From this the reference system was chosen. The C-2328/GRA-39 remote control unit was used for descriptive and preventive maintenance data and the C4162(V) AIC-22(V) ICS control was used for corrective maintenance data.

Intra-Vehicular Remote Control (IVRC)

The IVRC was chosen from two units for similar reasons as the SRCU. The descriptive data was found on the C4162(V) AIC-22(V) ICS control which was used IVRC for workload data.

Net Control Unit

No directly comparable existing equipment was uncovered for the Net Control Unit reference. Therefore, engineering judgment was applied in deciding to chose the KYK-15/TSEC and utilizing R/M data from the KYK-13/TSEC for the Net

Control Unit. The KYK-15 partially met the functional requirements that Cincinatti Electronics' net control had. Those net control functions in the ITT design are integrated into the ECCM module.

Proposed Systems

Two contractors, Cincinnati Electronics (CE) and International Telephone and Telegraph (ITT) Aerospace/ Optical Division, are competitors as the SINCGARS hardware designers. The two contractor designs differ significantly in terms of equipment configuration, operability, and maintainability. Equipment configurations for each contractor are shown on Table 3.2-5.

The CE and ITT design proposals which were available for analysis substantially defined the two proposed system equipment configurations utilized during comparability analysis. Only the design of the Securable Remote Control Unit (SRCU) had to be projected based upon the reference system AN/GRA-39 remote control unit and technological improvements anticipated to be incorporated in the new design. Development of the SRCU, while still an element of the SINCGARS concept, has been delayed one year. For that reason, contractor data on the SRCU was lacking.

As mentioned previously, development of the next generation communications security (COMSEC) equipment, the KYV-4 VANDAL, was not addressed. For the purposes of this study, the existing KY-57 VINSON COMSEC was included in the reference and both proposed equipment configurations.

Table 3.2-5 PROPOSED SYSTEMS

Cincinnati Electronics	ITT
Basic Units	
Receiver - Transmitter	Manpack/Vehicular R/T
Manpack Antenna Coupler	
Manpack Whip Antenna	Manpack Whip Antenna
Vehicular Antenna	Vehicular Antenna
Manpack R/T Battery	Manpack Battery, Dry
Mounting Assembly (Single or Dual)	Mounting Base
Interconnecting Box	(Single Vehicular or Radio Dual)
Mounting Adapter	
RF Amplifier	Power Amplifier
Optional Components	
VINSON COMSEC	VINSON COMSEC
ECCM	ECCM Module
ECCM Fill Device	KYK-13/TSEC
Digital Data Device	Data Rate Adapter
SRCU	Interconnecting Box, Remote Control
IVRC Control Assembly and Access Control Box	IVRC Unit
Net Control Unit	

Cincinnati Electronics

The Cincinnati Electronics (CE) SINCGARS design employs large scale integration (LSI) circuitry and advanced microprocessing technology. A feature of the CE SINCGARS design is the use of a sidehat design philosophy for the SINCGARS optional units. Each sidehat is a self-contained unit with all operator controls located on its face. Sidehat units slide onto the R/T or other sidehat units from the front and are secured with a single thumbscrew lock. This design philosophy allows rapid reconfiguration for changing operational missions and for manpack or vehicular adaptation. The sidehat approach positively affects system supportability by minimizing system downtime and facilitates repair at each maintenance level. Diagnostic capability has been designed into the CE hardware with built-in test (BIT). New Special Test Equipment (STE) will facilitate fault isolation to the module level; modules are easily replaced with their plug-in/pull-out design. Direct Support (D/S) level maintenance will essentially require module remove and replace actions, General Support (G/S) maintenance personnel will isolate faults within modules and repair them by piece part replacement.

The CE SINCGARS R/T is physically much smaller than its ITT counterpart. All optional components are separate sidehat units and are not inherent functions of the basic R/T unit. Similarly, the antenna coupler, which matches impedence to the manpack whip antenna, is a separate unit and plugs into the back of the R/T. In the vehicular models, single or dual mounting assemblies and interconnecting boxes are used for one- and two - R/T models, respecti ely.

The CE ECCM unit is designed to provide orthogonal frequency hopping which allows frequency hopping flexibility without mutual inference within a force structure of many co-located hopping and non-hopping radios. Exact synchronization time is automatically transferred via the radio net to permit frequency hopping. ECCM and keying information can be transferred electronically, using the ECCM Fill Unit, to individual radios or the complete net.

The Digital Data Device in the CE proposed design will permit tactical digital data transmission for a variety of uses such as facsimiles, terminal printers, and missile/gun fire control coordination nets.

A separate Net Control Unit (NCU) is unique to the CE SINCGARS proposed design. Rather than incorporate the net control function into the R/T unit, an NCU was designed for adapting R/T units for net control mode operation. The NCU has a cable interface with the ECCM unit, ECCM fill device, or the KOI-18/TSEC.

International Telephone and Telegraph (ITT)

The ITT SINCGARS design, while using similarly advanced technology (LSI circuitry and microprocessing) took a course different than CE, with respect to the configuration of functional units. All add-on or optional functions were designed to be incorporated within the basic R/T unit rather than being designed as separate units as in the CE concept. As a result, the ITT R/T is physically larger and operator controls for all functions have been placed on its control panel.

Main functions, optional and required, are performed by separate modules within the R/T unit. The manpack antenna matching network is enclosed within all R/Ts and is bypassed in vehicular configurations. The Data Rate Adapter module and the ECCM module are inserted into R/Ts operating in the digital communication and frequency hopping modes, respectively. Both modules perform the same functions as in the CE design. The ITT frequency hopping design is tolerant to large discrepancies in time (+ 1 minute) between R/Ts participating in the net. Initially, the time-of-day is automatically set with the first net coordination transmissions and the oscillator used for frequency derivation maintains synchronization. Up to 100 hours of radio net inactivity can similarly be tolerated without re-synchronization. Net control functions are also accomplished by the ECCM module and any radio equipped with the ECCM module can function is the net control mode. Remote control using either the Securable Remote Control Unit (SRCU) or Intravehicular Remote Control Unit (IVRC) is also inherent in the basic R/T design.

Only the COMSEC unit is external to the ITT R/T. An interface is provided for VANDAL COMSEC by attaching the unit to the R/T while the VINSON COMSEC is connected via cabling. A single vehicular mounting base and mounting adapter accommodates both one- and two- R/T SINCGARS models in the ITT design. The modular design of the ITT/SINCGARS contributes to its increased maintainability. Built-in Test (BIT) features facilitate fault isolation to the module level to permit rapid diagnosis and restoration of operations.

Design Differences

In the SINCGARS study, there were two significant steps required in the analysis of design differences (between the baseline comparison, or reference, system and the proposed systems). First was the identification of all design differences, to the level of detail required by the study. Generally, the detail of design difference identification required increases as a system acquisition progresses.

Additionally, manpower and personnel requirements analyses of a new system usually require the support of a less-detailed analysis of design differences than required for a training resource requirements analysis. For the study of SINCGARS, equipments were compared and design differences derived at the "black box" level (i.e., elements of the basic R/T unit and all optional components).

The second step in design difference analysis was the most judgment-intensive process through steps 1 and 2 of the methodology: assessment of the impacts on MPT requirements of each design difference. While identification of design differences is fairly straightforward, assessment of their impacts requires considerable research and thought, and often, contact with subject matter experts. Due to the advanced state of the SINCGARS development, and the contractor data available as a result, SINCGARS design difference impact assessments were simplified, as explained below.

For the SINCGARS study, identification of design differences was accomplished in one of two ways. For subsystem described in the contractor proposals, merely a side-by-side comparison with the reference subsystem was required to identify design differences. This was able to be accomplished to varying degrees of detail, based upon the depth of the contractor equipment descriptions and the available sources of reference equipment descriptions. For example, a wealth of data was available on the R/T reference subsystem, the AN/ARC-114( ), while very little data was available on the ECCM unit reference subsystem, the SN416( ) /APX76( ) Electronic Synchronizer. Appendix A lists, on Design Difference Index (DDI) sheets, all the design differences between reference equipments and each of the two contractor-proposed SINCGARS designs. Table 3.2-6 summarizes the data available for the design difference analysis. Depth of analysis detail corresponded generally with the reference equipment descriptive data available.

Table 3.2-6 also summarizes the assessments of design difference impacts on workload. For SINCGARS, the two contractors provided workload data on Logistic Support Analysis Records (LSARs) for many of the subsystems involved. Where these data were available, they were utilized with minor adjustments (to account for induced failure rates), in the computation of manpower. Subsystems for which this was the case are marked with a "C" in the Workload Impact column of Table 3.2-6. A sample of the LSA-02, Personnel and Skill Summary is provided in Table 3.2-7.

SINCGARS subsystems for which the contractor did not provide R/M data or workload data required a careful estimate of design difference impacts on reference system workload. These subsystems are marked by a "P" in the Workload Impact columns of Table 3.2-6. The DDI sheet for the Digital Data Unit provides a good example, Table 3.2-8 Contractor workload data was not provided for either of the proposed

Table 3.2-6 Design Difference Analysis Summary

Reference System Equipment Descriptive Data Available

A - Much
B - Moderate
C - Little

Proposed System Design

C - Contractor Provided
P - Projected

Workload Impact

C - Contractor Provided Workload
P - Projected Workload (Perturbed Reference Workload)

Equipment	Reference System Descriptive Data Available	CE		ITT	
		Proposed System Design	Workload Impact	Proposed System Design	Workload Impact
Receiver/Transmitter	A	C	C	C	C
Antenna Coupler	C	C	C	N/A	N/A
Manpack Antenna	A	C	P	C	P
Vehicular Antenna	A	C	C	C	C
Manpack Battery	A	C	C	C	C
Mounting Assembly	C	C	C	C	C
Interconnecting Box	C	C	C	C	C
RF Amplifier	C	C	C	C	C
COMSEC Unit	A	P	P	P	P
ECCM Unit	B	C	C	C	P
ECCM Fill Uint	B	C	C	C	P
Digital Data Unit	C	C	P	C	P
SRCU	A	P	P	P	P
IVRCU	C	C	C	C	P
Net Control Unit	B	C	C	N/A	N/A

Table 3.2-7 Sample LSA Personnel and Skill Summary

LSA-02

LOGISTIC SUPPORT ANALYSIS RECORD

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PERSONNEL AND SKILL SUMMARY

END ITEM ACRONYM	LSA CONTROL NUMBER	MFR PART NUMBER	FSCM	ITEM NAME	SERVICE DESIGNATION
GARS	016	390916	80045	IVRC OPTION	ARMY

OPTIONS EMPLOYED: 1. SKILL SPECIALTY EVALUATION SELECTED - ALL SKILLS

2. NUMBER OF SYSTEMS SUPPORTED BY MAINTENANCE LEVEL:

OPERATOR/CREW - 1
ORGANIZATIONAL/AVUM - 80
INTERMEDIATE/D.S./AVIM/AFLOAT - 400
INTERMEDIATE/G.S./ASHORE - 1667
INTERMEDIATE/ASHORE AND AFLOAT (NAVY) - 1
DEPOT/SHIPYARDS/SPECIALIZED REPAIR ACTIVITY - 10000

SKILL SPECIALTY CODE	LSA CONTROL NUMBER / ITEM NAME	TASK CODE	TASK IDENTIFICATION	TASK FREQ	SKILL SPEC EVAL	NUM OF MEN	TRNG EQUP REQD	MAN-HRS PER TASK	MHS TYPE CODE	ANNUAL MAN-HRS PER ITEM	TOTAL ANNUAL MAN-HRS
19E10	016 IVRC OPTION	AACXXBA	PREOPERATIVE INSPECTION-IVRC OPTION	365.00	A	1	N	.01	P	3.6500	3.6500
		AHCXXBA	POSTOPERATIVE INSPECTION-IVRC OPTION	365.00	A	1	N	.01	P	3.6500	3.6500
31E10	01634 CONTROL ASSY-IVR	JGFXXYC	REPAIR CONT ASSY BY R&R CKT CD ASSY-MISC	.01	A	1	N	.01	P	.0001	.0400
		JGFXXYE	REPAIR CONT ASSY BY R&R CKT CD ASSY-PROM	.01	A	1	N	.01	P	.0001	.0400
		JGFXXYF	REPAIR CONT ASSY,IVR ,R&R CKT CD ASSY-TTL	.01	A	1	N	.01	P	.0001	.0400
		NGFXXYA	FAULT ISOLATE - CONTROL ASSY,IVR	.09	A	1	N	.41	A	.0369	14.7600
		BGFXXYA	FUNCTIONAL TEST - CONTROL ASSY-IVR	.09	A	1	N	.22	A	.0198	7.9200
		JGFXXVA	REPAIR CONT ASSY,IVR ,R&R CONNECTOR ASSY	.04	A	1	N	.24	P	.0096	3.8400
		JGFXXYB	REPAIR CONT ASSY BY R&R CKT CD ASSY-DSPL	.02	A	1	N	.01	P	.0002	.0800

Table 3.2-8 Sample Design Difference Index

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
80ZZ CE	CV2837/ARC84 (V) Signal Data Converter (P-3A/C)	Digital Data Device	REF: Has an analog to digital converter/Hardmounted Unit CE: Add-on unit/ more complex circuitry To compensate for greater range of bands per second/ Also has measuring unit and memory	3M Data P-3 Aircraft DEP 11-5820-891-10	Increase CM	1.2	Apply to Task Freqs
80ZZ ITT	Same	Data Rate Adapter	REF: Same as Above ITT: Module to be installed and removed from R/T Unit/ Easier remove and replace done at ORG level	3M Data P-3 Aircraft DEP 11-5820-890-10	Increase CM -Shift some CM to lower maint. level	1.2 -	Apply to Task Freqs Shift all R&R workload to Org level

designs, therefore modified reference system data was utilized. The nature of the modification was based upon the identified design differences. From Table 3.2-6, the descriptive data available for the Digital Data Unit reference component was relatively little, therefore, little detail was achieved during design difference identification. Nonetheless, as can be seen in the "Difference" column of Table 3.2-8, some significant design differences were derived.

The Impact section of the Design Difference Index, Table 3.2-8 is the last three columns. The "Impact" column describes, generally, the impact on workload of the identified design differences. For the Digital Data Unit, both CE and ITT proposed system were projected to involve increased corrective maintenance (CM). Additionally, for ITT, some of the CM was expected to be shifted to a lower maintenance level. The "PV", or perturbation value, column quantifies the stated workload impact and the Remarks column states how the PV factor is to be applied. Also qualitative impacts on workload, such as a shift of maintenance level, are explicitly stated in the "Remarks" column. The modified reference system workload became the proposed system workload which was then utilized in the subsequent manpower analysis.

3.3 MANPOWER REQUIREMENTS ANALYSIS

3.3.1 General

Manpower requirements analysis is concerned with the total manpower (operator and maintainer) based upon the total workload (operations and maintenance) for the system under analysis. The SINCGARS analysis was different in that the manpower was based solely on the maintenance workload generated by the system. This was because SINCGARS, in most cases, is a sub-system of a larger system used by a unit. Because of this, SINCGARS operation is driven by the communications requirement of the system or unit of which it is a part. The specific operator manpower requirement by MOS was different from unit to unit and was not practical to determine in this analysis. The most logical approach was to confine the analysis to the maintenance workload and the operator and maintainer manpower it generates. The analysis approach for manpower requirements determination involved construction of general scenario, determination of the maintenance workload and the operator and maintenance manpower from the maintenance workload.

3.3.2 Data Inputs and Sources

To determine the manpower requirement for SINCGARS, various information and data were required:

- o Contractor system descriptions
- o Functional requirements
- o Maintenance MOS assigned by equipment and maintenance level
- o System Reliability and Maintainability Data

- o Productivity Allowance
- o Criteria for the authorization of military positions

The above information and data were provided by the following:

- o O & O Plan
- o Preliminary Data Collection
- o Engineering Analysis
- o MOS/Grade Assignment
- o AR 570-2

3.3.3 Analytical Procedures

System Scenario Analysis

Manpower requirements analysis for SINCGARS began with determining the system distribution and usage. Determining the system distribution was accomplished through the use of the SINCGARS O&O Concept and substituting the existing radios with their respective SINCGARS replacement configurations. The results were the units and networks in which SINCGARS would be utilized as well as number of the respective SINCGARS configurations. This information is important in deriving usage rates for SINCGARS and determining workload and manpower requirements.

Because SINCGARS will be widely used, there was not a single scenario based upon a single unit or network that will accurately describe system usage. The scenario constructed was a composite based upon the estimated operational hours for the units and/or networks in which the respective configurations of SINCGARS would be used. Two scenarios were prepared for each of the seven configurations and their options. One scenario provided the peacetime usage for each of the configurations and associated options, while the second scenario was an estimate of wartime usage. The outputs of scenario determination were used in workload determination and manpower determination.

Workload Determination

Workload determination involved the calculation of the maintenance workload for each SINCGARS configuration as well as assigning this workload to the appropriate MOS(s) at the appropriate maintenance levels. The first step in workload determination was the identification of the system maintenance tasks by component and maintenance level. Next was the identification of the MOS(s) responsible for maintenance at the respective maintenance levels. The final step was the matching of maintenance tasks by equipment (component) and maintenance level to the MOS(s) for that level.

The second portion of workload determination was the calculation of system workload by MOS, maintenance level and SINCGARS sub-system. Note that the maintenance tasks which produce the workload had already been aggregated by MOS and maintenance level for each equipment subsystem during the first portion of this process. The peacetime usage rates from the system scenario process were combined with the reliability and maintainability data for each component line item to produce the system direct productive manhours. The majority of these manhours (except manhours from maintenance allocation charts) were multiplied by an indirect productive factor (from AR 570-2) to produce the total manhours (workload) for each component in the system. These aggregated manhours were totaled to produce by MOS the workload associated with one of each of the components in each of the respective SINCGARS configurations. This process was repeated using the wartime usage rates. The results of workload determination were wartime and peacetime workload aggregated by MOS and maintenance level. These results were used in the computation of the manpower requirements (operator and maintainer) that were driven by maintenance workload.

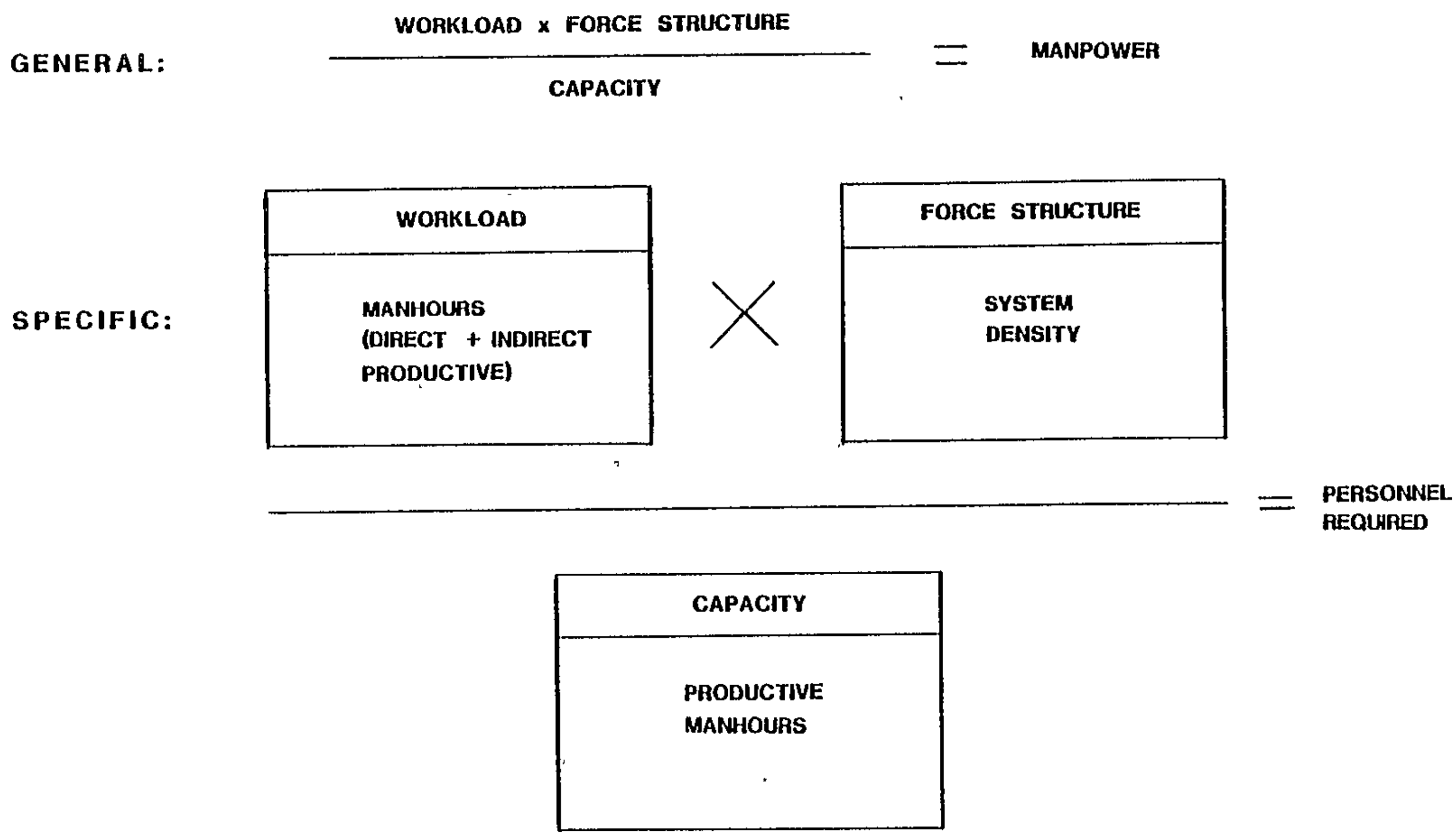
Manpower Determination

Manpower determination converted the operator and maintainer maintenance workload to the actual number of each MOS required. This determination is used as a modified MACRIT process and began with the basic MACRIT equation (Figure 3.3-1) at a general level and with the specific data element inputs required by AR 570-2. The modifications to MACRIT were due to the data elements and not the basic equation. There were two basic modifications to the input data elements in developing manpower requirements for SINCGARS:

1. Assumptions were made concerning minimum essential mission capabilities which allow derivation of operator and maintainer workload.

2. An alternative value was developed for the productive capacity data element for operators and maintainers of SINCGARS.

Figure 3.3-1 Basic MACRIT Equation



The assumptions concerning minimum mission capabilities were identified and analyzed during workload determination. The workload from that process had to be integrated with the productivity allowance for maintenance allowed by MACRIT. This allowance of 40 percent was added to specified maintenance workload figures to produce the total workload generated by the system.

The second modification involved developing an alternative value for operators and maintainers respectively. MACRIT presently uses Annual Productive Manhours which can vary from 2500 to 3000 per individual, depending upon assumptions about unit movement. (Unit movement is the deployment of entire units, and is over and above the requirement for tactical positioning, i.e., movements in response to battlefield conditions). An annual period, however, can encompass many different and unique environments, each with a different and unique workload and set of manpower requirements. The mission requirement of SINCGARS is to provide communication capability for its organic unit. Many of the units or systems to which SINCGARS are assigned are required to operate until the Nth day of battle. Many reference sources regard this period as varying from three to ten days. Therefore, a seven day period was selected. This enabled a standard workweek to be calculated, consisting of the elements shown in Table 3.3-1.

The workweek and associated values were developed using MACRIT as a guide. The nonproductive hours associated with sleeping, messing and personal needs were factored out of time available for work. This decision was consistent with MACRIT in that time for sleep, mess and personal needs was not considered as time available for work. Although unit

Table 3.3-1 Standard Workweek Calculation

1. Analysis of Available Hours

Total Hours Available Weekly		(24x7)	168
Minus:	Sleep	((8x7)	56
	Mess	((2x7)	14
	Personal Needs	((2x7)	14
			84

2. Productive Capability

Operators (Crew):	Available Hours	84.00
	No Allowances	0
Productive Capacity per Week		84.00
Non-Operator:	Available Hours	84.00
Minus:	Movement Allowance	21.00
Productive Capacity per Week		63.00

movement which included tactical deployment was considered as a percent (from MACRIT) of the 84 hour workweek, it was examined to ensure the correctness of this percentage in SINCGARS. Because no assumption was provided as to the tactical movement of maintenance personnel, the percentage method was suitable. Regarding the system operator, however, the actual time required to perform tactical movement would probably be significantly less than allowed for by the MACRIT percentage. To resolve this problem, the time associated with performing this movement was classified as workload and not a percentage allowance. The end result was 84 and 63 hours of productive time per week for operators and maintainers respectively. Determining manpower requirements at this point required the placing of the data elements in the MACRIT equation for each configuration and performing the necessary calculations.

3.3.4 Results

The results associated with SINCGARS Manpower Requirements Analysis were divided into two categories, Mission Profiles and SINCGARS Manpower Requirements. General information of interest to the reader is included.

General Information

General information for SINCGARS included the miscellaneous scenario information not contained in scenario sheets (Tables 3.3-2, 3.3-3) as well as the composition of the Heavy Divisions (Table 3.3-4).

Table 3.3-2

SINCGARS OPERATIONAL SCENARIOS

Workload Dependencies:

(1) Hours - 8760 per year
(2) Manpack Operating Hours (MOH) - Varies with system sub-unit and configuration
(3) Vehicular Operating Hours (VOH) - Varies with system sub-unit and configuration

SINCGARS Configurations:

(1) V1 - AN/PRC - ( ) (V1) Manpack Radio
(2) V2 - AN/VRC - ( ) (V2) Vehicular Short Range Radio
(3) V3 - AN/GRC - ( ) (V3) Vehicular Short Range Dismountable Radio
(4) V4 - AN/VRC - ( ) (V4) Vehicular Short Range and Long Range Radio
(5) V5 - AN/VRC - ( ) (V5) Vehicular Long Range Radio
(6) V6 - AN/GRC - ( ) (V6) Vehicular Short Range Dismountable and Long Range Radio
(7) V7 - AN/VRC - ( ) (V7) Vehicular Dual Long Range Radio

Unit Population:

(1) Army - Wide
(2) Heavy Division

Table 3.3-3 MISCELLANEOUS SCENARIO INFORMATION

	FREQUENCY PER YEAR
ECCM INSTALLATION AND REMOVAL	37
V3 MISSION PROFILE CHANGE	24
V6 MISSION PROFILE CHANGE	18

Table 3.3-4

HEAVY DIVISION COMPOSITION

TOE NUMBER	NAME	QUANTITY
07-246S700	HHC, INF BN	5
07-247S700	RIFLE CO	20
07-248S600	ANTI-ARMOR CO	5
57-257S600	CBT SPT AVN CO	1
17-236S600	HHC TANK BN M1	5
17-237S600	TANK CO	20
17-202S600	HHT CBAA	1
17-206S620	HHT, CAV SQDN	1
17-207S600	RECON TROOP	2
17-248S600	AERO RECON TROOP	2
17-186S600	HQ & SVC AHB	1
17-278S600	ATK HEL CO	3
19-217S600	MP CO	1
29-202S700	HHC SPT CMD	1
29-203S700	DIV MMC	1
29-216S700	HHD BDE SPT BN	3
29-217S700	FWD SPT CO	3
29-218S72	FWD MAIN CO	3
29-236S700	HQ & SPT CO, MAINT BN	1
29-237S700	LT MAINT & EVAC CO	1
29-238S700	HVY MAINT CO	1
09-257S700	MISSLE SPT CO	1
03-387S600	NBC CO	1
29-206S700	HHC S&T BN	1
29-207S700	S&S CO, S&T BN	1
55-287S700	TRANS MOTOR TRANS CO	1
11-036S600	HHC, SIG BN	1
11-437S600	COMMAND OPS CO	1
11-438S600	FORWARD COMM CO	1
11-439S600	SIG SUPPORT OPN CO	1
05-246S600	HHC ENGINEER BN	1

Table 3.3-4 (Con't.)

TOE NUMBER	NAME	QUANTITY
05-247S600	ENGINEER CO	4
05-248S600	BRIGADE CO RIBBON	1
08-206S800	HHD MED BN	1
08-207S800	MEDICAL CO	3
08-208S800	MEDICAL SUPPORT CO	1
44-276S600	HHB ADA BN	1
44-277S600	ADA BATTERY, GUN/STINGER	3
44-278S600	ADA BATTERY, CHAP/STINGER	1
06-302S600	DIVARTY	1
06-266S600	HHB, FA BN, 155 MM	3
06-267S600	FA BTRY 155 MM SP	9
06-269S600	SVC BTRY 155 MM	3
06-296S600	HHB 8IN/MLRS BN	1
06-297S600	FA BTRY 8IN SP	2
06-298S600	FA BTRY GSRS	1
06-299S600	SVC BTRY 8IN/GSRS	1
34-266S600	HQ, HQ AND OPN CO, CEWI BN	1
34-267S600	EW CO	1
34-268S600	INTEL SURVL CO	1
34-269S600	SERVICE SPT CO	1
34-273S600	CBT EW/INTEL AVN	1
01-286S600	HHD CSAB	1
01-287S600	GSAC	1
17-204S600	HHC ARMORED DIV	1
17-242S600	HHC HEAVY DIV BDE	3

Mission Profiles

Tables 3.3-5 through 3.3-11 depict the operational scenario for each configuration of SINCGARS. The usage hours manpack operating hours (MOH) and vehicular operating hours (VOH), are in terms of hours per year. Because the determination of manpower was based upon weekly availability on the part of maintenance personnel these hours had to be converted. Table 3.3-12 and 3.3-13 contain the weekly conversions for peacetime and wartime respectively.

Manpower Requirements

Table 3.3-14 and 3.3-15 depict the peacetime and wartime Army-wide manpower requirements based upon maintenance workload, while Tables 3.3-16 and 3.3-17 shown the peacetime and wartime manpower requirements for a Heavy Division.

Table 3.3-5 OPERATIONAL SCENARIO - VI

	PEACETIME		WARTIME		# OF UNITS	
	MOH	VOH	MOH	VOH	ARMY–WIDE	HEAVY DIVISION
BASIC UNIT	730	–	6,570	–	30,614	229
COMSEC	365	–	5,453	–	10,800	81
ECCM	365	–	5,847	–	16,100	130
ECCM FILL DEVICE	73	–	2,891	–	4,500	34
DIGITAL DATA DEVICE	183	–	5,847	–	2,000	15
SRCU	365	–	5,847	–	22,500	169
IVRCU	730	–	6,570	–	9,750	73
NET CONTROL UNIT	730	–	6,570	–	1,021	8

Table 3.3-6 OPERATIONAL SCENARIO - V2

	PEACETIME		WARTIME		# OF UNITS	
	MOH	VOH	MOH	VOH	ARMY-WIDE	HEAVY DIVISION
BASIC UNIT	–	1,095	–	6,570	22,073	403
COMSEC	–	361	–	5,453	7,200	132
ECCM	–	361	–	5,847	16,100	300
ECCM FILL DEVICE	–	77	–	2,891	4,500	83
DIGITAL DATA DEVICE	–	186	–	5,847	2,000	37
SRCU	–	361	–	5,125	15,000	274
IVRCU	–	1,095	–	6,570	3,250	60
NET CONTROL UNIT	–	1,095	–	6,570	736	14

Table 3.3-7 OPERATIONAL SCENARIO - V3

	PEACETIME		WARTIME		# OF UNITS	
	MOH	VOH	MOH	VOH	ARMY-WIDE	HEAVY DIVISION
BASIC UNIT	108	987	720	6,580	36,811	742
COMSEC	36	326	648	5,922	10,800	217
ECCM	36	326	648	5,922	32,200	650
ECCM FILL DEVICE	8	69	288	2,632	9,000	182
DIGITAL DATA DEVICE	18	168	648	5,922	2,000	41
SRCU	36	326	504	4,606	30,000	605
IVRCU	108	987	720	6,580	6,500	131
NET CONTROL UNIT	108	987	720	6,580	1,227	25

Table 3.3-8 OPERATIONAL SCENARIO - V4

	PEACETIME		WARTIME		# OF UNITS	
	MOH	VOH	MOH	VOH	ARMY-WIDE	HEAVY DIVISION
BASIC UNIT	–	1,095	–	7,300	72,326	29
COMSEC	–	361	–	6,570	14,760	6
ECCM	–	361	–	6,570	59,570	24
ECCM FILL DEVICE	–	77	–	2,920	13,500	6
DIGITAL DATA DEVICE	–	186	–	6,570	3,000	2
SRCU	–	361	–	5,110	42,500	18
IVRCU	–	1,095	—	7,300	17,550	8
NET CONTROL UNIT	–	1,095	–	7,300	2,411	1

Table 3.3-9 OPERATIONAL SCENARIO - V5

	PEACETIME		WARTIME		# OF UNITS	
	MOH	VOH	MOH	VOH	ARMY-WIDE	HEAVY DIVISION
BASIC UNIT	–	1,095	–	7,300	56,232	2,602
COMSEC	–	361	–	6,570	24,000	1111
ECCM	–	734	–	6,570	32,200	1,490
ECCM FILL DEVICE	–	77	–	2,920	9,000	417
DIGITAL DATA DEVICE	–	361	–	6,570	6,000	278
SRCU	–	361	–	5,110	34,500	1,597
IVRCU	–	1,095	–	7,300	22,100	1,023
NET CONTROL UNIT	–	1,095	–	7,300	1,875	87

Table 3.3-10 OPERATIONAL SCENARIO - V6

	PEACETIME		WARTIME		# OF UNITS	
	MOH	VOH	MOH	VOH	ARMY-WIDE	HEAVY DIVISION
BASIC UNIT	108	730	648	6,570	3,190	0
COMSEC	54	365	577	5,847	1,200	0
ECCM	54	365	577	5,847	1,610	0
ECCM FILL DEVICE	11	73	285	2,891	1,500	0
DIGITAL DATA DEVICE	54	365	577	5,847	2,000	0
SRCU	54	365	505	5,125	3,000	0
IVRCU	108	730	648	6,570	1,950	0
NET CONTROL UNIT	0	730	0	6,570	107	0

Table 3.3-11 OPERATIONAL SCENARIO - V7

	PEACETIME		WARTIME		# OF UNITS	
	MOH	VOH	MOH	VOH	ARMY-WIDE	HEAVY DIVISION
BASIC UNIT	–	730	–	7,300	5,084	120
COMSEC	–	365	–	6,570	3,240	77
ECCM	–	365	–	6,570	3,220	77
ECCM FILL DEVICE	–	73	–	2,920	3,000	71
DIGITAL DATA DEVICE	–	365	-	6,570	3,000	71
SRCU	–	365	–	5,110	2,500	60
IVRCU	–	730	–	7,300	3,900	93
NET CONTROL UNIT	–	730	–	7,300	170	5

Table 3.3-12
SINCGARS WEEKLY PEACETIME USAGE

COMPONENT	CONFIGURATION								
	V1	V2	V3		V4	V5	V6		V7
	MOH	VOH	MOH	VOH	VOH	VOH	MOH	VOH	VOH
BASIC UNIT	14.00	21.00	2.00	19.00	21.00	21.00	2.00	14.00	14.00
COMSEC	7.00	6.93	.67	6.27	6.93	6.93	1.00	7.00	7.00
ECCM	7.00	6.93	.67	6.27	6.93	14.00	1.00	7.00	7.00
ECCM FILL DEVICE	1.40	1.47	.14	1.33	1.47	1.47	.20	1.40	1.40
DIGITAL DATA DEVICE	3.50	3.57	.33	3.24	3.57	6.93	1.00	7.00	7.00
SRCU	7.00	6.93	.67	6.27	6.93	6.93	1.00	7.00	7.00
IVRCU	14.00	21.00	2.00	19.00	21.00	21.00	2.00	14.00	14.00
NET CONTROL UNIT	14.00	21.00	2.00	19.00	21.00	21.00	0	14.00	14.00

Table 3.3-13
SINCGARS WEEKLY WARTIME USAGE

COMPONENT	CONFIGURATION								
	V1	V2	V3		V4	V5	V6		V7
	MOH	VOH	MOH	VOH	VOH	VOH	MOH	VOH	VOH
BASIC UNIT	126	126	14	126	140	140	12	126	140
COMSEC	105	105	12	114	126	126	11	112	126
ECCM	112	112	12	114	126	126	11	112	126
ECCM FILL DEVICE	55	55	5.5	50	56	56	5.5	55	56
DIGITAL DATA DEVICE	112	112	12	114	126	126	11	112	126
SRCU	112	98.3	9.65	88	98	98	9.68	98.3	98
IVRCU	126	126	14	126	140	140	12	126	140
NET CONTROL UNIT	126	126	14	126	140	140	0	126	140

Table 3.3-14

SINCGARS

ARMY-WIDE/PEACETIME

MAINTENANCE MANPOWER REQUIREMENTS

MAINTENANCE	MOS/SKILL	REFERENCE	CE	ITT
CREW	11B10/19E10	16,642	3,415	14,119
ORG	31V10	8,335	431	375
D/S	31E10	1,386	28	27
	31S10	2,129	70	1,163
G/S	31E10	1,745	11	11
	31S10	58	47	44
	32G10	189	2	60
	32G20	84	3	60
	35C10	45	12	125
	35C20	519	37	52

Table 3.3-15

SINCGARS

ARMY-WIDE/WARTIME

MAINTENANCE MANPOWER REQUIREMENTS

MAINTENANCE	MOS/SKILL	REFERENCE	CE	ITT
CREW	11B10/19E10	17,182	3,898	15,056
ORG	31V10	54,218	1,863	2,809
D/S	31E10	11,935	401	240
	31S10	13,445	1,228	8,913
G/S	31E10	12,177	143	280
	31S10	890	814	728
	32G10	1,683	23	1,055
	32G20	1,479	43	1,064
	35C10	675	85	1,367
	35C20	3,696	195	1,897

Table 3.3-16

SINCGARS

HEAVY DIVISION/PEACETIME

MAINTENANCE MANPOWER REQUIREMENTS

MAINTENANCE	MOS/SKILL	REFERENCE	CE	ITT
CREW	11B10/19E10	279	48	210
ORG	31V10	186	9	10
D/S	31E10	16	1	1
	31S10	41	2	21
G/S	31E10	26	1	2
	31S10	2	1	2
	32G10	2	1	2
	32G20	2	1	1
	35C10	1	1	1
	35C20	10	1	1

Table 3.3-17

SINCGARS

HEAVY DIVISION/WARTIME

MAINTENANCE MANPOWER REQUIREMENTS

MAINTENANCE	MOS/SKILL	REFERENCE	CE	ITT
CREW	11B10/19E10	284	53	226
ORG	31V10	1,103	39	41
D/S	31E10	141	8	4
	31S10	209	29	164
G/S	31E10	172	3	10
	31S10	18	18	18
	32G10	25	1	18
	32G20	24	1	18
	35C10	15	2	19
	35C20	59	4	20

3.4 PERSONNEL REQUIREMENTS ANALYSIS

3.4.1 General

The objective of the Personnel Requirements Analysis (PRA) is to estimate the number of personnel needed to sustain any one set of system specific manpower requirements, typically those of a single Military Occupational Specialty (MOS). This information is essential for evaluating the impact of an emerging system's demands on the Army's personnel resources, taking into consideration the quantity and quality of individuals available.

Figure 3.4-1 illustrates the logic upon which the Army personnel system is based. The PRA must determine the size and structure of the personnel pipelines in steady state condition by estimating the losses that occur to a paygrade. The primary types of losses which occur to a paygrade are promotion and attrition. The promotion rate is the rate at which an MOS advances from one paygrade cell to another. The attrition rate is the rate at which individuals leave a particular MOS/paygrade cell. Two types of attrition exist. There are individuals who attrite out of the Army (vertical attrition) and individuals who attrite from one MOS to another (horizontal attrition). Personnel who are trainees, transients, holdees or students (TTHS) are temporarily non-active and are classified as overhead. Individuals that fall into this category are not a direct loss to the Army or paygrade (since they may become active again), but a substantial loss to the operational force of that MOS/ paygrade, therefore they must be compensated for. The PRA's primary output is the number of personnel which must be

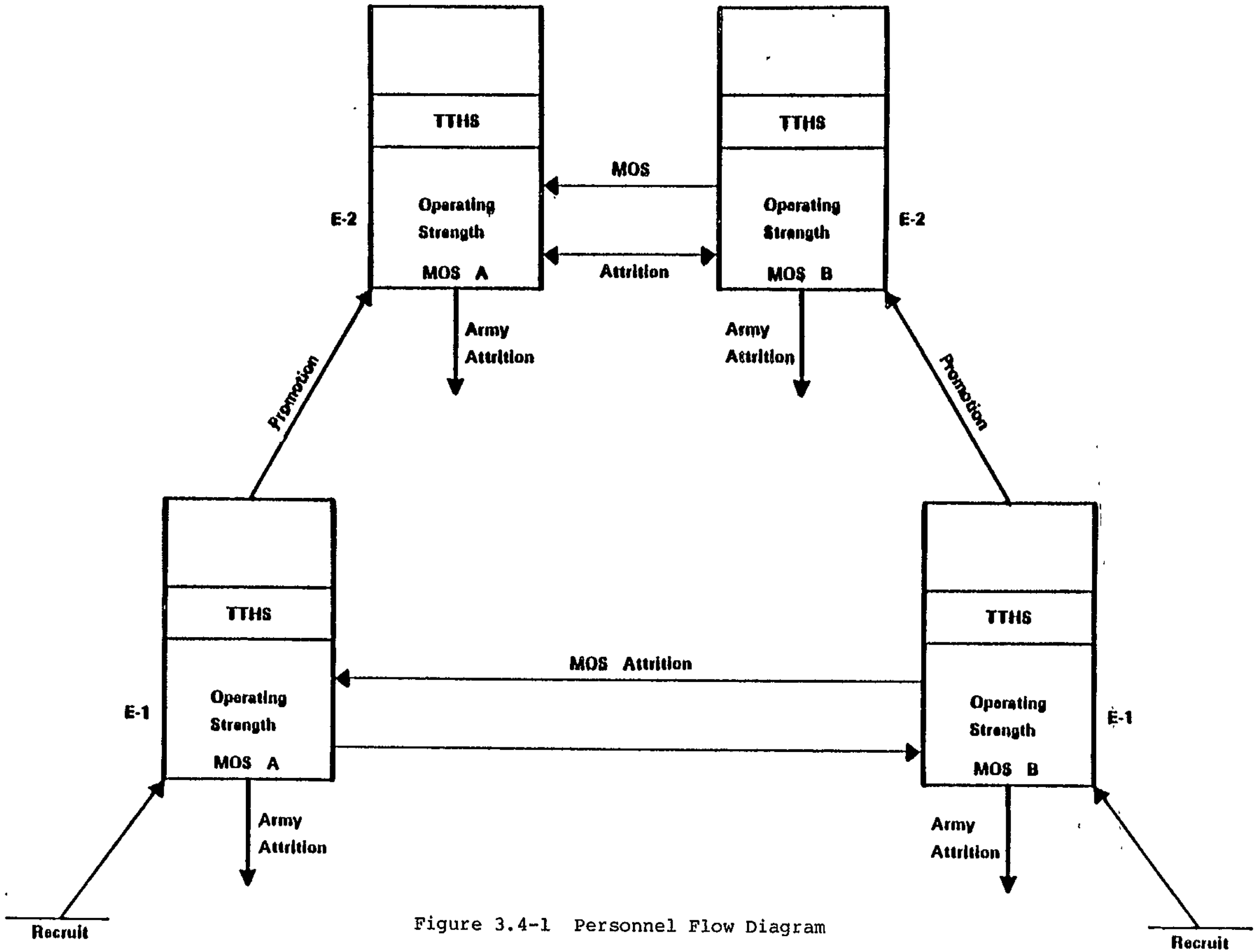


Figure 3.4-1 Personnel Flow Diagram

trained per year to support manpower requirements. Its secondary output is a personnel structure.

It is important to note the difference between manpower and personnel requirements. A manpower requirement is a statement of the necessary numbers of people, described by MOS and paygrade, needed to directly perform a specific set of mission-oriented tasks for a particular weapon system. A manpower requirement is calculated based on workload required for the tasks. A personnel requirement is an estimate of the number of people carried within the MOS and paygrade to offset various losses from the manpower requirement over a specified period of time. During a standard time period (one year) it is assumed that there are no changes to a manpower requirement ("steady-state").

3.4.2 Data Inputs and Sources

The personnel flow rates for the SINCGARS application were calculated by MOS/paygrade. The attrition and promotion rates were calculated by tracking individuals across successive quarters. Several variables affect the personnel flow rates which account for different attrition and promotion rates among MOSs and paygrades. For example, as systems are presently being deployed or retired, manpower requirements are changing for particular MOSs. If the demand for an MOS decreases as a result of a system retirement, promotion rates should decrease and attrition rates should increase. An individual will either attrite out of the Army or that MOS due to a lack of advancement opportunity in their field. The opposite may occur when a system is deployed, if a higher demand for a single MOS is encountered. Promotion rates may increase and attrition rates may decrease. Occasionally, when job splits occur, a new MOS is either created or an old MOS will pick up additional required tasks. The demand for an MOS that is assigned additional tasks may increase. Feeder MOS are another situation where promotion rates may be low and attrition rates high. An example of leader MOS would be MOS 31S of Figure 3.4-2.

As demand for particular MOS(s) are decreasing or increasing, personnel policies will also change to meet manpower requirements. Reenlistment bonuses would be offered in an MOS where the future demand is high and the present supply is low. The standards of grade will also alter the distribution of manpower in paygrades to allow opportunity for career advancement.

Personnel rates may also be sorted by MOS/paygrade/mental category vs. MOS/paygrade as was done for the SINCGARS study.

The objective of sorting personnel flow rates by MOS/paygrade/mental category is to observe the patterns among groups of individuals with similar initial abilities and experience. For example, the question would be raised whether one group of mental category individuals are more predictable than another. Would that group of individuals have lower personnel attrition rates and require less personnel to support manpower requirements than another mental category group? The following paragraph explains how individuals are classified into mental categories and how this information can assist training analysts.

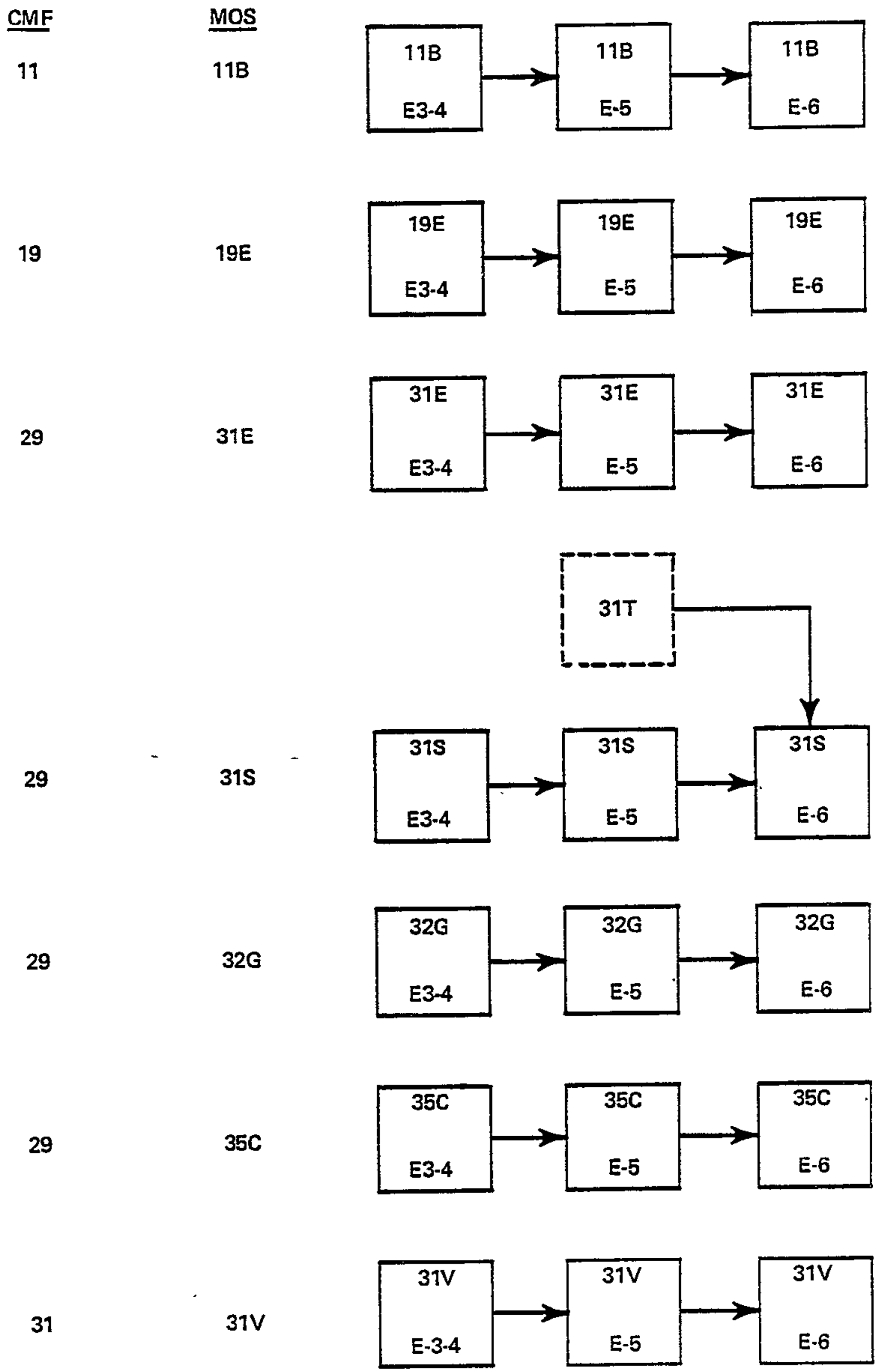


Figure 3.4-2. Career Management Fields

Each individual entering the services is required to take the Armed Services Vocational Aptitude Battery (ASVAB 8/9/10). The Armed Forces Qualification Tests (AFQT) are subtests of ASVAB and are used to categorize individuals upon entrance into the Army. The AFQT is made up of 3 composite tests: Verbal Word Knowledge and Paragraph Comprehension, Arithmetic Reasoning, and Numerical Operation. The raw scores of the tests are weighted and converted to AFQT percentiles. These AFQT percentiles are then categorized into mental categories as follows:

Average Raw Scores	AFQT %	Mental Categories	Welchsler IQ
105-101	99-93%	I	122 and above
100-84	92-65%	II	121-106
83-76	64-50%	IIIA	105.93
75-65	49-31%	IIIB	92-81
64-38	30-10%	IV	80 and Below

The correlation between AFQT and individually administered intelligence test (The Welchsler Adult Intelligence Scale) is about .8.[1] The correlation is significant enough to indicate that the two tests illustrate a clear commonality. Tables 3.4-1 and 3.4-2 illustrate the numerical breakdown of the selected SINCGARS MOSs by mental categories. Individuals placed in MC IIIA know they scored in the 64-50% bracket or scored higher than 49% of the population entering the services. The ASVAB test is used for service selection,

[1] Analysis of Aptitude, Training and Job Performance Measures (February 1982).

Table 3.4-1

Inventory of SINCGARS Selected MOSs by Mental Categories

	I	II	IIIA	IIIB	IV	TOTAL
11B	1,549	9,986	8,836	15,234	21,773	57,468
19E	325	2,625	2,373	3,681	5,655	14,659
31E	50	350	265	363	442	1,470
31S	77	315	132	103	47	674
31V	162	1,157	1,026	1,547	1,482	5,374
32G	73	267	100	91	41	572
35C	***** New MOS *****					

Table 3.4-2

Inventory Percentages of SINCGARS Selected MOSs by Mental Categories

	I	II	IIIA	IIIB	IV	TOTAL
11B	3%	17%	15%	27%	38%	
19E	2	18	16	25	39	
31E	3	24	18	25	30	
31S	11	47	20	15	7	
31V	3	22	19	29	28	
32G	13	47	17	16	7	
35C	***** New MOS *****					

while the AFQT subtests are used for an individual's placement into an MOS.

Analyzing these AFQT scores allows the personnel analyst to observe whether entrance requirements are being met. If requirements are or are not achieved, how does that effect the personnel flow rates? For example, if requirements are not met, are attrition rates high as a result of present training standards? Is advancement low and attrition high as a result of a soldier not knowing the job? Are training courses presently designed to the ability of its student? And if not, how should they change? These are issues which need to be addressed and answered in order to improve the effectiveness of the Army.

Due to lack of Army historical data on the career history of individual MOSs (formal and on the job training), career paths could not be examined. The purpose of studying career paths in detail, when feasible, is to differentiate between individuals with different patterns of schooling and career histories, since these different profile factors generate different personnel flow rates. Figure 3.4-2 shows the career paths for SINCGARS MOSs.

For this application the Defense Manpower Data Center supplied two of the input rates for the Interactive Manpower - Personnel Assessment and Correlation Technology (IMPACT) Model: promotion and attrition, as well as inventory information. DRC received in tape form quarterly rates for the years 1980 and 1981. The Chief of Personnel Operations (COPO) 45 Report was the source of the third parameter: TTHS. DRC received the TTHS data, in microfiche form, by quarters for the years 1980 to 1981 from the U.S. Army

Military Personnel Center (MILPERCEN). Quarterly snapshots were taken over a two year period of current personnel status beginning in December 1979.

3.4.3 Analytic Procedures

DRC used the IMPACT Model to determine personnel requirements. The concept which underlines the IMPACT model is the conservation of people. This means that the quantities of personnel which leave a particular paygrade must be replaced by personnel entering that paygrade. The IMPACT Model determines the quantities of personnel needed in the personnel structure to support specific manpower requirements and to sustain itself so that the personnel structure can composite for incurred losses.

There are three input parameters to the IMPACT Model. They represent reductions in the ability of a given total MOS/paygrade population to support its manpower requirements. These parameters are (a) promotion rates, (b) attrition rates, and (c) the percentage of the MOS/paygrade population in a trainee, transient, holdee, or student (TTHS) status at any given time.

The IMPACT Model's objective is to calculate the minimum amount of personnel needed at each level in the personnel structure. It is constrained so that each paygrade must support losses incurred by the next higher paygrade, since replacements for these losses must be promoted from the paygrade below. The process will iterate several times before the optimal structure is established. Once each paygrade is able to support the paygrade above, the model stops.

Personnel to be trained per year is the primary output parameter of the IMPACT Model. The quantities of personnel to be trained per year represent the flow through each paygrade due to yearly losses to the personnel structure and therefore, the flow through the training system. The parameters are split into the following categories: manpower and overhead losses per year. Manpower losses are losses given promotion, attrition, and the application of the TTHS percentage to the manpower requirements. Overhead losses are losses to the personnel structure minus manpower requirements and manpower losses. (Table 3.4-3, IMPACT Output).

Steady-state personnel requirements of the personnel structure are the secondary output parameter of the IMPACT Model. Their parameters are used as a relative measure of the personnel requirements of the system as compared to those of another system. Replacement for losses primarily occur by promotions from the lower paygrade. Therefore, if manpower requirements begin at an E-4 level, personnel are needed in lower paygrade, to support and replace manpower vacancies. These personnel requirements over and above manpower requirement are considered to be overhead supporting a particular weapon system, although potentially they may be used by another weapon system. A measure of the quantity and quality of the personnel structure provides an indication of how efficiently specific manpower requirements sustain themselves. For example, two equal sets of manpower requirements with different grade distributions will incur two different personnel structures. Table 3.4-4, Comparative

Table 3.4-3 IMPACT Output

MOS = 31E   RECRUITS PER YEAR = 1023.5

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	628.0	0.	0.	1023.6	0.	1023.6
E-2	215.6	0.	0.	372.4	0.	372.4
E-3	291.5	260.0	291.5	333.1	333.1	0.0
E-4	426.2	260.0	276.1	277.5	179.8	97.7

MOS = 31E

PAYGRADE	MANPOWER	ATTRITION	UPGRADE	TTHS
E-1	0.	1.037	0.593	0.
E-2	0.	0.182	1.545	0.013
E-3	260.0	0.191	0.952	0.121
E-4	260.0	0.217	0.434	0.062

Table 3.4-4 Comparative Personnel Structure Impact

MOS = 31S RECRUITS PER YEAR = 448.5

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	224.2	0.	0.	448.5	0.	448.5
E-2	196.1	90.0	105.3	322.9	173.4	149.5
E-3	201.7	80.0	93.5	230.6	106.9	123.7
E-4	159.8	70.0	77.7	158.6	77.1	81.5
E-5	106.6	60.0	62.5	55.9	32.8	23.2
E-6	50.0	40.0	41.2	26.6	21.9	4.7
E-7	20.0	20.0	20.0	10.0	10.0	0.0

MOS = 31S RECRUITS PER YEAR = 788.7

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	394.3	0.	0.	788.7	0.	788.7
E-2	344.8	0.	0.	567.8	0.	567.8
E-3	354.7	0.	0.	405.5	0.	405.5
E-4	281.1	180.0	199.8	278.8	198.2	80.6
E-5	187.4	180.0	187.4	98.4	98.4	0.0

Personnel Structure Impacts is an illustrative example where a large variance of a grade distribution requires less personnel than a smaller variance of a grade distribution.

3.4.4 Results

Summary result charts of the IMPACT model for the MOSs considered in the SINCGARS application are to be found in Table 3.4-5 thru Table 3.4-7, depicting annual recruits, pesonnel requirements by MOS, and by paygrade, respectively.

Table 3.4-5 Annual Recruits

MOS	REFERENCE BCS	PROPOSED CE	ITT
11B	1,750	961	3,814
19E	20,552	3,640	13,874
31E	47,463	1,071	1,024
31S	12,265	3,180	22,071
31V	49,949	1,717	2,589
32G	1,582	46	1,138
35C	3,953	209	2,029
	137,514	10,824	46,539

Table 3.4-6 Personnel Requirements by MOS

	REFERENCE	PROPOSED	
MOS	BCS	CE	ITT
11B	4,044	2,221	8,814
19E	33,700	5,969	22,749
31E	72,395	1,634	1,562
31S	26,612	5,743	38,476
31V	121,151	4,164	6,279
32G	7,772	226	5,592
35C	19,422	1,025	9,968
	285,096	20,982	93,440

Table 3.4-7 Personnel Requirements by Paygrade

PAYGRADE	REFERENCE BCS	PROPOSED CE	PROPOSED ITT
E-1	79,492	5,556	24,424
E-2	41,466	3,655	17,792
E-3	63,101	4,990	22,323
E-4	95,484	6,526	25,723
E-5	5,553	255	3,178
	285,096	20,982	93,440

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3.5 TRAINING RESOURCE REQUIREMENTS

3.5.1 General

This section describes the results of the SINCGARS Training Resource Requirements Analysis (TRRA) and outlines the general procedures that were employed in this analysis. A more detailed discussion of the procedures employed in a TRRA is contained in the Army Research Institute's (ARI) technical report on the application of the HARDMAN methodology to the Division Support Weapon System (DSWS).[1]

Objectives

Like the other steps in the HARDMAN methodology, the TRRA is tailored to meet the requirements of each study. This tailoring is based on the purpose and scope of the effort and the availability of data to support the analysis. The purposes of the SINCGARS analysis are discussed in Section 2.1 of this report. These objectives were further refined into the following TRRA objectives.

- Identify the entry level resident training requirements for the maintainers of SINCGARS through the general support level of maintenance and a representative set of operators.
  - Identify the courses impacted
  - Determine course content and length

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[1] Application of the HARDMAN Methodology to the Division Support Weapon System (DSWS), Detailed Technical Report, Volume II, December 1982.

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- Identify candidate training devices
- Determine instructor requirements
- Determine course costs

o Compare the training resource requirements of the proposed systems (CE and ITT) to a baseline comparison system and analyze the differences.

o Assess the adequacy of the MOS assignments in the contractor's Logistic Support Analysis Record (LSAR).

These objectives support the primary purpose of the HARDMAN methodology, which is to influence design during the early phases of the weapon system acquisition process. Additionally, the TRRA provides early estimates of training requirements to training developers and supports the development of new systems planning documents such as the Individual and Collective Training Plan (ICTP) and the Cost and Training Effectiveness Analysis (CTEA), and the Qualitative and Quantitative Personnel Requirements Information (QQPRI). Application of the TRRA is designed to contribute substantially to the achievement of these objectives, but is not designed or intended to answer all of the early training estimation questions related to SINCGARS.

Two types of TRRA's can be conducted: general and detailed. In a general TRRA, the focus of analysis is the blocks of instruction within programs of instruction. Only very general task and skill information is collected, while in a detailed TRRA, more specific training data is collected and analyzed. The general TRRA produces quicker results and requires less extensive analysis. Therefore, it can be easily applied during the earliest phases of the acquisition process. However, the general scope and focus of the general TRRA makes it less appropriate for detailed tradeoffs of training settings and instructional methods and media. Also, the general type of task data it utilizes makes it less appropriate for many of the procedures which have been developed for the Instructional Systems Development (ISD) process. The detailed TRRA is designed to be applied later in the acquisition process, when detailed tradeoffs of instructional strategies are required, and more time, resources, and task data are available for extensive analyses.

A general TRRA was conducted in the SINCGARS effort. This type of analysis was selected because the general analysis was commensurate with the overall study and TRRA objectives, and neither the time nor resources were available to conduct a detailed TRRA.

Assumptions

The following assumptions helped to further define the general scope and focus of the TRRA.

- o Training associated with the operational test and evaluation of the proposed system and training associated with initial fielding of the system (e.g., new equipment training) are not estimated.

- o In the initial iteration of the TRRA, it is assumed that existing courses of instruction used for analysis purposes are meeting stated performance standards (e.g., graduates are qualified to the stated task standards). It is also assumed that the analyses associated with the development of these courses are valid (e.g., the training task analysis, methods and media selected, etc.).

- Only the resources and costs associated with formal school training are estimated in the present version of the TRRA. Training resources and costs associated with unit training are not estimated.

- Training resources to support supervised on-the-job training (SOJT), collective training, advanced technical training, and training other than for entry level institutional training are not identified.

- Development and acquisition costs associated with training devices, equipment, media and other products are not estimated.

- Training resources and costs are estimated for the "steady-state" or average value year where the "steady-state year" is defined as the first year in which the Army training system is producing replacement training only (that is, all systems have been deployed and training is focused on filling manpower positions vacated through attrition and promotion).

- o Training resources and costs associated with civilian, noncommissioned officer, warrant officer and officer training are not estimated.

- o Training resources and costs are estimated for maintainers through the general support echelon of maintenance.

- o All estimates in the TRRA are based on the best available data, and projections are made from the existing subsystems, courses, etc., which most closely meet the functional requirements of the proposed system.

- o MOS chosen for operator analysis are assumed to operate the following SINCGARS configurations:

MOS	SINCGARS CONFIGURATION
11B	V1 Manpack and V5 Vehicular Long Range
13E	V6 Vehicular Short Range Dismountable and Long Range
19E	V5 Vehicular Long Range

- o It is assumed that the automated test equipment (ATE) AN/MSM-105 will only be available at the Specialized Repair Activity (SRA).

- o All Army systems identified for comparison purposes do not include built-in-test (BIT). It is estimated that approximately 40% of the training in troubleshooting could be eliminated from existing training by using BIT and the proposed diagnostic test equipment.

Constraints

All of the major steps in a general Training Resource Requirements Analysis (TRRA) were conducted for SINCGARS. However, the following constraints affected the analysis:

1) The lack of in-depth functional and technical information about the components in the proposed systems hindered the overall analysis. This was particularly true of the International Telephone and Telegraph (ITT) design.

2) The security classification of the existing net control device (KYK-15/TSEC) and COMSEC equipment (TSEC/KY-57) precluded the acquisition of detailed descriptive operator information.

3) The Automatic Test Equipment Repairer (MOS 35C) is a new MOS. As a result, the program of instruction (POI) and course cost information were not available.

4) Detailed operating procedures on built-in test equipment (BITE) and the test equipment used with each proposed system were not available. This limited the usefulness of applying comparability analysis for estimating maintenance training requirements.

3.5.2 Data Inputs and Sources

Inputs for the TRRA are of two types: (1) information describing the reference or proposed systems, and (2) information which describes existing training. Information describing the systems was obtained from the previous steps in the analysis or from the SINCGARS program office. Information describing existing training was obtained from the DRC data base or the proponent school or command responsible for the training.

The following sources of information were extracted from both types of documents and used as input to the training resource requirements analysis.

1. Operational/Maintenance Scenario Information:

   - Final Qualitative and Quantitative Personnel Requirements Information (FQQPRI)
   - Organizational and Operational (O&O) Plan
   - Manpower Requirements Analysis
   - Joint Integrated Logistics Support Plan (JILSP)
   - Functional Requirements Analysis

2. Equipment Configuration Information:

   - Engineering Analysis.
   - Technical and Field Manuals for Existing Equipment
   - Draft Technical Manuals from Contractors
   - Equipment Descriptions from Program Office

3. Task Information:

   - Trainer's Guides
   - Soldier's Manuals
   - Functional Requirements Analysis
   - Logistics Support Analysis Record (LSAR), Task Inventory List (LSA-14) and Personnel and Skill Summary (LSA-02)

4. Personnel Classification Information:

- AR 611-201, Enlisted Career Management Fields and Military Occupational Specialties
- Final Qualitative and Quantitative Personnel Requirements Information (FQQPRI)
- Logistics Support Analysis Record (LSAR), Task Inventory List (LSA-14) and Personnel and Skill Summary (LSA-02)
- Manpower Requirements Analysis

5. Training Plans/Course Information:

- DA Pam 351-9, EPMS Master Training Plan
- DA Pam 351-4, US Army Formal Schools Catalog
- Programs of Instruction

6. Training Cost Information:

- Program of Instruction
- Personnel Requirements Analysis
- TRADOC Cost Analysis Program (MOS Training Costs) Requirements Control Symbol (RCS) ATRM-159(R1) Reports
- TRADOC Form 377-R, ICH Computation Worksheet
- TRADOC Form 812-R, TRADOC School Course Data
- Programs of Instruction for Proposed Systems
- DA Pam 570-558, Staffing Guide for US Army Service Schools

7. Training Device Information:

- DA Pam 310-12, Index and Description of Army Training Devices
- US Army Comprehensive Plan for Training Devices
- Training Device Development with Logistic Implications (PM TRADE)
- TRADOC Pam 71-9, Catalog of TASO Training Devices

3.5.3 Analytic Procedures

Format Existing Data and Develop TRRA Worksheets

Inputs for the TRRA consisted of the system requirements, functional requirements scenario data, generic task list, manpower task assignments, and equipment lists. This information was provided by the two previous steps in the analysis. The concurrent step, Personnel Requirements Analysis, exchanges information with the Training Resource Requirements Analysis in an interactive fashion by taking the MOS identified during the TRRA and providing the numbers of personnel who must be trained for the MOS. In addition, specific training related data, e.g. ASVAB and AFQT test results for the MOS, are collected for the TRRA.

Worksheets were used to record the relationship between SINCGARS equipment, existing comparable equipment and existing courses of instruction. These worksheets are divided into two sets: one set to plan and document the analysis of system operation and the other to plan and document the analysis of system maintenance. This division was made because the requirements for system operator tasks are mission-based via the systems functional requirements. The equipment used by the operator to perform the system functions is a means to this end. In comparison, maintenance task requirements are the results of equipment design and technology. Hence, the equipment configurations become the primary focus of analysis.

Operator Training Source Index

Figure 3.5-1 contains an example of the Operator Training Source Index for system operator analysis. Included at the top of each index page is the mission event and the SINCGARS equipment configuration to be operated by the MOS under study. The functional organization (Column 1) for these worksheets was derived from the generic task list in Section 3.1. This was done to provide a functional context in which to analyze the effects of equipment design differences on the operation of the system.

The second column of the index contains the baseline comparison (reference) equipment while the next column is used to record the equipment chosen for training estimation. In selecting equipment for either purpose, comparable equipment was chosen that met the functional requirements. Another important selection criteria was insuring that appropriate data for the equipment were available. Some differences in equipment are found between the equipment chosen for training estimation and equipment chosen for R/M estimation during Engineering Analysis (Section 3.2) because the desired data is available for one purpose, but not for the other.

MISSION EVENT: PREPARE FOR OPERATION

END ITEM V6 VEHICULAR SHORT RANGE DISMOUNTABLE AND LONG RANGE

Figure 3.5-1

OPERATOR TRAINING SOURCE INDEX

MOS 13E

FUNCTION	BASELINE COMPARISON SYSTEM				PROPOSED SYSTEM			
	BASELINE EQUIPMENT	REPRESENTATIVE EQUIPMENT FOR TRAINING ESTIMATION	SOURCE OF TASK INFORMATION	SOURCE OF COURSE INFORMATION	PROPOSED EQUIPMENT	REPRESENTATIVE EQUIPMENT FOR TRAINING ESTIMATION	SOURCE OF TASK INFORMATION	SOURCE OF COURSE INFORMATION
1.1.3 Initialize Configurations/ Components	8GZZ ECCM Unit	TSEC/KY-57 Communications Security Equipment	FM 6-13E/TG: SL1: 113-609-2008 SL2: None SL3: BNCOC/CA None	250-13E10: CC10VA (In Part) - -	CE: Same as Baseline	—	—	—
			Also: FM 6-15J/CM: SL1: No Task No. SL2: None SL3: Course Planned	250-15J10: CC43VA - -	ITT: Same as Baseline	—	—	—
	8RZZ COMSEC Unit	TSEC/KY-57 Communications Security Equipment	FM 6-13E/TG: SL1: 113-609-2008 SL2: None SL3: BNCOC/CA None	250-13E10: CC10VA CC10VB - -	CE: Same as Baseline	—	—	—
					ITT: Same as Baseline	—	—	—
	8MZZ Net Control Unit	KYX-15 Net Control Device	FM 6-13E/TG SL1: 113-609-2008 SL2: None SL3: BNCOC/CA None	250-13E10: CC10VC - -	CE: Same as Baseline	—	—	—
					ITT: Same as Baseline	—	—	—

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Sources of task information are indicated in the next column, while the last column is used to indicate the formal school training found for the equipment selected for training estimation. Information recorded includes: (1) the course number, and (2) the annex, file number, or objective containing the instruction.

The second half of the worksheet is used to record the same kind of information for the proposed system(s) as for the baseline system.

Maintenance Training Source Index

Figure 3.5-2 contains an example of the Maintenance Training Source Index used for system maintenance analysis. At the top of the page is the end item. In this study, end items are configurations V1-V7, while components are the common and optional components which make up the configurations.

The first and second columns contain the equipment configuration code and the baseline comparison (reference) equipment selected during the engineering analysis. In this study, the logistics control numbers (LCN) were used as the equipment configuration code. Some logistics control numbers were not included because either they were aggregated under other numbers or they represented minor equipment for which no training was found. Within the course information columns of these worksheets, training information was broken down into the three echelons of maintenance required for the SINCGARS study: organizational, direct, and general support. These three levels of maintenance were included for the reference and proposed systems.

Figure 3.5-2

MAINTAINER TRAINING SOURCE INDEX

END ITEM   CONFIGURATIONS V1-V7

EQUIPMENT CONFIGURATION CODE	BASELINE COMPARISON SYSTEM				PROPOSED SYSTEM			
	BASELINE EQUIPMENT	REPRESENTATIVE EQUIPMENT FOR TRAINING ESTIMATION	SOURCE OF TASK INFORMATION	SOURCE OF COURSE INFORMATION	PROPOSED EQUIPMENT	REPRESENTATIVE EQUIPMENT FOR TRAINING ESTIMATION	SOURCE OF TASK INFORMATION	SOURCE OF COURSE INFORMATION
8AA2 8BA2 8DQ2	Receiver-Transmitter AN/ARC-114	ORG: Receiver-Transmitter RT-246(*)/VRC Automatic Timing Circuits	FM 11-31V/TG: Tasksby configuration only - See previous indexes	101-31V10: CR26HN	CE: Same as Baseline	—	—	—
					ITT: Same as Baseline	—	—	—
		DS/GS: AN/ARC-114	FM 11-35L/CM: SL1: 113-586-0003 113-586-0004 113-586-0005 113-586-0006	101-35L10: Annex G: G01	CE: Same as Baseline	—	—	—
			113-586-4020 113-586-4021 113-586-4022 113-586-4023	G02	ITT: Same as Baseline	—	—	—
			113-586-5002 113-586-5003 113-586-5004 113-586-5006 113-586-5008 113-586-5009	G03				
			Examination	G04				
			113-586-0002 113-586-4008 113-586-4009 113-586-4010 113-586-4011 113-586-4012 113-586-4013 113-586-4014 113-586-4015 113-586-4016 113-586-4017 113-586-4018 113-586-4019 113-586-5001	G05				
			SL2: 113-586-5004 113-586-5007 Examination	G06				

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The selection of representative equipment for maintenance training posed a problem in that SINCGARS contains state-of-the-art digital technology. No Army radio systems were identified which currently employ this technology to the extent proposed for SINCGARS and also has training data available to support a training analysis. The AN/ARC-114 does employ digital and logic circuitry in its frequency generation circuits and, therefore, was selected as the reference system radio at the direct and general support echelons of maintenance. However, it does not provide a reasonable comparison for organizational maintenance.

The AN/ARC-114 is part of the standard lightweight avionics configurations and is a standard avionics configuration found in Army aircraft. The organizational maintenance performed on the ARC-114 is significantly different from the organizational maintenance performed on vehicular and manpack systems. Some of the reasons for this difference are the number of different configurations and optional components in vehicular ratios, the difference in platform integration of subsystems between vehicles and aircraft, and the difference in maintenance organization and procedures which exist between Army aviation and the rest of the Army. For these reasons, the AN/VRC-12 was judged to be more representative of the organizational maintenance requirements for SINCGARS.

MOS Assignment

The next step in the TRRA is the assignment of functions and equipment to MOS. Some of the considerations involved are:

- o Which MOS now receives training in similar tasks, skills and knowledges.

- o Which MOS is assigned to similar systems.
- o The branch of service of the predecessor MOS.
- o The units the existing MOS is assigned to.
- o Historical precedent.
- o The impacts on soldier career progression rates.
- o The workload requirements or equipment densities.
- o LSAR MOS assignments.

Normally, the assignments of MOS to equipment and tasks made during the Manpower Analysis are reviewed during this step using training materials for reference, and adjustments in MOS assignment are made, if required. If adjustments are made during this step, these are incorporated into the Manpower Analysis. This study, however, was phased and the Manpower Analysis was completed before the Training Analysis began. Because MOS selections were made in the first phase of the study and the first two steps of the HARDMAN methodology had been conducted using these MOS assignments, it was decided to complete the training and personnel steps of the methodology using the same MOS assignments. Table 3.5-1 contains the SINCGARS MOS's selected during the initial phase. These MOS's are assigned to the various SINCGARS components in Table 3.5-2.

Table 3.5-1 SINCGARS Military Occupational Specialties

MOS	CMF	Title (With Abbreviation)
11B	11	Infantryman (*)
13E	13	Cannon Fire Direction Specialist (Cannon FD Sp)
19E	19	M48-M60 Armor Crewman (M48-M60 Arm Crmn)
31E	29	Field Radio Repairer (*)
31S	29	Field General COMSEC Repairer (Field Gen COMSEC Rep)
31V	31	Tactical Communications Systems Operator/Mechanic (Tac Comm Sys Op/Mech)
32G	29	Fixed Cryptographic Equipment Repairer (Fixed Crypto Eq Rep)
35C	29	Automatic Test Equipment Repairer (ATE Repairer)

* Indicates no abbreviation.

Table 3.5-2 Summary of SINCGARS MOS Assignments

EQUIPMENT CONFIGURATION CODE	GENERIC EQUIPMENT	REFERENCE BASELINE COMPARISON				PROPOSED CE				PROPOSED ITT			
		C	O	F	H	C	O	F	H	C	O	F	H
	Common Components:												
8AAZ 8BAZ 8DQZ	Receiver Transmitter	11B 13E 19E	31V	31E	31E 35C (SRA)	11B 13E 19E	31V	31E	31E 35C (SRA)	11B 13E 19E	31V	31E	31E 35C (SRA)
8ABZ	Antenna Coupler	11B	31V	31E	31E 35C (SRA)	11B	31V	31E	31E 35C (SRA)	-	-	-	-
8ACZ 8BEZ	Antenna	11B 13E 19E	31V	31E	31E	11B 13E 19E	31V	31E	-	11B 13E 19E	31V	31E	-
8BGZ 8DIZ 8BOZ 8DWZ 8CXZ 8BDZ 8CYZ 8DSZ	Vehicular Applique	13E 19E	31V	31E	31E 35C (SRA)	13E 19E	31V	31E	31E 35C (SRA)	13E 19E	31V	31E	31E 35C (SRA)
8AOZ 8VZZ	Manpack Applique	11B	31V	-	-	11B	31V	-	-	11B	31V	-	-
8CHZ	RF Power Amplifier	13E 19E	31V	31E	31E 35C (SRA)	13E 19E	31V	13E	31E 35C (SRA)	13E 19E	31V	31E	31E 35C (SRA)
8ASA 8ASB 8ARZ	Handset/Headset	11B 13E 19E	31V	31E	-	11B 13E 19E	31V	31E	-	11B 13E 19E	31V	31E	-

Table 3.5-2 Summary of SINCGARS MOS Assignments (Con't.)

EQUIPMENT CONFIGURATION CODE	GENERIC EQUIPMENT	REFERENCE BASELINE COMPARISON				PROPOSED CE				PROPOSED ITT			
		C	O	F	H	C	O	F	H	C	O	F	H
	Optional Components:												
8GZZ	ECCM Units	11B 13E 19E	31V	31S	32G	11B 13E 19E	31V	31S	32G	11B 13E 19E	31V	31S	32G
8NZZ	Remote Fill Device	11B 13E 19E	31V	31S (SRA)	32G (SRA)	11B 13E 19E	31V	31S	32G (SRA)	11B 13E 19E	31V	31S	32G (SRA)
8OZZ	Digital Data Device	11B 13E 19E	31V	31E	31E 35C (SRA)	11B 13E 19E	31V	31E	31E 35C (SRA)	11B 13E 19E	31V	31E	31E 35C (SRA)
8QAZ	Securable Remote Control Unit (SRCU)	11B 13E 19E	31V	31E	31E	11B 13E 19E	31V	31E	31E	11B 13E 19E	31V	31E	31E
8PZZ	Intravehicular Remote Control Unit (IVRCU)	13E	31V	31E	31E 35C (SRA)	13E	31V	31E	31E 35C (SRA)	13E	31V	31E	31E 35C (SRA)
8MZZ	Net Control Unit (NCU)	13E	31V	31S (SRA)	32G (SRA) 35C (SRA)	13E	31V	31S	32G (SRA) 35C (SRA)	-	-	-	-
8RZZ	COMSEC Unit	13E	31V	31S (SRA)	31S (SRA)	13E	31V	31S (SRA)	31S (SRA)	13E	31V	31S (SRA)	31S (SRA)

Develop Reference and Proposed Courses

Once the MOS have been determined, the existing courses of instruction associated with the MOS are identified. These courses were identified by consulting (1) DA Pam 351-4 US Army Formal Schools Catalog, (2) DA Pam 351-9 EPMS Master Training Plan, or (3) the school with proponency for the MOS. Table 3.5-3 summarizes the SINCGARS entry level courses of instruction.

Modify/Add Courses of Instruction

The programs of instruction for the courses identified were examined to determine the equipment/subject matter areas covered in each course module/annex. These subject matter areas were compared with the functional, equipment, and task requirements for each proposed design. Those general skill areas in the existing courses which were no longer needed were identified first and the modules associated with these skill areas were eliminated. New skill areas which had to be added to the existing courses to reflect the modified/additional skill requirements were then identified and these modules were added to the course outline.

The Course Modification Worksheet is used to record these changes and an example is shown in Figure 3.5-3. This worksheet is divided into three sections. The left-hand section is used to record course modules/files that are found in existing courses. All of the courses developed for the SINCGARS study were developed from an existing course, except for 35C which is a new MOS. The entry level course for this MOS was not available; however, no change in course content is apparent from the introduction of SINCGARS. For

Table 3.5-3 Summary of SINCGARS Technical Courses of Instruction

MOS	Course Number	Course Title
11B	11B10-OSUT	Infantryman OSUT
13E	250-13E10	Cannon Fire Direction Specialist
19E	010-19E10 (M60A3)	Basic Armor Training
31E	101-31E10	Field Radio Repairer
31S	160-31S10	Field General COMSEC Repairer
31V	101-31V10	Tactical Communications Systems Operator/Mechanic
32G	160-32G10	Fixed Cryptographic Equipment Repairer
35C	XXX-35C10	Automatic Test Equipment Repairer

Figure 3.5-3

COURSE MODIFICATION WORKSHEET

COURSE: 101-31E10

SYSTEM: BCS, ITT

MOS 31E

EXISTING COURSE					NEW COURSE				COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
A09	6.9	C	1		A09	6.9	C	1				
Inductive Circuits	2.0	PE1	4		Inductive Circuits	2.0	PE1	4				
	2.1	PE3	1			2.1	PE3	1				
Subtotal	11.0				Subtotal	11.0						
A10	7.0	C	1		A10	7.0	C	1				
Capacitive Circuits	2.0	PE1	4		Capacitive Circuits	2.0	PE1	4				
	2.0	PE3	1			2.0	PE3	1				
Subtotal	11.0				Subtotal	11.0			From: 041-34Y10			
					A11				34Y10-C1			
					Boolean Algebra	.4	PI	1	Boolean Algebra	.4	PM	
						3.0	PE2	1		3.0	PE2	
						.6	E3	1		.6	E3	
					Subtotal	4.0			Subtotal	4.0		
					A12							
					Biode Logic	.4	PI	1	34Y10-C3	.4	PM	
						3.0	PE2		Biode Logic	3.0	PE2	
						.6	E3			.6	E3	
					Subtotal	4.0			Subtotal	4.0		
A11	3.0	E1	1		A13	3.0	E1	1				
Examination	3.0	E3	1		Examination	3.0	E3	1				
Subtotal	6.0				Subtotal	6.0						
Annex B: Radio Fundamentals					Annex B: Radio Fundamentals							
B01					B01							
Introduction to Annex, Radio	3.5	C	1	113-598-4029	Introduction to Annex, Radio	3.5	C	1				
Principles, Troubleshooting,	.5	D	1	113-607-4006	Principles, Troubleshooting,	.5	D	1				
and Test, Measurement,	.5	PE1	4	113-620-4001	and Test, Measurement,	.5	PE1	4				
and Diagnostic Equipment	.5	E3	1	113-620-4002	and Diagnostic Equipment	.5	E3	1				
Subtotal	5.0				Subtotal	5.0						
B02	.5	C	1	113-598-4029	B02	.5	C	1				
Schematic Diagrams	1.0	PE3	1	113-607-4006	Schematic Diagrams	1.0	PE3	1				
	.5	E3	1	113-620-4001		.5	E3	1				
Subtotal	2.0			113-620-4002	Subtotal	2.0						

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those parts of an existing course that are not changed, it is not necessary to describe that part of the course in great detail. In such cases, those parts of the existing course are recorded at the annex level. However, if part of the annex is to be modified, the course elements effected are recorded at the more detailed level of file, task or objective. In this way, the pertinent parts of the course module can be specifically identified and modified in projecting the new course.

The right-hand section of the worksheet contains course information taken from other courses from which additional instruction is projected for the new course. The course number and military branch (if non-Army) are indicated at the beginning of each new instructional module/file.

In the middle section of the worksheet the new course is developed. All of the existing and additional course module/elements are combined into a projected course which will meet the function and task requirements of the equipments associated with the new course. This notional course draws upon the left-hand side for existing course information and upon the right-hand side for additional instruction to be taken from other courses. In this manner, it is easy to identify where course elements are being taken from in the development of new courses.

Each of the three sections contains the same course information: (1) the total number of instructional hours required for each module, (2) the instructional hours for each module broken down by type of instruction , and (3) the number of groups/sections the class is divided into.

A column for indicating task numbers is provided between the existing course and new course sections. This column is used to record the task numbers which apply to each unit of instruction in the new course. This column is not completed during a general TRRA as in this study.

Once the new course modules have been developed, the instructional method(s) to be utilized with each module is determined. Table 3.5-4 lists the types of instruction that are available for use with Army courses. Instructional methods found in each additional course module were changed (if necessary) to reflect the types of instruction and the number of sections and groups found in the existing course. DRC encountered difficulties in obtaining the number of sections and groups for some courses. In these instances, student/instructor ratios were taken from either TRADOC Circular 351-12 or DA Pam 570-558 and an estimate of sections and groups were derived from them. The student/instructor ratio for each type of instruction is also listed in Table 3.5-4.

In developing a new course, care is taken to project into the new course, the course philosophy and instructional strategy found in the existing course. This is done because the existing course is most similar in content and is being taught at the school where the new course would be most likely to be taught. Accordingly, the types of instruction and number of sections and groups found in the courses used for projecting new instruction are generally changed to reflect the existing course. The Course Modification Worksheets for the SINCGARS MOSs are found in Appendix C.

Table 3.5-4 Army Types of Instruction and Associated Student/Instructor Ratios

AT	Audio Tape	20:1
C	Conference/Lecture	1 per class
CAI	Computer Assisted Instruction	20:1
CS	Case Study	20:1
D	Demonstration	20:1
DF	Dual Flight Hours (Only Aviator Courses)	-
E1	Hardware Performance Examination	6:1
E2	Nonhardware Performance Examination	6:1
E3	Nonhardware Perforamnce Examination	1 per class
EL	Elective (In-House Only, Except for CGSC)	1 per class
F	Film	1 per class
GS	Guest Speaker	1 per class
IS	Independent Study	Local appraisal
NC1	Non-contact Instruction with an Instructor Available in Classroom	-
NC2	Non-contract Instruction without an Instructor Available	-
PE1	Hardware Oriented (Hands-On) Practical Application	6:1
PE2	Nonhardware Oriented (Non-Classroom) Practical Application	6:1
PE3	Classroom Practical Application	20:1
PI	Programmed Instruction (Using Programmed Text)	20:1
PM	Printed Materials	20:1
QC	Besseler Cue See	20:1
S	Seminar	20:1
SF	Solo Flight Hours (Only Aviator Courses)	-
SI	Simulation Instruction	Local appraisal
SP	Self-Paced Instruction	20:1
ST	Slide Tape	20:1
TV	Television	1 per class
WC1	Instructor Led Work Group	Local appraisal
WC2	Student Led Work Group	Local appraisal

Sources: DA Pam 570-558
Staffing Guide for U.S Army Service Schools
TRADOC Cir 351-12
Format for Programs of Instruction

As shown in Table 3.5-5, a total of seven (7) courses were modified to reflect the reference system. Of these seven courses, four (4) courses were modified to reflect differences between the reference system and the CE system, and, two (2) of the reference courses were modified to reflect the ITT system. Altogether thirteen (13) new courses were developed in the study.

Table 3.5-6 shows the affects of these differences on course length in hours and identifies the component/topic area that caused the difference. The hours in the "+" column indicate the addition of time, the "-" column indicates the deletion of time, and the "Δ" column includes the net change for the entire course. Hours in parentheses represent an overall decrease in time.

3.5.4 Results

Four parameters were chosen to depict the training resource requirements for SINCGARS:

- Training Man-Days - the length of time needed to train an individual student in a course.
- Instructors - the number of instructors required to conduct a course of instruction (COI).
- Course Costs - the amount of money required to train a graduate of a COI.
- Training Devices - a list of candidate training devices for use in COI's.

Table 3.5-5 Summary of Course Modifications by System

MOS	Reference Course Number	Proposed Course Title	BCS	CE	ITT
11B	11B10-OSUT	Infantryman	1	1	1
13E	250-13E10	Cannon FD Sp	2	2	2
19E	101-19E10	M48-M60 Arm Crmn	3	3	3
31E	101-31E10	Field Radio Repairer	4	8	4
31S	160-31S10	Field Gen COMSEC Rep	5	9	12
31V	101-31V10	Tac Comm Sys Op/Mech	6	10	10
32G	160-32G10	Fixed Crypto Equ Rep	7	11	13
35C	XXX-35C10	ATE Repairer	NC	NC	NC

NC No change from existing course.

Table 3.5-6 Summary of SINCGARS Course Impacts (MANHOURS)

MOS	COURSE	EQUIPMENT/TOPIC AREA	REFERENCE BASELINE COMPARISON +	REFERENCE BASELINE COMPARISON −	REFERENCE BASELINE COMPARISON Δ	PROPOSED CE +	PROPOSED CE −	PROPOSED CE Δ	PROPOSED ITT +	PROPOSED ITT −	PROPOSED ITT Δ
11B	11B10-OSUT	ECCM Unit	2.5			2.5			2.5		
		Securable Remote Control Unit (SRCU)	.7			.7			.7		
		TOTALS	3.2		3.2	3.2		3.2	3.2		3.2
13E	250-13E10	ECCM Unit	2.5			2.5			2.5		
		Antijamming Procedures		4.2			4.2			4.2	
		TOTALS	2.5	4.2	(1.7)	2.5	4.2	(1.7)	2.5	4.2	(1.7)
19E	010-19E10	ECCM Unit	2.5			2.5			2.5		
		TOTALS	2.5		2.5	2.5		2.5	2.5		2.5
31E	101-31E10	Basic Electronics	8.0			8.0			8.0		
		Common Components	42.0	120.0		25.2[1]	120.0		42.0	120.0	
		Intravehicular Remote Control Unit (IVRCU)	20.0			12.0[1]			20.0		
		TOTALS	70.0	120.0	(50.0)	45.2	120.0	(74.8)	70.0	120.0	(50.0)
31S	160-31S10	Basic Electronics	8.0			8.0			8.0		
		ECCM Unit	6.3			3.8[1]			6.3		
		Net Control Unit (NCU)	15.1			9.1[1]			-		
		TOTALS	29.4		29.4	20.9		20.9	14.3		14.3
31V	101-31V10	SINCGARS Configurations V1-V7 with Intravehicular Control Unit (IVRCU)	40.8	50.8		24.5[1]	50.8		28.5[1]	50.8	
		Net Control Unit (NCU)	6.7			4.0[1]			-		
		TOTALS	47.5	50.8	(3.3)	28.5	50.8	(22.3)	28.5	50.8	(22.3)
32G	160-32G10	ECCM Unit	41.0			12.0[1]			20.0		
		Net Control Unit (NCU)	13.9			13.9			-		
		TOTALS	54.9		54.9	25.9		25.9	20.0		20.0
35C	XXX-35C10	No Change									

[1] Represents 40% reduction from the use of built-in test or proposed diagnostic equipment.

The selection of these parameters takes into consideration (1) the training data available for analysis, and (2) the level and kinds of meaningful training resource estimation needed by the program office to make decisions at this stage in the acquisition process. Subsequent iterations of the methodology allow for more detailed and varied analyses of training resource requirements.

The SINCGARS study is the first HARDMAN application to use DRC's recently developed Training Resource Requirements Analysis Master Program (TRRAMP). TRRAMP is an interactive computer model that calculates the institutional MOS training resources associated with new weapon systems. It incorporates the first three training resource requirements of training man-days, instructors, and course costs.

TRRAMP uses the following input data: (1) detailed cost per graduate data for TRADOC courses produced annually by the Army Cost Analysis Program (MOS Training Costs) under Requirements Control Symbol ATRM-159, (2) instructor determination algorithms and training course data used for computing instructor requirements maintained by the Management Engineering Branch, HQ TRADOC, and (3) detailed training course data contained in the programs of instruction (POI) obtained from the proponent TRADOC schools and training centers.

Training resource requirements were not determined for the operator MOSs (11B and 19E) due to the lack of sufficient data required in the Manpower Analysis to determine the intended fielding of the various SINCGARS configurations to specific weapon systems and, hence, to the operators of the systems. For example, the 11B student loads reflect the manpower and personnel impacts from the assignment of the total buy of the SINCGARS V1 Manpack configuration to this MOS. These student loads, as well as those for 19E, are so unrealistic that they could not be used to estimate training resource requirements.

o Training Man-Days

The number of man-days required for the various SINCGARS courses was obtained from the Course Modification Worksheets (Appendix C1) and input into TRRAMP. Table 3.5-7 is a summary of the annual training man-day requirements for SINCGARS. The reference system will have the largest total requirement for training time, while the CE system will have the least.

o Instructors

Estimation of the number of instructors required by the SINCGARS courses was also determined through TRRAMP. The Course Modification Worksheets provided all the necessary SINCGARS - specific data for determining instructor requirements. This included: (1) the types of instruction employed in each course, (2) the number of hours required for each type of instruction, and (3) the number of sections and groups to be used in the training environment. Table 3.5-8 is a summary by system and MOS of the annual instructor requirements. The overall range of instructor requirements varied substantially from 517 for the CE configuration to 8,324 for the reference system.

Table 3.5-7 Annual Training Man-Day Requirements

		Reference	Proposed	
MOS	Course Number	BCS	CE	ITT
11B	11B10-OSUT	1/	1/	1/
19E	010-19E10 (M60A3)	1/	1/	1/
31E	101-31E10	6,296,758	137,659	135,851
31S	160-31S10	961,198	245,386	1,682,489
31V	101-31V10	2,672,634	87,489	131,922
32G	160-32G10	301,526	8,581	211,276
35C	XXX-35C10	428,695	22,666	220,041
	TOTAL	10,660,811	501,782	2,381,579

1/ Insufficient Data

Table 3.5-8 Annual Instructor Requirements

MOS	Course Number	Reference BCS	Proposed CE	Proposed ITT
11B	11B10-OSUT	1/	1/	1/
19E	010-19E10 (M60A3)	1/	1/	1/
31E	101-31E10	6,828	150	148
31S	160-31S10	880	249	1,518
31V	101-31V10	1,967	83	120
32G	160-32G10	244	9	177
35C	XXX-35C10	323	32	243
	TOTAL	10,242	524	2,206

1/ Insufficient Data

o Training Course Costs

Estimates of the training costs for all SINCGARS courses were also determined from TRRAMP. The ATRM-159 data used was the latest course cost data available (FY1981) and had been converted to FY1983 dollars. Appendix C2 contains the individual course detail outputs from TRRAMP for all three of the training resource parameters. Table 3.5-9 summarizes the annual training course costs for the SINCGARS courses. Again, the CE design was substantially less intensive in training costs than the other configurations.

o Training Devices

During the initial iteration of the training resource requirements analysis, only general requirements for major training devices are determined. Training devices are concentrated on because they are the major source of media-related training costs. Table 3.5-10 contains a candidate list of major training devices.

For each possible training device identified, the table lists the type of device; description of the use of the device; the course(s) the device might be used in; a brief listing of existing, proposed, or developing devices; and the source from which the comparable devices were obtained.

It is important to emphasize that this list of training devices is intended to identify the general requirements for training devices. The final determination of training device requirements cannot be completed without a more indepth determination of training tasks, the application of a media selection model to these tasks, and the review and evaluation of appropriate school personnel.

Table 3.5-9 Annual Training Course Costs ($K)

		Reference	Proposed	
MOS	Course Number	BCS	CE	ITT
11B	11B10-OSUT	1/	1/	1/
19E	010-19E10 (M60A3)	1/	1/	1/
31E	101-31E10	514,512,791	15,217,955	15,059,467
31S	160-31S10	92,792,857	25,575,696	160,716,102
31V	101-31V10	311,548,798	13,387,420	18,514,529
32G	160-32G10	29,394,580	2,972,622	21,242,313
35C	XXX-35C10	40,924,216	4,784,185	23,939,124
	TOTAL	989,173,241	61,937,878	239,471,535

1/ Insufficient Data

Table 3.5-10 Candidate List of Major Training Devices

	TRAINING DEVICE	TYPE	DESCRIPTION	COURSE	COMPARABLE DEVICES	SOURCE
1.	ECCM Simulator	Three Dimensional (3D) Simulator	Provide realistic electronic warfare conditions for radio operators.	11B10-OSUT 250-13E10 010-19E10	Proposed ECCM simulator appears to be identical to this device.	U.S. Army Comprehensive Plan for Training Devices. July 1981
2.	Digital Logic Trainer	Three Dimensional (3D) Programmable	Provides training of maintenance concepts and enabling knowledges required to troubleshoot digital logic circuits.	101-31E10 160-31S10	Current logic trainer used in troubleshooting computer circuits.	POI: 041-34Y10 File: C-3
3.	Modular Maintenance Trainer	Three Dimensional (3D) Programmable	- Provides modular component interchange and custom configuration for various SINCGARS maintenance requirements - Supports both institutional and unit training - Closed-loop in design - Generic in construction	101-31E10 160-31S10 101-31V10 160-32G10 XXX-35C10	Developing Army Maintenance and Evaluation Simulation System (AMTESS)	U.S. Army Comprehensive Plan for Training Devices July 1981

3.6 IMPACT ANALYSIS

3.6.1 General

The objective of Impact Analysis is to compare a new system's demand for manpower, personnel, and training (MPT) resources to the present and likely future supply of those resouces. Impact Analysis identifies those characteristics of a new system which will require management attention due to either an intense demand for or projected lack of supply of MPT resources. Characteristics thus identified can be investigated and examined for potential solutions.

The new system's MPT resource demands are the results of the previous steps in the HARDMAN methodology. These are first analyzed to identify the MPT high drivers. A high driver is a system element - not restricted to hardware or equipment - which consumes a disproportionate share of MPT resources compared to (1) the same system element in the predecessor or BCS systems or (2) other system elements within the new system.

Impact Analysis then obtains estimates of the present and future supply of MPT resources and makes the supply demand comparison. Two outcomes are possible from the comparison: (1) the demands of the new system will be equal to or less than the projected supply, or (2) the demands will exceed the supply. When the latter case exists, the resource elements involved are termed critical resources. Management has two basic courses of action to address the problem posed by the identification of critical resources. Supply of MPT resources may be increased, by transfer, reallocation, or in the case of personnel, increased retention and recruitment, for example. The other course of action is to reduce a system's demand for MPT resources, with the previously identified high drivers offering the potential for the most significant reductions.

Because DRC computes a new system's MPT demand as part of previous steps in the HARDMAN methodology, it can always determine the high drivers of a new system's demand, simply by rank-ordering the demands within each MPT resource parameter. However, the ability to make a supply/demand comparison varies from application to application, and depends upon the existence of (or DRC's ability to make reasonable estimates in lieu of the existence of) supply information for the MPT parameters of interest. Supply information on MPT resources is typically not available because such information is usually aggregated by MOS, and is not apportioned to specific weapon systems. Further, when supply information is available, it is projected to about 3 years in the future, making its use for a system which will not appear for 8-10 years problematic. In previous applications of HARDMAN, and on a selected basis, DRC has developed a number of analytic techniques, or "work-arounds", which may give the decision-maker some feeling, however rudimentary, for the supply/demand comparison. These were applied, where possible, in SINCGARS. Additionally, DRC developed a more general approach, for an MOS which is responsible for maintaining many systems, to apportioning the existing population of the MOS to each system. The objective was to determine the impact a single new system would have on the MOS as a whole, where the new system replaced only one of the systems for which the MOS is responsible. However, the application of the general approach was frustrated due to the inability to obtain certain data. (The approach is explained in more detail in 3.6.3 below.)

The remainder of this section is subdivided into three sections: (1) Manpower Impacts, (2) Personnel Impacts, and (3) Training Resource Impacts.

3.6.2 Manpower Impacts

A manpower requirement is a statement of the necessary numbers of people, described by MOS and paygrade, needed to directly perform a specific set of mission-oriented tasks for a particular weapon system. A manpower requirement is calculated based on workload required for those tasks.

Because data on the apportioning of the existing population of an MOS to specific systems is not available, no estimates can be made as to the current or future supply of manpower, as defined in HARDMAN, on a system-specific basis. The question of what impact a new system's manpower requirement will have on people resources is only addressable on an MOS-wide basis, and hence is considered under personnel impacts when it is feasible to perform such an analysis. Manpower impacts are thus limited to the identification of high drivers. For the SINCGARS application, MOS's which are high drivers for manpower requirements are apparent from the values shown in Table 3.6-1.

It should be noted that in this and all the other charts in this section, only SINCGARS maintainers are addressed. Operators were included in the analysis until Impact Analysis to illustrate what the MPT requirements for subsets

Table 3.6-1 Manpower Impacts

REFERENCE		PROPOSED			
BCS		CE		ITT	
MOS	MANPOWER	MOS	MANPOWER	MOS	MANPOWER
31V	54,218	31S	2,042	31S	14,173
31E	24,112	31V	1,864	35C	3,264
31S	9,803	31E	544	31V	2,809
35C	4,371	35C	280	32G	2,119
32G	3,162	32G	66	31E	520

of operators might be. Without more complete information as to the total deployment concept for SINCGARS, no estimates can be made for operators for either high drivers or supply/demand comparison.

3.6.3 Personnel Impacts

A comparison of the personnel demands of a new system to available personnel resources can indicate three conditions: (a) an overage of resources relative to demand, (b) a shortage of resources, or (c) an adequate supply of resources to meet demand. The first condition is called a surplus, the second a shortfall, and the third condition is referred to as neutral. For each MOS, this comparison can be expressed in the form of a ratio which DRC refers to as the Availability Ratio (AR). AR is calculated by dividing the actual or projected strength of an MOS by the actual or projected manpower requirements for the MOS. These requirements[1] are in the form of authorizations or manpower spaces. The AR is then expressed.

$$AR = \frac{\text{Available}}{\text{Authorized}}$$

when $AR > 1$, Surplus
$AR < 1$, Shortfall
$AR = 1$, Neutral

1 The distinction between authorizations and "true requirements" is acknowledged but is considered not relevant to this discussion.

For each MOS, DRC has estimates from the U.S Army Military Personnel Center (MILPERCEN) for both authorized and available personnel. These are for the current fiscal year plus one, and are for the MOS as a whole, i.e., unapportioned to specific systems within the MOS. The question that DRC seeks to address by calculating the AR may be stated as follows: "given that the availability (strength) of personnel resources is likely to remain constant, will the introduction of the proposed system change the AR for the MOS as a whole and if so in which direction?"

Since the availability or supply of personnel resources is assumed to remain constant, the new system impacts are due to changes in the requirements, or authorizations. Two circumstances affect the ability to arrive at an estimate of the new AR that is of rudimentory utility. These circumstances are (a) the extent to which the proposed system is either an addition to the present force structure, or replaces a system already in the force structure, and (b) the extent to which the system demands personnel in MOS which cannot be made specific to the proposed system. An additional system using only system-specific MOS is assumed to be a 100% addition to present authorizations; thus the personnel and training demands of this system are their own impacts. SINCGARS, however, constituted the more difficult case: it will replace the AN/VRC-12 radio, and its maintainers, with few exceptions, must be shared with other systems. Thus there are two possible ways to change the authorizations to arrive at a new AR for an MOS which will maintain SINCGARS: (1) add the new manpower requirement to the present authorizations figure, if the MOS does not now maintain the AN/VRC-12 but will maintain SINCGARS, or (2) add the net change between SINCGARS and the AN/VRC-12, if the MOS presently maintains the latter. For the SINCGARS application, MOS 35C and 32G belonged to the first category, while 31V, 31E, and 31S belonged to the second. DRC was able to compute the AR for the first category, but was unable to do so for the second.

The existing authorizations in the MOS's of interest in the second category-31V, 31E and 31S and could not be apportioned to the AN/VRC-12 radio and the other systems which each MOS is responsible for. The change in the AR resulting from replacing the AN/VRC-12 radio with SINCGARS could not be computed, because the subset of each MOS's authorizations associated with the AN/VRC-12 could not be derived. DRC did, however, develop a derivation procedure, but was unable to apply it because certain data, while available, could not be obtained by DRC.

The derivation procedure is as follows:

1. From the Soldier's Manual and Trainer's Guide, identify all the systems for which an MOS is responsible.

2. Obtain from MACRIT or similar source the estimates of workload (annual maintenance manhours) associated with the systems identified in the first step.

3. Multiply the single item workloads by the quantity of the systems deployed in the field.

4. Sum the products of the previous step across all the systems identified in the first paragraph. Because workload and manpower are related by constants, this result is proportional to the total authorizations for the MOS.

5. The percentage contribution of each system to the total authorizations required by the MOS is the ratio of each system's workload (paragraph 3) to the total workload (paragraph 4).

6. A new system's impact may be computed by substituting the new system's workload for the replaced system's workload and recalculating the authorizations required.

Although it was available, DRC was unable to obtain the quantity data for the systems associated with the MOS's of interest - 31V, 31E, and 31S. Table 3.6-2 thus displays the present (1984) ARs for all the MOS, and the changes induced by SINCGARS for 35C and 32G. Table 3.6-3 displays the high drivers for the personnel parameter of annual recruits.

3.6.4 Training Impacts

To determine the availability of training resources, additional information would be required on the predecessor training system. Training resources include training requirements with relatively long lead-times such as (1) instructor requirements, (2) system-specific training devices and equipment, and (3) training facilities. As in personnel, the present availability of these resources had to be known in order to evaluate the impact that the training for a new system will place upon these resources. Due to the lack of availability of this data, training supply/demand comparison was not performed. High drivers were identified by rank ordering student man-days, instructor requirements, and course costs. This information is depicted in Tables 3.6-4 thru 3.6-6, respectively.

Table 3.6-2 Summary of Authorizations and Availability (1984)

	1984			A.R. with SINCGARS		
MOS	AUTH	AVAIL	A.R. 1/	REF.	CE	ITT
31E	1,714	1,682	0.98		2/	
31S	687	836	1.22		2/	
31V	7,231	6,623	0.92		2/	
32G	559	648	1.16	0.30	1.07	0.38
35G	335	210	0.63	0.05	0.39	0.09

Notes:

1. Availability ratio excluding SINCGARS.
2. Insufficient data for these MOS.

Table 3.6-3 Personnel Impacts: Annual Recruits

REFERENCE		PROPOSED			
BCS		CE		ITT	
MOS	RECRUITS	MOS	RECRUITS	MOS	RECRUITS
31V	49,949	19E	3,640	31S	22,071
31E	47,463	31S	3,180	19E	13,874
19E	20,552	31V	1,717	11B	3,814
31S	12,265	31E	1,071	31V	2,589
35C	3,953	11B	961	35C	2,029
11B	1,750	35C	209	32G	1,138
32G	1,582	32G	46	31E	1,024

Table 3.6-4 Training Impacts: Man-Days

RANK ORDER	REFERENCE BCS MOS	REFERENCE BCS MAN-DAYS	PROPOSED CE MOS	PROPOSED CE MAN-DAYS	PROPOSED ITT MOS	PROPOSED ITT MAN-DAYS
1	31E	6,344,221	31S	245,386	31S	1,682,802
2	31V	2,653,846	31E	138,730	35C	220,041
3	31S	959,113	31V	86,964	32G	211,276
4	35C	428,695	35C	22,666	31E	136,875
5	32G	301,526	32G	8,568	31V	131,129
6	11B	–	11B	–	11B	–
7	19E	–	19E	–	19E	–

Table 3.6-5 Training Impacts: Instructors

RANK ORDER	REFERENCE BCS MOS	REFERENCE BCS INSTRUCTORS	PROPOSED CE MOS	PROPOSED CE INSTRUCTORS	PROPOSED ITT MOS	PROPOSED ITT INSTRUCTORS
1	31E	6,845	31S	250	31S	1,528
2	31V	1,952	31E	151	35C	315
3	31S	879	35C	42	32G	177
4	35C	323	31V	30	31E	149
5	32G	244	32G	9	31V	44
6	11B	-	11B	-	11B	-
7	19E	-	19E	-	19E	-

Table 3.6-6 Training Impacts: Course Costs
($K)

	REFERENCE		PROPOSED			
	BCS		CE		ITT	
RANK ORDER	MOS	COST	MOS	COST	MOS	COST
1	31E	517,753	31S	25,609	31S	160,979
2	31V	309,394	31E	15,290	35C	25,811
3	31S	92,619	31V	12,109	32G	21,242
4	35C	40,924	35C	4,977	31V	16,586
5	32G	29,395	32G	2,971	31E	15,151
6	11B	-	11B	-	11B	-
7	19E	-	19E	-	19E	-

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3.7 TRADEOFF ANALYSIS

3.7.1 General

Tradeoff analysis is the essence of the methodology's utility to system decision-makers. Potential solutions to problems uncovered by the basic analysis can be economically "tested" by the iteration of the analysis. Tradeoff analysis prioritizes the critical factors identified in the impact analysis according to their effect on resource availability. In keeping with this schedule, four candidates for tradeoff analysis were submitted for consideration (only two were selected for analysis). These are described in the following paragraphs.

3.7.2 Tradeoff Candidates

Alternative 1:

Assume that 75% of the "total buy" of systems would reflect the actual distribution of SINCGARS systems to operating units. Rerun the analysis using this figure to demonstrate the non-linear sensitivity of changing this number. This tradeoff alternative would also generate more realistic manpower figures since equipment not in the user community requires no operator or maintenance support.

Alternative 2:

The SINCGARS utilization rate used in the present study was based on an average rate for all types of assigned units. In reality, the utilization rate will vary across the various

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branches (e.g., Field Artillery, Armor, etc.) and within the kinds of units within the branches. The use of rates based on differential branch and unit assignments would provide MPT results that would be, in general, more accurate and would provide useful workload data that would be helpful in resolving specific MOS assignment and organizational support problems, e.g., direct support and general support maintenance assignments for ECCM and COMSEC. The conduct of this tradeoff would be predicated on having the variable rates provided to DRC.

Alternative 3:

The MPT results obtained from the initial HARDMAN iteration was based on a wartime usage rate. A tradeoff using a peacetime rate, would provide results useful for planning training resource requirements which will meet the peacetime and wartime manpower requirements for SINCGARS.

Alternative 4:

In the initial effort, general support maintenance responsibility for the COMSEC unit was split between MOS 31S, Field General COMSEC Repairer, and MOS 35C, Automatic Test Equipment Repairer. In order to conform with the SINCGARS Operational and Organizational (O&O) plan, MOS 35C should be replaced by MOS 31S, ASIX9, General COMSEC Maintenance at SRA. This replacement would involve shifting the worklaod and training associated with the operation of automatic test sets and repair of printed circuit boards form MOS 35 C to the ASI. Another shift in MOS assignment at the GS level needed to conform with current program plans, would be to change the ECCM assignments from MOS 32G, Fixed Cryptographic Equipment Repairer, to MOS 31S, Field General COMSEC Repairer. This assignment would result in additional changes in workload assignment and training requirements.

3.7.3 Human Resource Ramifications

Alternatives two and four were selected for tradeoff analysis with results presented in the following tables. The variable rate required for alternative #2 was provided and was a 24 hr. usage scenario input for all users. Table 3.7-1 and 3.7-2 detail the changes in SINCGARS manpower requirements and reflect the same format as the original tables in sections 3.3-3.6. Tables 3.7-3 through 3.7-10 display the impact of the changes in the manpower requirements on personnel requirements. Tables 3.7-11 through 3.7-14 display the three categories of training resources. Finally, Table 3.7-15 is the new set of availability ratios.

Tradeoff peacetime/wartime MPT results reflect the differences in utilization rates for the two scenarios. While peacetime/wartime comparisons reflect significantly higher requirements for maintainers, operator requirements remain relatively even. This is because the operator is required to man the equipment regardless of changes in utilization concerns such as message rate increases.

Table 3.7-1 Tradeoff #2:

SINCGARS
Army-Wide/Wartime
Maintenance Manpower Requirements

MAINTENANCE	MOS/SKILL	REFERENCE	CE	ITT
CREW	11B10/19E10	20,618	4,597	18,061
ORG	31V10	66,076	2,288	3,436
D/S	31E10	12,075	500	292
	31S10	16,297	1,539	10,909
G/S	31E10	14,886	177	336
	31S10	1,091	1,018	887
	32G10	2,003	27	1,292
	32G20	1,808	52	1,302
	35C10	817	105	1,687
	35C20	4,568	241	2,463

Table 3.7-2 Tradeoff #4:

SINCGARS
Army-Wide/Wartime
Maintenance Manpower Requirements

MAINTENANCE	MOS/SKILL	REFERENCE	CE	ITT
CREW	11B10/19E10	17,182	3,898	15,056
ORG	31V10	54,218	1,863	2,809
D/S	31E10	11,935	401	240
	31S10	13,445	1,228	8,913
G/S	31E10	12,177	143	280
	31S10	17,497	2,108	11,760
	31S10ASI	4,371	280	3,264

Table 3.7-3 Tradeoff #2:
Personnel Requirements by MOS

	Reference	C.E.	ITT
11B	4854	2619	10573
19E	40433	7041	27292
31E	80766	2036	1885
31S	47208	6939	32026
31V	89412	5113	7678
32G	9500	274	6842
35C	24004	1267	12943
TOTAL	296177	25289	99239

Table 3.7-4 Tradeoff #2:
Personnel Requirements by Paygrade

	Reference	C.E.	ITT
E-1	84978	6771	25516
E-2	46092	4226	18030
E-3	65273	6067	23366
E-4	92992	7910	28287
E-5	6842	315	4040
TOTAL	296177	25289	99239

Table 3.7-5 Tradeoff #2:
Annual Recruits

	Reference	C.E.	ITT
11B	2101	1133	4576
19E	24659	4294	16644
31E	52951	1335	1236
31S	27079	3981	18370
31V	36863	2108	3165
32G	1934	56	1393
35C	4886	258	2634
TOTAL	150473	13165	48018

Table 3.7-6 Tradeoff #4 (Wartime):
Personnel Requirements by MOS

	Reference	C.E.	ITT
11B	4044	2221	8814
19E	33700	5969	22749
31E	72395	1634	1562
31S	71235	7244	22871
31V	121151	4164	6279
32G	-	-	-
35C	-	-	-
TOTAL	302525	21232	62275

Table 3.6-7 Tradeoff #4 (Wartime):
Personnel Requirements by Paygrade

	Reference	C.E.	ITT
E-1	86710	5788	16757
E-2	47520	3644	10941
E-3	69845	5209	15568
E-4	98450	6591	19009
TOTAL	302525	21232	62275

Table 3.7-8 Tradeoff #4 (Wartime)
Annual Recruits

	Reference	C.E.	ITT
11B	1750	961	3814
19E	20552	3640	13874
31E	47463	1071	1024
31S	40861	4155	13119
31V	49949	1717	2589
32G	-	-	-
35C	-	-	-
TOTAL	160575	11544	34420

Table 3.7-9 TRADEOFF #2:

ANNUAL TRAINING MAN-DAY REQUIREMENTS

MOS/COURSE	REF	CE	ITT
101-31E10	7024833	177110	158867
160-31S10	2122158	303475	1417529
101-31V10	1972438	107413	161272
160-32G10	368617	10397	259782
XXX-35C10	529877	27980	285652
TOTAL	12017922	626374	2283102

Table 3.7-10 TRADEOFF#2:

ANNUAL INSTRUCTOR REQUIREMENTS

MOS/COURSE	REF	CE	ITT
101-31E10	7618	193	174
160-31S10	1895	301	1285
101-31V10	1462	100	143
160-32G10	293	11	213
XXX-35C10	392	39	308
TOTAL	11659	644	2122

Table 3.7-11 TRADEOFF #2:

ANNUAL TRAINING COURSE COSTS

MOS/COURSE	REF	CE	ITT
101-31E10	573536453	18404285	16939077
160-31S10	93899844	31038779	135796488
101-31V10	230789442	15686387	21901244
160-32G10	35445653	3136231	25615881
XXX-35C10	49973275	5299894	30306562
TOTAL	983644666	73565577	230559252

Table 3.7-12 TRADEOFF #4:

ANNUAL TRAINING MAN-DAY REQUIREMENTS

MOS/COURSE	REF	CE	ITT
101-31E10	6296758	137659	135851
160-31S10	3202242	320622	1000072
101-31V10	2672634	87489	131922
TOTAL	12171634	545771	1267844

Table 3.7-13 TRADEOFF #4:

ANNUAL INSTRUCTOR REQUIREMENTS

MOS/COURSE	REF	CE	ITT
101-31E10	6828	150	148
160-31S10	2838	317	918
101-31V10	1967	83	120
TOTAL	11633	550	1186

Table 3.7-14 TRADEOFF #4:

ANNUAL TRAINING COURSE COSTS

MOS/COURSE	REF	CE	ITT
101-31E10	514512791	15217955	15059467
160-31S10	303309058	32650435	96544107
101-31V10	311548798	13387420	18514529
TOTAL	1129370646	61255809	130118103

Table 3.7-15 Tradeoff #2 (Wartime):
Availability Ratios (1984)

	Reference	C.E.	ITT
32G	0.15	0.21	1.01
35C	0.04	0.05	0.31

LIST OF ACRONYMS

AFQT	Armed Forces Qualification Tests
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
ASARC	Army System Acquisition Review Council
ASVAB	Armed Services Vocational Aptitude Battery
ATE	Automatic Test Equipment
BCS	Baseline Comparison System
BDP	Battlefield Development Plan
BIT	Built-In-Test
BITE	Built-In-Test-Equipment
CE	Cincinnati Electronics
CDB	Consolidated Data Base
CM	Corrective Maintenance
COMSEC	Communications Security
COPO	Chief of Personnel Operations
CTEA	Cost and Training Effectiveness Analysis
D/S	Direct Support
DDI	Design Difference Index
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DRC	Dynamics Research Corporation
DSWS	Division Support Weapon System
DT/OT	Development Test/Operational Test
ECCM	Electronic Counter-Counter Measures
EMF	Army Enlisted Master File
FQQPRI	Final Qualitative and Quantitative Personnel Requirements Information
G/S	General Support
HARDMAN	Military Manpower vs. Hardware Procurement
ICTP	Individual and Collective Training Plan
IMPACT	Interactive Manpower-Personnel Assessment and Correlation Technology
ISD	Instructional Systems Development
ITT	International Telephone and Telegraph
IVRC	Intra-Vehicular Remote Control
JILSP	Joint Integrated Logistics Support Plan
LCN	Logistics Control Numbers
LSA	Logistic Support Analysis
LSAR	Logistic Support Analysis Records
LSI	Large Scale Integration
MAC	Maintenance Allocation Charts
MACRIT	Army Manpower Authorization Criteria
MILPERCEN	U.S. Army Military Personnel Center
MOH	Manpack Operating Hours
MOS	Military Occupational Specialty
MPT	Manpower, Personnel and Training

LIST OF ACRONYMS (Continued)

NATO	North Atlantic Treaty Organization
NCU	Net Control Unit
O&O	Operational and Organizational
PM	Preventive Maintenance
PMCS	Preventive Maintenance Checks and Services
PM TRADE	Training Device Development with Logistic Implications
PRA	Personnel Requirements Analysis
PV	Perturbation Value
R/M	Reliability/Maintainability
R/T	Receiver/Transmitter
RAM	Reliability, Availability and Maintainability
RCS	Requirements Control Symbol
ROC	Required Operational Capability
SDT	System Description Technology
SINCGARS	Single Channel Ground-Airborne Radio System
SOJT	Supervised On-the-Job Training
SRA	Specialized Repair Activity
SRCU	Securable Remote Control Unit
SSC	U.S. Army Soldier Support Center
STE	Self Test Equipment
3-M	Navy Maintenance Material Management System
TM	Technical Manual
TRADOC	Training and Doctrine Command
TRRA	Training Resource Requirements Analysis
TRRAMP	Training Resource Requirements Analysis Master Program
TTHS	Trainees, Transients, Holdees and Students
VHF-FM	Very High Frequency-Frequency Modulated
VOH	Vehicular Operating Hours
WSAP	Weapon System Acquisition Plan

Appendix A

Engineering Analysis

This appendix is a detailed description of the Design Difference Index (DDI) worksheets. The charts record the results of engineering comparability analyses between reference and proposed equipments. Design differences between the reference components and corresponding components in each of the contractor proposals are listed. The R&M impacts of these design differences are assessed, and findings are recorded in the last three columns. Further understanding of DDI criteria is provided in Section 3.2.

COLUMN	MEANING
Code	• Audit number, contractor identification
Reference	• Reference system component
Proposed	• Contractor component
Difference	• Differences between reference and proposed
Source	• Data description
Impact	• Change in R/M values
PV	• Perturbation Value
Remarks	• Comments

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8AAZ CE	AN/ARC 114( ) R/T and Control Panel Group Front and Rear Section	Receiver - Transmitter	General REF: • R/T not used as a manpack; used in aircraft (Handmounted) configuration only • experiences considerable vibration and G-forces during normal operation • solid state LSI • synthesized self-test • retransmission capabilities CE: • used in both manpack and vehicular modes; R/T requires interfaces with pack frame, battery and antenna for adaption to manpack • plug-in interfaces for side-hat options • solid state LSI • synthesized self-test • retransmission capabilities	UH-1N 3M CM/PM Data DEP 11-5820-891-10 CE LSA-02	Decrease PM/CM	-	Utilize CE Predictions from LSA-02

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8AAZ CE (Continued)	AN/ARC- 114 ( ) R/T and Control Panel Group Front and Rear Section	Receiver- Transmitter	INDICATOR ASSY REF: Mechanical: Uses gears and chains to rotate indicator drum. Indicate frequency in 50KHZ steps CE: Digital Readout on seven segment led's. Indicates frequency (25KHZ steps) modes, and built-in test. Receiver-Transmitter Control REF: Manual Switches Change frequency by rotating knob until indicator reads desired frequency. Digitally tuned circuits. CE: Preset Channel switch or knob to increase or decrease frequency can be used • Digitally tuned circuits.				

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8AAZ ITT	AN/ARC-114 ( ) R/T and Control Panel Group Front and Rear Section	Manpack/ Vehicular R/T	<u>General</u> REF: • R/T not used as a manpack; used in aircraft (hardmounted) configuration only • experiences considerable vibration and G-forces during normal operation • solid state LSI • synthesized self-test • retransmission capabilities ITT: • used in both manpack and vehicular modes; R/T requires interfaces with pack frame, battery and antenna for adaption to manpack • plug-in interfaces for side-hat options • solid state LSI • synthesized self-test • retransmission capabilities	UH-IN 3M CM/PM Data DEP 11-5820-890-10 ITT LSA - 02	Decrease PM/CM	-	Utilize ITT Predictions from LSA - 02

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8AAZ ITT ( ) (Continued)	AN/ARC - 114 ( ) R/T and Control Panel Group Front and Rear Section		<u>Chassis and Display</u> REF: Mechanical: Uses gears and chains to rotate indicator drum. Indicate frequency in 50 KHZ steps ITT: Digital Readout on seven segment led's. Indicates frequency (25 KHZ steps) modes, and built-in test. <u>Control Module</u> REF: • Manual Switches Change frequency by rotating knob until indicator reads desired frequency. • Digitally tuned circuits ITT: • Keyboard is used to assign frequency. It also has preset channels to determine frequency • Digitally tuned circuits				

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8ABZ CE	Antenna Coupler CU 2041/AR (From E-2C)	Manpack Antenna Coupler	REF: Airborne Coupler Unit With analog devices such as coils and tuning drives CE: More state-of-the-art equipment/ Logic and Control Circuits utilized/improved R/M	Navy 3-M data from the E-2C TM 11-5821-259-20 CE LSA-02 DEP 11-5820-891-10	Decreased PM/CM	-	Utilize CE Predictions from LSA-02
8ABZ ITT	Same	-	REF: Same as Above. ITT: The impedance matching unit is contained in the R/T	Navy 3-M data from E-2C DEP 11-5820-890-10 ITT LSA-02	Decreased PM/CM	-	Included in ITT LSA-02 for R/T Unit (8AAZ)

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8ACZ CE	AT-892/ PRC-25	Whip Antenna Manpack	CE: Wght: .06 lb Length: 4.0 ft REF: Length: 3.0 ft Installation and removal similar Fewer tasks identified by contractor, repair task not identified by contractor	DEP 11-5820-891-10 TM 11-5820-667-12	Decreased PM	-	Change ORG quarterly (repair) task time from .2 to the .01 (replace) task time in contractor MAC For reference workload data, utilize MAC chart values for AT-271/PRC
8ACZ ITT	Same	Manpack Whip Antenna	ITT: Length: 1 Meter Installation and Removal similar	DEP 11-5820-890-10 ITT LSA-02,LSA MAC TM 11-5820-667-12	INCR/DECR PM Decrease PM	- -	Change freq of crew inspect task from 1/wk to 1/18 MOH Change ORG (repair) task time from .2 to the 2 .01 (R&R) tasks times and task freq from quarterly to .01/4380 MOH each For reference workload data, utilize MAC chart values for AT-27y PRC

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8BEZ CE	AS-1729/VRC	Vehicular Antenna	REF CE Wgt (lb) 10.0 7.5 Hgt (in) Base 14.25 9.0 Upper 64.0 56.0 Lower 52.5 57.0 REF & CE Similar	TM 11-5985-262-15 DEP 11-5820-891-10 CE LSA-02	Decrease PM/CM	-	Utilize CE Predictions from LSA-02 (for R/T Unit (8AAZ))
8BEZ ITT	Same	Vehicular Antenna	ITT: 2 Meter or 3 Meter Whip Antenna Control and Matching Function performed in REF By MX-6707/VRC is performed in ITT by Ant Contr and Matching component of R/T	TM 11-5985-262-15 DEP 11-5820-890-10 ITT LSA-02	Decrease PM/CM	-	Utilize ITT Predictions from LSA-02

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8BGZ CE 8DIZ CE	MT-1029/VRC (AN/VRC-12)	Mounting Assy Single or Dual	REF: Single Mount Designed to hold one R/T/No Reference Workload Available CE: Single or Dual Unit Depending upon conaguration/ each has interconnect box attached to it and is able to hold add-on equipment. (COMSEC, ECCM side hat, etc.)	TM 11-5820-401-12 TM 11-5820-401-34-3 DEP 11-5820-891-10 CE LSA-02	Increase PM/CM	-	Utilize CE Predictions from LSA-02
8DIZ CE	Same	Mounting Base	REF: Same as above. ITT: Dual Mount only used in all vehicular configurations/ mount has interconnecting box and is able to hold add-on units	DEP 11-5820-890-10 TM 11-5820-401-12 TM 11-5820-401-34-3 ITT LSA-02	Increase PM/CM	-	Utilize ITT Predictions from LSA-02

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8CHZ CE	AM 6176/URC RF Amplifier 6481 A-1 (from EC-130Q)	RF Amplifier	AM6176 used for CM/PM workload - detailed REF to proposed eqpt comparison could not be determined/improved R/M	EC-130Q 3M CM/PM Data & WUC Manual DEP 11-5820-891-10 CE: LSA-02	Decreased CM	-	Utilize CE Predictions from LSA-02
8CHZ ITT	Same	Power Amplifier	Same as Above	EC-130Q 3M CM/PM Data & WUC Manual DEP 11-5820-890-10 ITT LSA-02	Decreased CM	-	Utilize ITT Predictions from LSA-02

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8CXZ 8BDZ 8CYZ 8DSZ CE	Cable Assy (AN/VRC-12)	Cable Assys	REF: Similiar to the Proposed System CE: Cables may be of different sizes with little impact on workload	TM 11-5820-401-12 TM 11-5820-401-34-3 DEP 11-5820-891-10 CE LSA-02	Increase PM/CM	1.0	Utilize CE Predictions from LSA092
8CXZ 8BDZ 8CYZ 9DSZ ITT	Same	Cable Assys	REF: Same as Above ITT: Same as C.E.	TM 11-5820-401-12 TM 11-5820-401-34-3 DEP 11-5820-890-10	No Change	1.0	

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8AOZ CE	Battery, Dry BA-4386/u (AN/PRC-77)	Battery, RT-Manpack Case, Battery	REF: Battery Life 60 Hours DE: Battery Life 24+ Hours REF: Magnesium Battery CE: Disposable, Lithium Battery	TM 11-5820-667-12 DEP 11-5820-891-10	Increase PM/CM No Change PM/CM Increase PM	1.0 -	Utilize contractor LSA-02; Apply to 8AOZ Tasks/Freqs Utilize remove and replace freq of 1/24 OPHRS (Task included under 8AZZ in CELSA-02)
8AOZ ITT	Same	Manpack Battery, Dry Battery Case	REF: Battery Life 60 Hours ITT: Battery Life 32 Hours REF: Magnesium ITT: Lithium	TM 11-5820-667-12 DEP 11-5820-890-10	Decrease PM/CM	-	Utilize ITT predictions from LSA-02 Utilize remove and replace freq of 1/30 OPHRS

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8ASA CE	6482N 4173/AIC Headset	Headset	Similar		No Change	1.0	
8ASB	6482P M92A/u Microphone	Headset Microphone	Similar		No Change	1.0	
8ARZ CE	Handset H-189/u	Handset H-250/u	Similar CE Handset Lighter and More Rugged		Decrease CM	-	Utilize CE Predictions From LSA-02
8ASA ITT	Same	Headset	Similar		No Change	1.0	
8ASB ITT	Same	Headset Microphone	Similar		No Change	1.0	
8ARZ ITT	Handset H-189/u	Handset	Similar ITT Handset Lighter and More Rugged		No Change	1.0	

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8VZZ CE	Backpack (PRC-77)	Backpack	Similar	TM 11-5820-667-17 DEP 11-5820-891-10	No Change	1.0	
8VZZ ITT	Same	Backpack	Similar	TM 11-5820-667-12 DEP 11-5820-890-10	No Change	1.0	

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8GZZ CE	SN416( )/ APX 76( ) Electronic Synchronizer IFF Gear (ECCM)	ECCM Sidehat	REF: Different type of synchronizer than that of proposed systems but functions similar/R&R tasks performed at D/S Level/Modular type parts CE: Video gating, power supply and filter elements not required in proposed/ separate unit added to R/T/ R&R Tasks done at ORG Level/ Improved R/M/Separate unit instead of single card	Navy 3M Data KC-130F Aircraft R/M Summary Oct. 81 - Sep 82 Harris 3090P R/T Instruction Manual DEP 11-5820-891-10	Decrease CM	-	Utilize CE Predictions From LSA-02
8GZZ ITT	Same	ECCM Module	REF: Same as Above ITT: Video gating, Power Supply and filter elements not required in proposed/single card makes easier access for repair and fault isolation/improved R/M	Navy 3M Data KC-13- F Aircraft R/M Summary Oct. 81-Sep 82 Harris 3090P R/T Instruction Manual DEP 11-5820-890-10	Decrease CM	0.8	Apply to Task Freqs.

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8RZZ CE	VINSON COMSEC/ KY-57	VINSON COMSEC	None	TM 11-5810-256-12 TM 11-5810-256-OP-2/3/4 Navy 3-M Data for KY-28 Encoder from E-2c A/C DEP 11-5820-891-10	No Change	1.0	KY-28 R/M Data from E-2C Aircraft Utilized for reference in lieu of KY-57 Data which was unavailable
8RZZ LT	Same	VINSON COMSEC	None	TM 11-5810-256-12 TM 11-5810-256-OP-2/3/4 Navy 3-M Data for KY-28 Encoder from E-2C A/C DEP 11-5820-890-10	No Change	1.0	Same as Above

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8BOZ CE 8DWZ CE	C2645( )/ AIC-14 ICS Control	Interconnecting Box - Single or Dual	C2645 used for CM/PM workload-no other unit similiar to proposed REF: Single Unit utilized for both single and dual R/T applications CE: Single or Dual Unit/ Improved R/M	E-2C Aircraft 3M CM/PM Data & WUC Manual DEP 11-5820-891-10 CE: LSA-02	Decrease CM	-	Utilize CE Predictions from LSA-02
8DWZ ITT	Same	Mounting Adapter, Vehicle Radio	C2645 Used for CM/PM Workload No other unit similar to proposed REF: Same as above ITT: Single Unit utilized for both single and dual R/T Applications/improved R/M	E-2C Aircraft 3M CM/PM Data & WUC Manual DEP 11-5820-890-10 ITT LSA-02	Decrease CM	-	Utilize ITT Predictions from LSA-02

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8NZZ CE	KYK-13/TSEC Electronic Transfer Fill Device Fill Battery, BA-1372/U Fill Cable	ECCM Fill Device Battery, Memory Fill Cable	REF: PM Derived from 5810 TMS CM Derived from Navy 3-M Data for KGX-40 Crypto Device -Battery Replacement Quarterly CE: Similar Design and Use -Battery Replacement Annually	TM-11-5810-256-OP-2/3/4 TM-11-5810-256-12 Navy 3-M Data (R/M Summary 10/81 - 9/82) for KGX-40 Crypto Device DEP 11-5820-891-10 CE LSA-02	Decrease PM CM Should not change significantly but CE LSA-02 shows CM reduction	-	Utilize CE Predictions from LSA-02
8NZZ ITT	Same	KYK-13/TSEC Electronic Transfer Fill Device Fill Battery, BA-1372/U Fill Cable	No Change New Design not Specified by contractor	TM-11-5810-256-OP-2/3/4 TM-11-5810-256-12 Navy 3-M Data (R/M Summary 10/81 - 9/82) for KGX-40 Crypto Device DEP-11-5820-890-10	No Change PM/CM	1.0	

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8PZZ CE	C4162(V)/AIC22(V) ICS Control (P-3A/C)	IVR Control Assy	REF: Equipment Description of C4162(V) could not be found. Design differences based on comparision with AM-1780/VRC (AN/VIC-1) One box with amplifier most advanced item we have RAM-D.	Navy 3M-Data from P-3C Aircraft TM 11-5830-340-12	PMCM Workload Should increase but CE LBA-02 shows CM reduction	-	Utilize CE Predictions From LSA-02
		Access Control Box	CE: Two separate boxes/ More complex operation/ More troubleshooting needed to isolate fault/ Improve failure rate per box due to design comparability	DEP 11-5820-891-10 CE LSA-02			
8PZZ ITT	Same	Intra Vehicular Remote Control	REF: One box. The closest system to this unit.	Navy 3M-Data from P-3C Aircraft TM 11-5830-340-12			
			ITT: More functions are included in the box. Failure rate will increase as a result.	DEP 11-5820-890-10	Increase CM	1.2	Apply to task frequencies

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8QAZ CE 8QBZ CE	Control Radio Set C-2328/GRA-39 (Remote Control Group) Battery	Securable Remote Control Unit (SRCU) Battery	REF: Remote REC & XMT 3.3 KM, Battery Life Expectancy, 24 hours BASELINE: Remote REC & XMT 4KM, Battery Life Unspecified Basic Unit More Complex W/Reqmt to control more functions (BIT, ECCM, COMSEC, Etc.) BIT Electronics will simplify repair tasks	Required Operational Capabilities (ROC) O&O Plan	Decrease PM/CM	-	Utilize O&O Plan MTBOMF (MAV) of 1250 and MTTRS: 0 - .25 hr D/S - .75 hr G/S - 2.5 hr Spread task freqs across maint levels law ref ie 0 - .666 D/S - .312 G/s - .022
8QAZ ITT 8QBZ ITT	Same	Interconnecting Box, Remote Control Battery	Same As Above	ROC DEP 11-5820-890-10 O&O Plan	Decrease PM/CM	-	Same as Above

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
8MZZ CE	KYX-14/TSEC Net Control device Fill Battery, BA-1372/u Fill Cable	Net Control Unit Battery, NCU BA-5847 Fill Cable	REF: PM Derived from 5810 TMS CM derived from Navy 3-M data for KGX-40 Crypto device CE: Keyboard for PB Inputs Replaces Mechanical knobs and dials - Memory added for flexibility - NCU Battery Requires weekly Repl rather than quarterly, in REF	TM 11-5810-256-OP-2/3/4 TM 11-5810-256-12 Navy 3-M data (R/M summary 10/81-9/82) for KGX-40 Crypto device DEP 11-5820-891-10 CE LSA-02	Increase PM CM should increase by PV of 1.2 but CE LSA-02 shows CM Reduction	-	Utilize CE Predictions from LSA-02
8MZZ ITT	Same	-	Function Performed by Manpack/ Vehicular R/T	DEP-11-5810-890-10	Decrease PM/CM	-	Included in ITT LSA-02 for R/T Unit (8AAZ)

CODE	REFERENCE	PROPOSED	DIFFERENCE	SOURCE	IMPACT	PV	REMARKS
80ZZ CE	CV2837/ARC84 (V) Signal Data Converter (P-3A/C)	Digital Data Device	REF: Has an analog to digital converter/Hardmounted Unit CE: Add-on unit/ more complex circuitry To compensate for greater range of bands per second/ Also has measuring unit and memory	3M Data P-3 Aircraft DEP 11-5820-891-10	Increase CM	1.2	Apply to Task Freqs
0GZZ ITT	Same	Data Rate Adapter	REF: Same as Above ITT: Module to be installed and removed from R/T Unit/ Easier remove and replace done at ORG level	3M Data P-3 Aircraft DEP 11-5820-890-10	Increase CM -Shift some CM to lower maint. level	1.2 -	Apply to Task Freqs Shift all R&R workload to Org level

Appendix B

Manpower Requirements Analysis

Appendix B1 contains the worksheets used to record the annual maintenance manhours for SINCGARS. Tables B1-1 to B1-3 are the detailed sheets for each contractor and Table B1-4 summarizes the totals from the detail sheets.

Appendix B2 and B3 contain the worksheets used to record the annual maintenance manhours for Tradeoffs #2 and #4 respectively. As with Appendix B1, Tables B2-1 to B2-3 and B3-1 to B3-3 are the detailed sheets for the respective contractors and Tables B2-4 and B3-4 being the summary sheet.

The workload (annual maintenance manhours) was divided by the appropriate availability factor (4380 hours for operators and 3285 hours for maintainers) to produce the respective maintenance manpower requirements contained in the main section of this report.

Table B1-1:

SINCGARS
Reference System Army-Wide/Wartime
Annual Maintenance Manhours

MAINTENANCE LEVEL	MOS/SKILL LEVEL	CONFIGURATION V1	V2	V3	V4	V5	V6	V7	TOTAL
CREW	11B10/19E10	10062080	5350324	18887772	16687582	14050634	8863056	1352186	75253634
ORG	31V10	17267945	7374541	11576866	79333714	50498576	3549601	8502882	178104125
D/S	31E10	3760929	3182926	4782787	17007884	7723157	618387	2130333	39206403
	31S10	1945904	2061312	7798705	7829945	5314056	940052	18276482	44166456
G/S	31E10	3622744	2599360	5138740	18996536	7486868	795449	1360804	40000501
	31S10	342149	244950	726341	590178	806328	61626	152069	2923641
	32G10	602470	485168	1272621	1930864	1116334	10030	110453	5527940
	32G20	442176	442176	993654	1838260	993654	48579	99365	4857864
	35C10	120209	120209	433015	778795	565132	60476	139225	2217061
	35C20	2631481	690367	1559272	3776021	2950283	178901	354786	12141111

Table B1-2:

SINCGARS
CE Army-Wide/Wartime
Annual Maintenance Manhours

MAINTENANCE LEVEL	MOS/SKILL LEVEL	CONFIGURATION V1	V2	V3	V4	V5	V6	V7	TOTAL
CREW	11B10/19E10	5523302	1463782	3738850	3867990	1692432	476854	304709	17067919
ORG	31V10	330314	570534	137281	2346514	2219728	199172	305107	6118650
D/S	31E10	180520	103522	187121	350204	359856	48533	84308	1314064
	31S10	552705	369069	623626	854786	1378953	67655	186040	4032834
G/S	31E10	55662	26221	63023	122646	133905	26447	40694	468598
	31S10	366882	244588	412227	563337	916060	44785	125688	2673547
	32G10	6739	7025	14080	28729	16097	737	1507	74914
	32G20	12827	12799	28640	53015	28865	1410	2882	140438
	35C10	21095	21235	34735	130017	55709	5699	9845	278335
	35C20	67455	57344	103732	202011	162088	17066	29260	639556

Table B1-3:

SINCGARS
ITT Army-Wide/Wartime
Annual Maintenance Manhours

MAINTENANCE LEVEL	MOS/SKILL LEVEL	CONFIGURATION V1	V2	V3	V4	V5	V6	V7	TOTAL
CREW	11B10/19E10	21931476	1366323	26967100	5856217	4014747	5182768	620297	65939328
ORG	31V10	777266	931313	1867469	3464584	1227486	330483	626108	9224709
D/S	31E10	76015	63217	100757	256295	196326	36164	57105	785879
	31S10	2700463	2574807	6329166	9462488	6964439	432398	815326	29279087
G/S	31E10	47334	30239	47897	54659	595835	19883	123668	919515
	31S10	207073	228099	396176	563337	917060	43198	35453	2390396
	32G10	351186	351186	396590	1459985	789181	38352	78918	3456398
	32G20	353741	353741	397462	1472608	794923	42696	79492	3494663
	35C10	913238	320634	166498	1873674	941034	82381	192972	4490431
	35C20	1145218	557133	701862	2513532	1250246	23743	36882	6231616

Table B1-4:

SINCGARS
Army-Wide/Wartime
Annual Maintenance Manhour Summary

MAINTENANCE	MOS/SKILL	REFERENCE	CE	ITT
CREW	11B10/19E10	75,253,634	17,067,919	65,939,328
ORG	31V10	178,104,125	6,118,650	9,224,709
D/S	31E10	39,206,403	1,314,064	785,879
	31S10	44,166,456	4,032,834	29,279,087
G/S	31E10	40,000,501	468,598	919,515
	31S10	2,923,641	2,673,547	2,390,396
	32G10	5,527,940	74,914	3,345,398
	32G20	4,857,864	140,438	3,494,663
	35C10	2,217,061	278,335	4,490,431
	35C20	12,141,111	639,556	6,231,616

Table B2-1 Tradeoff #2:

SINCGARS
Reference System Army-Wide/Wartime
Annual Maintenance Manhours

MAINTENANCE LEVEL	MOS/SKILL LEVEL	CONFIGURATION V1	V2	V3	V4	V5	V6	V7	TOTAL
CREW	11B10/19E10	12071869	6419382	22661773	20021959	16858077	10633940	1622339	102361209
ORG	31V10	23023926	9832721	13892239	95200457	60598291	4307911	10203459	217059003
D/S	31E10	4014572	3243902	4739345	17409461	7267789	633495	2356399	59664963
	31S10	2594538	2748416	9350446	9394934	6373367	1140878	2193178	53534357
G/S	31E10	4839326	3465813	6166488	22795843	8984241	965383	1682964	48900058
	31S10	456198	326600	871610	703213	967594	74792	182482	3582489
	32G10	803294	646890	1327146	2317037	1339600	12172	132543	6578691
	32G20	589568	589568	1192385	2205912	1192385	58957	110238	5939012
	35C10	160279	160279	519617	930554	678158	72396	162070	2683353
	35C20	3505642	1900489	2871127	4531225	1054339	217121	925743	15005686

Table B2-2 Tradeoff #2:

SINCGARS
CE Army-Wide/Wartime
Annual Maintenance Manhours

MAINTENANCE LEVEL	MOS/SKILL LEVEL	CONFIGURATION V1	V2	V3	V4	V5	V6	V7	TOTAL
CREW	11B10/19E10	6514299	1729618	4386654	4563829	199684	588392	359554	20129190
ORG	31V10	440418	760712	164737	2865817	2663674	241722	378128	7515208
D/S	31E10	240693	138029	224545	447245	431827	58901	101170	1642410
	31S10	738939	492092	748351	1725743	1854744	82108	223248	5055225
G/S	31E10	74216	34962	75627	141175	167186	32897	48833	581396
	31S10	489176	326117	494273	676005	1145272	62353	150826	3344022
	32G10	8985	9266	13896	34474	19317	895	1809	88642
	32G20	17103	17066	34368	63618	33437	1712	3458	170762
	35C10	28126	28314	46682	156021	66851	6918	11814	344726
	35C20	89940	76458	124478	248413	194505	20712	25832	790338

Table B2-3 Tradeoff #2:

SINCGARS
ITT Army-Wide/Wartime
Annual Maintenance Manhours

MAINTENANCE LEVEL	MOS/SKILL LEVEL	CONFIGURATION V1	V2	V3	V4	V5	V6	V7	TOTAL
CREW	11B10/19E10	26313551	1638962	32348174	7024778	4851366	6218884	744495	79104210
ORG	31V10	1166354	1247751	2472963	3372983	1472983	601085	951330	11285449
D/S	31E10	101353	84289	120908	304592	235592	43890	68526	959150
	31S10	3600618	3433076	7590999	11354986	8352326	524772	978391	35835168
G/S	31E10	63112	40318	57476	65591	704001	24131	148402	1103031
	31S10	276097	304132	475411	672005	1090472	52427	42543	2913087
	32G10	468247	468247	475909	1715982	947017	46546	94702	4243650
	32G20	471654	471654	476954	1755130	953908	51817	95391	4276508
	35C10	1204651	427512	199798	2248409	1129241	99981	231567	5541159
	35C20	1526957	742843	842235	3316238	1581295	28815	52258	8090643

Table B2-4 Tradeoff#2:

SINCGARS
Army-Wide/Wartime
Annual Maintenance Manhour Summary

MAINTENANCE	MOS/SKILL	REFERENCE	CE	ITT
CREW	11B10/19E10	102,361,209	20,129,190	79,104,210
ORG	31V10	217,059,003	7,515,208	11,285,449
D/S	31E10	59,664,963	1,642,410	959,150
	31S10	53,534,357	5,055,225	35,835,168
G/S	31E10	48,900,058	581,396	1,103,031
	31S10	3,582,489	3,344,022	2,913,087
	32G10	6,578,691	88,642	4,243,650
	32G20	5,939,012	170,762	4,276,508
	35C10	2,683,353	344,726	5,541,159
	35C20	15,005,686	790,338	8,090,643

Table B3-1 Tradeoff #4:

SINCGARS
Reference System Army-Wide/Wartime
Annual Maintenance Manhours

MAINTENANCE LEVEL	MOS/SKILL LEVEL	CONFIGURATION V1	V2	V3	V4	V5	V6	V7	TOTAL
CREW	11B10/19E10	10062080	5350324	18887772	16687582	14050634	8863056	1352186	75253634
ORG	31V10	17267945	7374541	11576866	79333714	50498576	3549601	8502882	178104125
D/S	31E10	3760929	3182926	4782787	17007884	7723157	618387	2130333	39206403
	31S10	1945904	2061312	7798705	7829945	5314056	940052	18276482	44166456
G/S	31E10	3622744	2599360	5138740	18996536	7486868	795449	1360804	40000501
	31S10	1386795	1172294	2932617	4359302	2916316	120235	361887	13309446
	31SASI	2751690	810576	1992287	4554816	3515414	239378	414011	14358172

Table B3-2 Tradeoff #4:

SINCGARS
CE Army-Wide/Wartime
Annual Maintenance Manhours

MAINTENANCE LEVEL	MOS/SKILL LEVEL	CONFIGURATION V1	V2	V3	V4	V5	V6	V7	TOTAL
CREW	11B10/19E10	5523302	1463782	3738850	3867990	1692432	476854	304709	17067919
ORG	31V10	330314	570534	137281	2346514	2219728	199172	305107	6118650
D/S	31E10	180520	103522	187121	350204	359856	48533	84308	1314064
	31S10	552705	369069	623626	854786	1378953	67655	186040	4032834
G/S	31E10	55662	26221	63023	122646	133905	26447	40694	468598
	31S10	386448	264412	454947	645081	961022	46933	130077	2888900
	31SASI	88550	78579	138466	332028	71918	22766	39704	917891

Table B3-3 Tradeoff #4:

SINCGARS
ITT Army-Wide/Wartime
Annual Maintenance Manhours

MAINTENANCE LEVEL	MOS/SKILL LEVEL	CONFIGURATION V1	V2	V3	V4	V5	V6	V7	TOTAL
CREW	11B10/19E10	21931476	1366323	26967100	5856217	4014747	5182768	620297	65939328
ORG	31V10	777266	931313	1867469	3464584	1227486	330483	626108	9224709
D/S	31E10	76015	63217	100757	256295	196326	36164	57105	785879
	31S10	2700463	2574807	6329166	9462488	6964439	432398	815326	29279087
G/S	31E10	47334	30239	47897	54659	595835	19883	123668	919515
	31S10	911972	933025	1190228	3495930	2501165	124246	193863	9350459
	31SASI	2058456	877767	868361	4387206	2191280	106124	229054	10722048

Table B3-4 Tradeoff #4:

SINCGARS
Army-Wide/Wartime
Annual Maintenance Manhour Summary

MAINTENANCE	MOS/SKILL	REFERENCE	CE	ITT
CREW	11B10/19E10	75,253,634	17,067,919	65,939,328
ORG	31V10	178,104,125	6,118,650	9,224,709
D/S	31E10	39,206,403	1,314,064	785,879
	31S10	44,166,456	4,032,834	29,279,087
G/S	31E10	40,000,501	468,598	919,515
	31S10	13,309,446	2,888,900	9,350,459
	31Sa0ASI	14,358,172	917,891	10,722,048

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Appendix C

Training Analysis

C1 COURSE MODIFICATION WORKSHEETS

Tables C1-1 to C1-12 contain the worksheets that were used to modify existing courses and develop new courses. A full description of the information contained on these worksheets and how they are used in the training resource requirements analysis can be found in Section 3.5.3.

C2 DETAILED COURSE RESOURCE REQUIREMENTS

This appendix contains the detailed course resource outputs from the Training Resource Requirements Analysis Master Program (TRRAMP). Each table contains the detailed TRADOC cost matrix used in the ATRM-159 report. The individual cost elements in each matrix have been modified by the DRC-developed program to reflect the impact of changes made by the SINCGARS design configurations. The bottom of each table contains summaries of the various training resources by individual program of instruction (POI) and by total annual requirements.

Table C1-1

COURSE MODIFICATION WORKSHEET

COURSE: 11B10-OSUT

SYSTEM: BCS, CE, ITT

MOS 11B10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
FUNDAMENTAL TRAINING (Common)					FUNDAMENTAL TRAINING (Common)							
Annex A:	.5	C			Annex A:	.5	C					
Identification, Preparation	.5	D			Identification, Preparation	.5	D					
and Wear of the Uniform	1.0	PE2			and Wear of the Uniform	1.0	PE2					
Subtotal	2.0				Subtotal	2.0						
Annex B:	.5	C			Annex B:	.5	C					
Drill and Ceremonies	.5	D			Drill and Ceremonies	.5	D					
	23.0	PE2				23.0	PE2					
Subtotal	24.0				Subtotal	24.0						
Annex C:	1.5	C			Annex C:	1.5	C					
Guard Duty	.8	D			Guard Duty	.8	D					
	2.7	PE2				2.7	PE2					
Subtotal	5.0				Subtotal	5.0						
Annex D:					Annex D:							
Inspections	24.0	PE1			Inspections	24.0	PE1					
Subtotal	24.0				Subtotal	24.0						
Annex E:					Annex E:							
Personal Health and Hygiene	2.0	F			Personal Health and Hygiene	2.0	F					
	2.0	C				2.0	C					
Subtotal	4.0				Subtotal	4.0						
Annex F:	.5	C			Annex F:	.5	C					
Marches and Bivouacs	.5	D			Marches and Bivouacs	.5	D					
	6.0	PE1				6.0	PE1					
	21.0	PE2				21.0	PE2					
Subtotal	28.0				Subtotal	28.0						
Annex G:					Annex G:							
Conditioning Obstacle Course	4.0	PE2			Conditioning Obstacle Course	4.0	PE2					
Subtotal	4.0				Subtotal	4.0						
Annex GG:	.1	C			Annex GG:	.1	C					
Rifle Bayonet Fighting	.4	D			Rifle Bayonet Fighting	.4	D					
	7.5	PE1				7.5	PE1					
	1.0	PE2				1.0	PE2					
Subtotal	9.0				Subtotal	9.0						

MIL CW-4

Table C1-1 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 11B10-OSUT

SYSTEM: BCS, CE, ITT

MOS 11B10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex H:					Annex H:							
Confidence Obstacle Course	4.0	PE2			Confidence Obstacle Course	4.0	PE2					
Subtotal	4.0				Subtotal	4.0						
Annex I:	1.0	C			Annex I:	1.0	C					
Basic Military Communications	1.0	D			Basic Military Communications	1.0	D					
MC001: Operate Basic	5.0	PE1			MC001: Operate Basic	.9	TV					
Military Communication Equipment	1.0	E1			Military Communication Equipment	7.3	PE1					
and Learn the Phonetic Alphabet					and Learn the Phonetic Alphabet	1.0	E1					
Tasks:					Tasks:							
•Be familiar with basic mil'tary communication					•Be familiar with basic military communication							
•Operate telephone set TA-312/PT					•Operate telephone set TA-312/PT							
•Install and operate telephone set TA-1/PT					•Install and operate telephone set TA-1/PT							
•Install radio set AN/PRC-77 or AN/PRC-25 for operation					•Install SINCGARS V1 Manpack							
•Send a radio message					•Send a radio message				From: 250-13E10			
Subtotal	8.0				•Prepare for operation SINCGARS ECCM unit				CC10VA: Prepare for Operation	1.6	PE1	
									Speech Secure TSEC/KY-57	.9	TV	
									Subtotal	2.5		
					•Prepare for operation and operate SINCGARS Securable Remote Control Unit (SRCU)				CE100C Prepare for Operation and Operate AN/GRA-39	.7	PE1	
					Subtotal	11.2						

MIL CW-4

Table C1-1 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 11B10-OSUT

SYSTEM: BCS, CE, ITT

MOS 11B10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex J:	1.0	C			Annex J:	1.0	C					
Map Reading and Terrain	6.0	PE1			Map Reading and Terrain	6.0	PE1					
Association	1.0	E1			Association	1.0	E1					
Subtotal	8.0				Subtotal	8.0						
Annex K:	2.0	C			Annex K:	2.0	C					
Opposing Force Orientation	1.0	F			Opposing Force Orientation	1.0	F					
Subtotal	3.0				Subtotal	3.0						
Annex L:	3.5	C			Annex L:	3.5	C					
Individual Tactical Training	28.0	PE2			Individual Tactical Training	28.0	PE2					
	4.0	E1				4.0	E1					
Subtotal	35.5				Subtotal	35.5						
Annex M:	.5	C			Annex M:	.5	C					
M203 Grenade Launcher	.2	D			M203 Grenade Launcher	.2	D					
	6.3	PE1				6.3	PE1					
	1.0	E1				1.0	E1					
Subtotal	8.0				Subtotal	8.0						
Annex N:	.5	C			Annex N:	.5	C					
US Mines	5.5	PE1			US Mines	5.5	PE1					
	2.0	E1				2.0	E1					
Subtotal	8.0				Subtotal	8.0						
Annex O:	.5	C			Annex O:	.5	C					
US Mines and Antiarmor	.5	D			US Mines and Antiarmor	.5	D					
Training	6.0	PE1			Training	6.0	PE1					
	1.0	E1				1.0	E1					
Subtotal	8.0				Subtotal	8.0						
Annex P:	.5	C			Annex P:	.5	C					
M72A2 LAW	.5	D			M72A2 LAW	.5	D					
	6.0	PE1				6.0	PE1					
	1.0	E1				1.0	E1					
Subtotal	8.0				Subtotal	8.0						

Table C1-1 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 11B10-OSUT

SYSTEM: BCS, CE, ITT

MOS 11B10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex Q:	.5	D			Annex Q:	.5	D					
US Weapons Familiarization	3.5	PE1			US Weapons Familiarization	3.5	PE1					
Subtotal	4.0				Subtotal	4.0						
Annex R:	.5	C			Annex R:	.5	C					
M2 Caliber .50 Machinegun	3.5	PE1			M2 Caliber .50 Machinegun	3.5	PE1					
Subtotal	4.0				Subtotal	4.0						
Annex S:	.5	C			Annex S:	.5	C					
Hand Grenades	.5	D			Hand Grenades	.5	D					
	5.0	PE1				5.0	PE1					
	2.0	E1				2.0	E1					
Subtotal	8.0				Subtotal	8.0						
Annex T:	24.0	PE1			Annex T:	24.0	PE1					
Reinforcement Training and	4.0	PE2			Reinforcement Training and	4.0	PE2					
Testing	4.0	E2			Testing	4.0	E2					
Subtotal	32.0				Subtotal	32.0						
Total Fundamental Training	238.4				Total Fundamental Training	238.4						
MOS-UNIQUE TRAINING					MOS-UNIQUE TRAINING							
Annex U:	3.3	C			Annex U:	3.3	C					
M60 Machinegun Qualification	24.7	PE1			M60 Machinegun Qualification	24.7	PE1					
Subtotal	28.0				Subtotal	28.0						
Annex V:	1.9	C			Annex V:	1.9	C					
M16A1 Advanced Rifle	.2	D			M16A1 Advanced Rifle	.2	D					
Qualification	16.9	PE1			Qualification	16.9	PE1					
Subtotal	19.0				Subtotal	19.0						
Annex W:	.5	C			Annex W:	.5	C					
Military Operations on Urban	.5	D			Miliary Operations on Urban	.5	D					
Terrain	5.0	PE1			Terrain	5.0	PE1					
Subtotal	6.0				Subtotal	6.0						

MIL CW

Table C1-1 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 11B10-OSUT

SYSTEM BCS, CE, ITT

MOS 11B10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex X:	1.0	C			Annex X:	1.0	C					
Patrolling	9.0	PE1			Patrolling	9.0	PE1					
Subtotal	10.0				Subtotal	10.0						
Annex Y:	4.0	C			Annex Y:	4.0	C					
Squad Tactical Training	.5	D			Squad Tactical Training	.5	D					
	40.5	PE2				40.5	PE2					
Subtotal	45.0				Subtotal	45.0						
Annex Z:	1.0	C			Annex Z:	1.0	C					
Armored Carrier Operations	.5	D			Armored Carrier Operations	.5	D					
No change in tasks except:	14.5	PE1			No change in tasks except:	14.5	PE1					
• Prepare radio set AN/VRC-64 for operation	8.0	PE2			• Prepare SINCGARS radio set V5 vehicular long range for operation	8.0	PE2					
Subtotal	24.0				Subtotal	24.0						
Total MOS-Unique Training	132.0				Total MOS-Unique Training	132.0						
Common Military Education Training	22.6	C			Common Military Education Training	22.6	C					
	3.5	D				3.5	D					
	1.3	F				1.3	F					
	1.2	TV				1.2	TV					
	1.0	S				1.0	S					
	78.4	PE1				78.4	PE1					
	77.0	PE2				77.0	PE2					
	5.0	E1				5.0	E1					
Subtotal	190.0				Subtotal	190.0						
Total Academic Time	560.5				Total Academic Time	563.7						
Administrative Time	110.0				Administrative Time	110.0						
Total Course Time	670.5				Total Course Time	673.7						

MIL CW-4

Table Cl-1 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 11B10-OSUT

SYSTEM: BCS, CE, ITT

MOS 11B10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Instructional Breakdown:					Instructional Breakdown:							
C 49.9					C 49.9							
D 11.1					D 11.1							
F 4.3					F 4.3							
TV 1.2					TV 2.1							
S 1.0					S 1.0							
PE1 256.8					PE1 259.1							
PE2 214.2					PE2 214.2							
E1 18.0					E1 18.0							
E2 4.0					E2 4.0							
Total 560.5					Total 563.7							

MIL CW

Table C1-2

COURSE MODIFICATION WORKSHEET

COURSE: 250-13E10

SYSTEM. BCS, CE, ITT

MOS 13E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A: School of the Soldier Annex B: Weapons Training Annex C: Combat Skills and Techniques	OSUT ONLY				Annex A: School of the Soldier Annex B: Weapons Training Annex C: Combat Skills and Techniques	OSUT ONLY						
Annex D: Communication/ Electronics Department CE100C Radio Sets AN/VRC-46 VRC-47, and AN/GRA-39 Subtotal	 3.4 5.0 8.4	 C PE1			Annex D: Communication/ Electronics Department CE100C SINCGARS Radio Set V6 and Securable Remote Control Unit Subtotal	 3.4 5.0 8.4	 C PE1					
CC100J CEOI, Authentication Methods Encrypt/Decrypt Numbers and Letters and Operations Code Subtotal	 1.7 6.7 8.4	 C PE3			CC100J CEOI, Authentication Methods Encrypt/Decrypt Numbers and Letters and Operations Code Subtotal	 1.7 6.7 8.4	 C PE3					
CE10BO Intercommunications Set AN/VIC-1 Subtotal	 .8 1.7 2.5	 C PE1			CE10BO Intercommunications Set AN/VIC-1 Subtotal	 .8 1.7 2.5	 C PE1					
CE100E Antennas RC-292 and AT-984 A/G	 4.2	 PE1			CE100E Antennas RC-292 and AT-984 A/G	 4.2	 PE1					

MIL CW-4

Table C1-2 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 250-13E10

SYSTEM: BCS, CE, ITT

MOS 13E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
CE10BA Radio Set AN/GRC-160 and Security Equipment KY-38 Subtotal	 1.7 2.5 4.2	 C PE1			CE10BA SINCGARS Radio Set V6 (Short Range Dismountable) and Security Equipment KY-57 Subtotal	 1.7 2.5 4.2	 C PE1					
CC10BM Radiotelephone Procedure	 4.2	 PE3			CC10BM Radiotelephone Procedure	 4.2	 PE3					
CC10CN Low Level Antijamming Procedures	 4.2	 PE1										
					CC10XX Prepare for Operation SINCGARS ECCM Unit Subtotal	 1.6 .9 2.5	PE1 TV		From: 250-13E10 CC10VA Prepare for Operation Speech Secure TSEC/KY-57 Subtotal	 1.6 .9 2.5	 PE1 TV	
CC1001 Examination and Critique Subtotal	 1.7 4.2 5.9	 E3 E1			CC1001 Examination and Critique Subtotal	 1.7 4.2 5.9	 E3 E1					
Annex E: Gunnery Department Subtotal	.9 4.2 8.4 167.6 16.1 197.2	C D PE1 PE3 E3			Annex E: Gunnery Department Subtotal	.9 4.2 9.4 167.6 16.1 197.2	C D PE1 PE3 E3					
Annex F: Counterfire Department Subtotal	3.0 9.6 1.7 14.3	C PE3 E3			Annex F: Counterfire Department Subtotal	3.0 9.6 1.7 14.3	C PE3 E3					

MIL CW 4

Table C1-2 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 250-13E10

SYSTEM. BCS, CE, ITT

MOS 13E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUC-TION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUC-TION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUC TION	GROUPS
Annex G:	1.7	C			Annex G:	1.7	C					
TSEC/KY-57 Net Controller	.9	TV			TSEC/KYV-4 Net Controller	.9	TV					
Training (VINSON)**	18.4	PE1			Training (VANDAL)**	18.4	PE1					
** For Europe - bound	4.2	E1			** For Europe - Bound	4.2	E1					
students only Subtotal	25.2				students only Subtotal	25.2						
Total Academic Time	253.5				Total Academic Time	251.8						
Total Nonacademic Time	11.5				Total Nonacademic Time	11.5						
Total Course Time	265.0				Total Course Time	263.3						
Instructional Breakdown:					Instructional Breakdown:							
C 11.5					C 11.5							
D 4.2					D 4.2							
E1 4.2					E1 4.2							
E3 19.5					E3 19.5							
PE1 26.0					PE1 23.4							
PE3 188.1					PE3 188.1							
Total 253.5					TV .9							
					Total 251.8							

MIL CW-4

Table C1-3

COURSE MODIFICATION WORKSHEET

COURSE 010-19E10 (M60A3)

SYSTEM BCS, CE, ITT

MOS 19E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A:	.5	C			Annex A:	.5	C					
Drill and Ceremonies	.5	D			Drill and Ceremonies	.5	D					
	20.0	PE2				20.0	PE2					
Subtotal	21.0				Subtotal	21.0						
Annex B:	2.0	PE3			Annex B:	2.0	PE3					
Identification and Wearing					Identification and Wearing							
of the Uniform					of the Uniform							
Subtotal	2.0				Subtotal	2.0						
Annex C:	19.0	PE3			Annex C:	19.0	PE3					
Inspections					Inspections							
Subtotal	19.0				Subtotal	19.0						
Annex D:	1.0	C			Annex D:	1.0	C					
Guard Duty	4.0	PE2			Guard Duty	4.0	PE2					
Subtotal	5.0				Subtotal	5.0						
Annex E:	2.0	D			Annex E:	2.0	D					
Marches and Bivouacs	17.0	PE2			Marches and Bivouacs	17.0	PE2					
	6.0					6.0						
Subtotal	25.0				Subtotal	25.0						
Annex F:	2.0	C			Annex F:	2.0	C					
Individual Tactical Training	2.5	D			Individual Tactical Training	2.5	D					
	7.0	PE1				7.0	PE1					
	1.5	PE2				1.5	PE2					
Subtotal	13.0				Subtotal	13.0						
Annex G:					Annex G:							
Military Communications					Military Communications							
Basic Training: POI 21-114					Basic Training: POI 21-114							
p. C-17-2, para. 4a	1.0	D			p. C-17-2, para. 4a	1.0	D					
Send a Radio Message	1.0	PE1			Send a Radio Message	1.0	PE1					
Subtotal	2.0				Subtotal	2.0						

MIL CW-4

Table C1-3 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 010-19E10 (M60A3)

SYSTEM: BCS, CE, ITT

MOS 19E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Common Armor Training: CM 010 Communicate Using Visual Signalling Techniques Subtotal	1.0 1.0 2.0	C PE1			Common Armor Training: CM 010 Communicate Using Visual Signalling Techniques Subtotal	1.0 1.0 2.0	C PE1					
CM060 Task 1: Mount Radio Set AN/VRC-64 or AN/GRC-160 (AN/VRC-53 or AN/GRC-125) Subtotal	.5 1.0 1.5	D PE1			CM060 Task 1: Mount SINCGARS V4 Vehicular Short and Long Range Radio Set Subtotal	.5 1.0 1.5	D PE1					
Task 2: Perform Operator Preventive Maintenance Checks and Services (PMCS) on Radio Set AN/VRC-64 or AN/GRC-160 (AN/VRC-53 or AN/GRC-125) Subtotal	.5 1.0 1.5	D PE1			Task 2: Perform Operator Preventive Maintenance Checks and Services (PMCS) on SINCGARS V4 Vehicular Short and Long Range Radio Set Subtotal	.5 1.0 1.5	D PE1					
CM020 Task 1: Operate Radio Set AN/VRC-64 or AN/GRC-160 (AN/VRC-53 or AN/GRC-125) Subtotal	.5 1.0 2.5 4.0	C D PE1			CM020 Task 1: Operate SINCGARS V4 Vehicular Short and Long Range Radio Set Subtotal	.5 1.0 2.5 4.0	C D PE1					
Task 2: Operate Intercommunications Set AN/VIC-1 Subtotal	.5 1.5 2.0	D PE1			Task 2: Operate Intercommunications Set AN/VIC-1 Subtotal	.5 1.5 2.0	D PE1					
					Task 3: Prepare for Operation SINCGARS ECCM Unit	1.6 .9 2.5	PE1 D		From: 250-13E10 CC10VA· Prepare for Operation Speech Secure TSEC/KY-57 Subtotal	1.6 .9 2.5	PE1 TV	
Annex G: Summary Total	1.5 3.5 8.0 13.0	C D PE1			Annex G: Summary Total	1.5 4.4 9.6 15.5	C D PE1					

MIL CW-4

Table C1-3 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 010-19E10 (M60A3)

SYSTEM BCS, CE, ITT

MOS 19E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex H: Land Navigation Subtotal	2.0 .5 3.5 1.0 7.0	C D PE3 E1			Annex H: Land Navigation Subtotal	2.0 .5 3.5 1.0 7.0	C D PE3 E1					
Annex I: Hand Grenades Subtotal	1.5 6.5 8.0	D PE1			Annex I: Hand Grenades Subtotal	1.5 6.5 8.0	D PE1					
Annex J: Military Courtesies and Customs Subtotal	 .5 .5 3.0 4.0	 C D PE2			Annex J: Military Courtesies and Customs Subtotal	 .5 .5 3.0 4.0	 C D PE2					
Annex K: Conditioning Obstacle Course Subtotal	 2.0 2.0 4.0	 D PE2			Annex K: Conditioning Obstacle Course Subtotal	 2.0 2.0 4.0	 D PE2					
Annex L: Confidence Obstacle Course Subtotal	1.0 3.0 4.0	D PE2			Annex L: Confidence Obstacle Course Subtotal	1.0 3.0 4.0	D PE2					
Annex M: First Aid Subtotal	2.0 2.9 5.0 2.1 12.0	C D PE1 PE2			Annex M: First Aid Subtotal	2.0 2.9 5.0 2.1 12.0	C D PE1 PE2					
Annex N: Nuclear, Biological, and Chemical Defense Subtotal	4.1 .5 9.0 .9 14.5	C D PE1 PE2			Annex N: Nuclear, Biological, and Chemical Defense Subtotal	4.1 .5 9.0 .9 14.5	C D PE1 PE2					
Annex O-Y: Role of the Army Responsibilities of the Soldier Personal Health and Hygiene Code of Conduct	24.0	C			Annex O-Y: Role of the Army Responsibilities of the Soldier Personal Health and Hygiene Code of Conduct	24.0	C					

MIL CW 4

Table C1-3 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 010-19E10 (M60A3)

SYSTEM: BCS, CE, ITT

MOS 19E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Total Nonacademic Time	206.0				Total Nonacademic Time	206.0						
Total Course Time	654.4				Total Course Time	654.4						
Instructional Breakdown:					Instructional Breakdown:							
C 66.8					C 66.8							
D 22.0					D 22.0							
PE1 212.4					PE1 214.0							
PE2 92.7					PE2 92.7							
PE3 5.5					PE3 5.5							
E1 49.0					E1 49.0							
Total 448.4					Total 450.9							

MIL CW 4

Table C1-4

COURSE MODIFICATION WORKSHEET

COURSE 101-31E10

SYSTEM BCS, IFT

MOS 31E 10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A:					Annex A.							
Common Electronics Basic	37.0	C	1		Common Electronics Basic	37.0	C	1				
Subjects	1.0	D	1		Subjects	1.0	D	1				
	8.0	PI	1			8.0	PI	1				
	16.5	PE1	4			16.5	PE1	4				
	11.5	PE3	1			11.5	PE3	1				
	3.0	E1	1			3.0	E1	1				
	3.0	E3	1			3.0	E3	1				
Subtotal	80.0				Subtotal	80.0						
Annex B:					Annex B:							
Radio Fundamentals					Radio Fundamentals							
B01: Introduction to Annex,	3.5	C	1		B01: Introduction to Annex,	3.5	C	1				
Radio Principles: Trouble-	.5	D	1		Radio Principles, Trouble-	.5	D	1				
shooting, and Test, Measure-	.5	PE1	4		shooting, and Test, Measure-	.5	PE1	4				
ment, and Diagnostic Equipment	.5	E3	1		ment, and Diagnostic Equipment	.5	E3	1				
Subtotal	5.0				Subtotal	5.0						
B02: Schematic Diagrams	.5	C	1		B02: Schematic Diagrams	.5	C	1				
	1.0	PE3	1			1.0	PE3	1				
	.5	E3	1			.5	E3	1				
Subtotal	2.0				Subtotal	2.0						
B03: Electron Tubes	3.5	C	1		B03: Electron Tubes	3.5	C	1				
	.5	E3	1			.5	E3	1				
Subtotal	4.0				Subtotal	4.0						
B04: Semiconductor Devices	20.5	C	1		B04: Semiconductor Devices	20.5	C	1				
	2.5	PE1	1			2.5	PE1	1				
	2.0	E3	1			2.0	E3	1				
Subtotal	25.0				Subtotal	25.0						
B05: Power Transformers	.5	C	1		B05: Power Transformers	.5	C	1				
	1.0	PE3	1			1.0	PE3	1				
	.5	E3	1			.5	E3	1				
Subtotal	2.0				Subtotal	2.0						
B06: Electronic Power	3.5	C	1		B06: Electronic Power	2.5	C	1				
Supplies	5.0	PE1	4		Supplies	5.0	PE1	4				
	.5	E3	1			.5	E3	1				
Subtotal	9.0				Subtotal	9.0						

MIL CW-4

Table C1-4 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 101-31E10

SYSTEM BCS, ITT

MOS 31E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
B07: Decibels and Transitor Amplifiers	10.0	C	1		B07: Decibels and Transitor Amplifiers	10.0	C	1				
	4.5	PE1	4			4.5	PE1	4				
	1.5	E3	1			1.5	E3	1				
Subtotal	16.0				Subtotal	16.0						
B08: Resonant Circuits and Radio Frequency Filters	6.0	C	1		B08: Resonant Circuits and Radio Frequency Filters	6.0	C	1				
	1.0	E3	1			1.0	E3	1				
Subtotal	7.0				Subtotal	7.0						
B09: Coupling and Impedance Matching	.5	F	1		B09: Coupling and Impedance Matching	.5	F	1				
	2.0	C	1			2.0	C	1				
	.5	E3	1			.5	E3	1				
Subtotal	3.0				Subtotal	3.0						
B10: Oscillators	1.8	C	1		B10: Oscillators	1.8	C	1				
	2.7	PE1	4			2.7	PE1	4				
	.5	E3	1			.5	E3	1				
Subtotal	5.0				Subtotal	5.0						
B11: Examination	2.0	E3	1		B11: Examination	2.0	E3	1				
Subtotal	2.0				Subtotal	2.0						
B12: Continuous Wave Transmitter	15.0	C	1		B12: Continuous Wave Transmitter	15.0	C	1				
	10.0	PE1	4			10.0	PE1	4				
	1.0	E3	1			1.0	E3	1				
Subtotal	26.0				Subtotal	26.0						
B13: Amplitude - Modulated Transmitter	4.0	C	1		B13: Amplitude - Modulated Transmitter	4.0	C	1				
	9.0	PE1	4			9.0	PE1	4				
	1.0	E3	1			1.0	E3	1				
Subtotal	14.0				Subtotal	14.0						
B14: Single-Sideband Transmitter	5.0	C	1		B14: Single-Sideband Transmitter	5.0	C	1				
	15.0	PE1	4			15.0	PE1	4				
	2.0	E3	1			2.0	E3	1				
Subtotal	22.0				Subtotal	22.0						
B15: Frequency - Modulated Transmitter	5.0	C	1		B15: Frequency - Modulated Transmitter	5.0	C	1				
	5.0	PE1	4			5.0	PE1	4				
	1.0	E3	1			1.0	E3	1				
Subtotal	11.0				Subtotal	11.0						

MIL CW-4

Table C1-4 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 101-31E10

SYSTEM. BCS, ITT

MOS 31E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
B16: Radio Receivers	10.0	C	1		B16: Radio Receivers	10.0	C	1	From: 041-34Y10			
	10.0	PE1	4			10.0	PE1	4	34Y10-C1: Boolean Algebra	.4	PM	
	3.0	E1	1			3.0	E1	1		3.0	PE2	
Subtotal	23.0				Subtotal	23.0				.6	E3	
									Subtotal	4.0		
B17: AN/VRC-12 Series Radio: Troubleshoot, Analysis, and Alignment	35.0	C	1		B17: SINCGARS Series Radio: Troubleshoot, Analysis, and Alignment	11.1[1/]	PI	1				
	81.0	PE1	4			.4	TV	1	34Y10-C3: Biode Logic	.4	PM	
	4.0	E1	1			37.5[2/]	PE1	4		3.0	PE2	
Subtotal	120.0					15.0	PE3	1		.6	E3	
						4.8	E1	1	Subtotal	4.0		
						1.2	E3	1				
					Subtotal	70.0			From: 102-35L10			
					1/ Includes .8 hours of PM type of instruction.				Annex G: Standard Lightweight Avionics Communication Equipment			
					2/ Includes 6.0 hours of PE2 type of instruction.							
									G01: Performing Basic Tests on Radio Set AN/ARC-114	4.8	PE1	
										2.2	PI	
									Subtotal	7.0		
									G02: Isolating Malfunctions in Radio Set AN/ARC-114	20.3	PE1	
										4.3	PI	
										.4	TV	
									Subtotal	25.0		
									G03: Adjust Radio Set AN/ARC-114	6.4	PE1	
										.6	PI	
									Subtotal	7.0		
									G04. Examination	2.9	E1	
										.1	PI	
									Subtotal	3.0		
									G05: Troubleshoot Malfunctions in C-6533/ARC	15.0	PE3	
										3.0	PI	
									Subtotal	18.0		
									G06: Examination	1.9	E1	
										.1	PI	
									Subtotal	2.0		

MIL CW-4

Table C1-4 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 101-31E10

SYSTEM. BCS,. ITT

MOS 31E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
B18: AN/GRC-106 Radio:	35.0	C	1		B18: AN/GRC-106: Troubleshoot-	35.0	C	1				
Troubleshooting, Analysis, and	90.0	PE1	4		ing, Analysis, and Alignment	90.0	PE1	4				
	6.0	E1				6.0	E1	1				
Subtotal	131.0				Subtotal	131.0						
B19: Antennas, Transmission	7.0	C	1		B19: Antennas, Transmission	7.0	C	1				
Lines, and Radio - Wave	1.0	E3	1		Lines, and Radio - Wave	1.0	E3	1				
Subtotal	8.0				Subtotal	8.0						
B20: Radio Teletypewriter	4.0	C	1		B20: Radio Teletypewriter	4.0	C	1				
Principles	1.0	E3	1		Principles	1.0	E3	1				
Subtotal	5.0				Subtotal	5.0						
Annex B: Summary	171.8	C	1		Annex B: Summary	136.8	C	1				
	.5	D	1			.4	TV	1				
	.5	F	1			.5	F	1				
	235.2	PE1	4			11.1	PI	1				
	2.0	PE3	1			191.7	PE1	4				
	13.0	E1	1			.5	D	1				
	17.0	E3	1			17.0	PE3	1				
Total	440.0					13.8	E1	1				
						18.2	E3	1				
					Total	390.0						
Annex C:					Annex C							
Common Precision Soldering	.5	C	1		Common Precision Soldering	.5	C	1				
	.8	TV	1			.8	TV	1				
	33.7	PE1	4			33.7	PE1	4				
	5.0	E1	1			5.0	E1					
Subtotal	40.0				Subtotal	40.0						
Annex D:					Annex D:							
Job Training Exercise	5.5	C	1		Job Training Exercise	5.5	C	1				
	2.3	TV	1			2.3	TV	1				
	17.3	PI	1			17.3	PI	1				
	198.3	PE1	4			198.3	PE1	4				
	1.6	PE3	1			1.6	PE3	1				
	41.0	E1	1			41.0	E1	1				
Subtotal	266.0				Subtotal	266.0						

MIL CW-4

Table Cl-4 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 101-31E10

SYSTEM BCS, ITT

MOS 31E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Total Academic Time	826.0				Total Academic Time	776.0						
Inprocessing	12.0				Inprocessing	12.0						
Outprocessing	8.0				Outprocessing	8.0						
Total Nonacademic Time	20.0				Total Nonacademic Time	20.0						
Total Course Time	846.0				Total Course Time	796.0						
Instructional Breakdown:					Instructional Breakdown:							
C 214.3					C 179.8							
TV 3.1					TV 3.5							
D 1.5					D 1.5							
F .5					F .5							
PI 25.3					PI 36.4							
PE1 483.7					PE1 440.2							
PE3 15.1					PE3 30.1							
E1 62.0					E1 62.8							
E3 20.0					E3 21.2							
Total 826.0					Total 776.0							

MIL CW-4

Table C1-5

COURSE MODIFICATION WORKSHEET

COURSE 101-31E10

SYSTEM · CE

MOS 31E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A:					Annex A:							
Common Electronics Basic Subjects	37.0	C	1		Common Electronics Basic Subjects	37.0	C	1				
	1.0	D	1			1.0	D	1				
	8.0	PI	1			8.0	PI	1				
	16.5	PE1	4			16.5	PE1	4				
	11.5	PE3	1			11.5	PE3					
	3.0	E1	1			3.0	E1	1				
	3.0	E3	1			3.0	E3	1				
Subtotal	80.0				Subtotal	80.0						
Annex B:					Annex B:							
Radio Fundamentals	3.5	C	1		Radio Fundamentals	3.5	C	1				
B01: Introduction to Annex,	.5	D	1		B01: Introduction to Annex,	.5	D	1				
Radio Principles, Trouble-	.5	PE1	4		Radio Principles, Trouble-	.5	PE1	4				
shooting, and Test, Management,	.5	E3	1		shooting, and Test, Management	.5	E3	1				
and Diagnostic Equipment					and Diagnostic Equipment							
Subtotal	5.0				Subtotal	5.0						
B02: Schematic Diagrams	.5	C	1		B02: Schematic Diagrams	.5	C	1				
	1.0	PE3	1			1.0	PE3	1				
	.5	E3	1			.5	E3	1				
Subtotal	2.0				Subtotal	2.0						
B03: Electron Tubes	3.5	C	1		B03: Electron Tubes	3.5	C	1				
	.5	E3	1			.5	E3	1				
Subtotal	4.0				Subtotal	4.0						
B04: Semiconductor Devices	20.5	C	1		B04: Semiconductor Devices	20.5	C	1				
	2.5	PE1	1			2.5	PE1	1				
	2.0	E3	1			2.0	E3	1				
Subtotal	25.0				Subtotal	25.0						

MIL CW-4

Table C1-5 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 101-31E10

SYSTEM. CE

MOS 31E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUC-TION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUC TION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUC-TION	GROUPS
B05: Power Transformers	.5	C	1		B05: Power Transformers	.5	C	1				
	1.0	PE3	1			1.0	PE3	1				
	.5	E3	1			.5	E3	1				
Subtotal	2.0				Subtotal	2.0						
B06: Electronic Power Supplies	3.5	C	1		B06: Electronic Power Supplies	3.5	C	1				
	5.0	PE1	4			5.0	PE1	4				
	.5	E3	1			.5	E3	1				
Subtotal	9.0				Subtotal	9.0						
B07: Decibels and Transmitter Amplifiers	10.0	C	1		B07: Decibels and Transmitter	10.0	C	1				
	4.5	PE1	4			4.5	PE1	4				
	1.5	E3	1			1.5	E3	1				
Subtotal	16.0				Subtotal	16.0						
B08: Resonant Circuits and Radio Frequency Filters	6.0	C	1		B08: Resonant Circuits and Radio Frequency Filters	6.0	C	1				
	1.0	E3	1			1.0	E3	1				
Subtotal	7.0				Subtotal	7.0						
B09: Coupling and Impedence Matching	.5	F	1		B09: Coupling and Impedence Matching	.5	F	1				
	2.0	C	1			2.0	C	1				
	.5	E3	1			.5	E3	1				
Subtotal	3.0				Subtotal	3.0						
B10: Oscillators	1.8	C	1		B10: Oscillators	1.8	C	1				
	2.7	PE1	4			2.7	PE1	4				
	.5	E3	1			.5	E3	1				
Subtotal	5.0				Subtotal	5.0						
B11: Examination	2.0	E3	1		B11: Examination	2.0	E3	1				
Subtotal	2.0				Subtotal	2.0						
B12: Continuous Wave Transmitter	15.0	C	1		B12: Continuous Wave Transmitter	15.0	C	1				
	10.0	PE1	4			10.0	PE1	4				
	1.0	E3	1			1.0	E3	1				
Subtotal	26.0				Subtotal	26.0						
B13: Amplitude-Modulated Transmitter	4.0	C	1		B13: Amplitude-Modulated Transmitter	4.0	C	1				
	9.0	PE1	4			9.0	PE1	4				
	1.0	E3	1			1.0	E3	1				
Subtotal	14.0				Subtotal	14.0						

MIL CW-4

Table C1-5 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 101-31E10

SYSTEM CE

MOS 31E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
B14: Single-Sideband Transmitter	5.0	C	1		B14: Single-Sideband Transmitter	5.0	C	1				
	15.0	PE1	4			15.0	PE1	4				
	2.0	E3	1			2.0	E3	1				
Subtotal	22.0				Subtotal	22.0						
B15: Frequency-Modulated Transmitter	5.0	C	1		B15: Frequency-Modulated Transmitter	5.0	C	1				
	5.0	PE1	4			5.0	PE1	4				
	1.0	E3				1.0	E3	1				
Subtotal	11.0				Subtotal	11.0						
B16: Radio Receivers	10.0	C	1		B16: Radio Receivers	10.0	C	1				
	10.0	PE1	4			10.0	PE1	4				
	3.0	E1	1			3.0	E1	1				
Subtotal	23.0				Subtotal	23.0						
B17: SINCGARS Series Radio: Troubleshoot, Analysis, and Alignment	11.1	PI	1		B17: SINCGARS Series Radio: Troubleshoot, Analysis, and Alignment	6.4	PI	1				
	.4	TV	1			.3	TV	1				
	37.5	PE1	4			25.4	PE1	4				
	15.0	PE3	1			15.0	PE3	1				
	4.8	E1	1			4.8	E1	1				
	1.2	E3				1.2	E3	1				
Subtotal	70.0				Subtotal	45.2						
B18: AN/GRC-106:Troubleshooting, Analysis, and Alignment	35.0	C	1		B18: AN/GRC-106: Troubleshooting, Analysis, and Alignment	35.0	C	1				
	90.0	PE1	4			90.0	PE1	4				
	6.0	E1				6.0	E1	1				
Subtotal	131.0				Subtotal	131.0						
B19: Antennas, Transmission Lines, and Radio - Wave Propagation	7.0	C	1		B19: Antennas, Transmission Lines, and Radio - Wave Propagation	7.0	C	1				
	1.0	E3	1			1.0	E3	1				
Subtotal	8.0				Subtotal	8.0						
B20: Radio Teletypewriter Principles	4.0	C	1		B20: Radio Teletypewriter Principles	4.0	C	1				
	1.0	E3	1			1.0	E3	1				
Subtotal	5.0				Subtotal	5.0						

MIL CW-4

Table C1-5 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 101-31E10

SYSTEM. CE

MOS 31E10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex C:					Annex C:							
Common Precision Soldering	.5	C	1		Common Precision Soldering	.5	C	1				
	.8	TV	1			.8	TV	1				
	33.7	PE1	4			33.7	PE1	4				
	5.0	E1	1			5.0	E1	1				
Subtotal	40.0				Subtotal	40.0						
Annex D:					Annex D:							
Job Training Exercise	5.5	C	1		Job Training Exercise	5.5	C	1				
	2.3	TV	1			2.3	TV	1				
	17.3	PI	1			17.3	PI	1				
	199.9	PE1	4			199.9	PE1	4				
	41.0	E1	1			41.0	E1					
Subtotal	266.0				Subtotal	266.0						
Total Academic Time	776.0				Total Academic Time	751.2						
Inprocessing	12.0				Inprocessing	12.0						
Outprocessing	8.0				Outprocessing	8.0						
Total Nonacademic Time	20.0				Total Nonacademic Time	20.0						
Total Course Time	796.0				Total Course Time	771.2						
Instructional Breakdown					Instructional Breakdown							
C 179.8					C 179.8							
TV 3.5					TV 3.4							
D 1.5					D 1.5							
F .5					F .5							
PI 36.4					PI 31.7							
PE1 440.2					PE1 429.7							
PE3 30.1					PE3 22.5							
E1 62.8					E1 60.9							
E3 21.2					E3 21.2							
Total 776.0					Total 751.2							

MIL CW 4

Table C1-6

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM: BCS

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A:					Annex A:							
Basic Electronics Training	5.4	C	1		Basic Electronics Training	5.4	C	1				
	34.6	PE1	2/3			34.6	PE1	2/3				
	4.0	E1	2			4.0	E1	2				
Subtotal	44.0				Subtotal	44.0						
Annex B:					Annex B:							
Security Subjects	7.0	C	1		Security Subjects	7.0	C	1				
	.5	D	1			.5	D	1				
	11.5	PE1	2/3			11.5	PE1	2/3				
Subtotal	19.0				Subtotal	19.0						
Annex C:					Annex C:							
Communications Security					Communications Security							
C01: Operate Common Fill Devices	1.0	C	1		C01: Operate Common Fill Devices	1.0	C	1				
	1.0	D	1			1.0	D	1				
	2.0	PE1	2/3			2.0	PE1	2/3				
Subtotal	4.0				Subtotal	4.0						
C02: Connecting the TSEC/KY-57 in a Back to Back Configuration	5.5	C	1		C02: Connecting the TSEC/KY-57 in a Back to Back Configuration	5.5	C	1				
	11.0	D	1			11.0	D	1				
	5.5	PE1	2/3			5.5	PE1	2/3				
Subtotal	12.0				Subtotal	12.0						
C03: Restore the TSEC/KY-57	5.0	C	1		C03: Restore the TSEC/KY-57	5.0	C	1				
	.5	D	1			.5	D	1				
	11.5	PE1	2/3			11.5	PE1	2/3				
Subtotal	17.0				Subtotal	17.0						
C04: Performance Test	.2	C	1		C04: Performance Test	.2	C	1				
	5.8	E1	2			5.8	E1	2				
Subtotal	6.0				Subtotal	6.0						
C05: Connect the Wireline Adapter in a Back to Back Configuration	1.5	C	1		C05: Connect the Wireline Adapter in a Back to Back Configuration	1.5	C	1				
	.5	D	1			.5	D	1				
	3.0	PE1	2/3			3.0	PE1	2/3				
Subtotal	5.0				Subtotal	5.0						

MIL CW-4

Table C1-6 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM. BCS

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
C06: Restore the Wireline Adapter HYX-57/TSEC	2.0	C	1		C06: Restore the Wireline Adapter HYX-57/TSEC	2.0	C	1				
	.7	D	1			.7	D	1				
	4.3	PE1	2/3			4.3	PE1	2/3				
Subtotal	7.0				Subtotal	7.0						
C07: Performance Test	.2	C	1		C07: Performance Test	.2	C	1				
	4.8	E1	2			4.8	E1	2				
Subtotal	5.0				Subtotal	5.0						
C08-C10: TSEC/KY-58	2.7	C	1		C08-C10: TSEC/KY-58	2.7	C	1				
	1.5	D	1			1.5	D	1				
	7.0	PE1	2/3			7.0	PE1	2/3				
	4.8	E1	2			4.8	E1	2				
Subtotal	16.0				Subtotal	16.0						
Annex D:					Annex D:							
	4.6	C	1			4.6	C	1				
Speech Security Equipment	1.0	D	1		Speech Security Equipment	1.0	D	1				
TSEC/KY-8	55.0	PE1	2/3		TSEC/KY-8	55.0	PE1	2/3				
	9.4	E1	2			9.4	E1	2				
Subtotal	70.0				Subtotal	70.0						
Annex E:					Annex E:							
Speech Security Equipment	6.6	C	1		Speech Security Equipment	6.6	C	1				
TSEC/KY-38	2.0	D	1		TSEC/KY-38	2.0	D	1				
	31.0	PE1	2/3			31.0	PE1	2/3				
	9.4	E1	2			9.4	E1	2				
Subtotal	49.0				Subtotal	49.0						
Annex F:					Annex F:							
Speech Security Equipment	2.9	C	1		Speech Security Equipment	2.9	C	1				
TSEC/KY-28	1.0	D	1		TSEC/KY-28	1.0	D	1				
	44.5	PE1	2/3			44.5	PE1	2/3				
	5.6	E1	2			5.6	E1	2				
Subtotal	54.0				Subtotal	54.0						

MIL CW-4

Table C1-6 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM BCS

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex G:					Annex G:							
Electronic Tactical Teletypewriter TSEC/KW-7	1.0	C	1		Electronic Tactical Teletypewriter TSEC/KW-7	1.0	C	1				
	62.0	PE1	2/3			62.0	PE1	2/3				
	7.0	E1	2			7.0	E1	2				
Subtotal	70.0				Subtotal	70.0						
					Annex H:							
					SINCGARS Related Systems				From: 041-34Y10			
					H02: Boolean Algebra	.4	PM	1	C1: Boolean Algebra	.4	PM	
						3.0	PE2	1		3.0	PE2	
						.6	E3	1		.6	E3	
					Subtotal	4.0			Subtotal	4.0		
					H02: Biode Logic	.4	PM	1	C3: Biode Logic	.4	PM	
						3.0	PE2	1		3.0	PE2	
						.6	E3	1		.6	E3	
					Subtotal	4.0			Subtotal	4.0		
					H03: SINCGARS ECCM Unit	5.8	PE1	2/3	From: 102-35L10 G01: Performing Basic Tests on Radio Set AN/ARC-114	4.8	PE1	
						.5	E1	2		2.2	PI	
					Note: This is an estimate of the total training time spent on the A1, A5, and A17 Circuit Card assemblies in the ARC-114, 10 MHZ Oscillator and phase detector circuit in the ARC-114.				Subtotal	7.0		
									G02: Isolating Malfunctions in Radio Set AN/ARC-114	20.3	PE1	
										4.3	PI	
										.4		
									Subtotal	25.0		
									From: 041-34Y10			
					Subtotal	6.3			TT76KH: DMD Operation	1.6	D	
										3.4	PE1	
					H04: SINCGARS Net Control Unit	1.7	C	1	Subtotal	4.0		
						3.3	D	1				
						10.1	PE1	2/3	TT76KJ: Disassembly and Assembly of the DMD	1.7	D	
					Subtotal	15.1				4.2	PE1	
									Subtotal	5.9		

MIL CW-4

Table C1-6 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM: BCS

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
									TT76KK - Functions of Major Sections in the DMD	1.7	C	
										2.5	PE1	
									Subtotal	4.2		
Annex H:					Annex I:							
COMSEC Systems Training	7.0	C	1		COMSEC Systems Training	7.0	C	1				
	5.0	D	1			5.0	D	1				
	54.0	PE1	2/3			54.0	PE1	2/3				
	9.0	E1	2			9.0	E1	2				
Subtotal	75.0				Subtotal	75.0						
Annex I:					Annex J:							
Common Precision Soldering	1.6	TV	1		Common Precision Soldering	1.6	TV	1				
	33.4	PE1	2/3			33.4	PE1	2/3				
	4.0	E1	2			4.0	E1	2				
Subtotal	39.0				Subtotal	39.0						
Total Academic Time	492.0				Total Academic Time	521.4						
Inprocessing	5.0				Inprocessing	5.0						
Outprocessing	8.0				Outprocessing	8.0						
Physical Conditioning	19.0				Physical Conditioning	19.0						
Total Nonacademic Time	32.0				Total Nonacademic Time	32.0						
Total Course Time	524.0				Total Course Time	553.4						
Instructional Breakdown:					Instructional Breakdown:							
C 52.6					C 54.3							
D 14.7					D 18.0							
TV 1.6					TV 1.6							
PE1 215.3					PM .8							
PE1 144.0					PE1 231.2							
E1 63.8					PE1 144.0							
Total 492.0					PE2 6.0							
					E1 64.3							
					E3 1.2							
					Total 521.4							

MIL CW-4

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Table C1-7

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM: CE

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A: Basic Electronics Training	5.4	C	1		Annex A: Basic Electronics Training	5.4	C	1				
	34.6	PE1	2/3			34.6	PE1	2/3				
	4.0	E1	2			4.0	E1	2				
Subtotal	44.0				Subtotal	44.0						
Annex B: Security Subjects	7.0	C	1		Annex B: Security Subjects	7.0	C	1				
	5.2	D	1			5.2	D	1				
	11.5	PE1	2/3			11.5	PE1	2/3				
Subtotal	23.7				Subtotal	23.7						
Annex C: Communications Security					Annex C: Communications Security							
C01: Operate Common Fill Devices	1.0	C	1		C01: Operate Common Fill Devices	1.0	C	1				
	1.0	D	1			1.0	D	1				
	2.0	PE1	2/3			2.0	PE1	2/3				
Subtotal	4.0				Subtotal	4.0						
C02: Connecting the TSEC/KY-57 in a Back to Back Configuration	5.5	C	1		C02: Connecting the TSEC/KY-57 in a Back to Back Configuration	5.5	C	1				
	1.0	D	1			1.0	D	1				
	5.5	PE1	2/3			5.5	PE1	2/3				
Subtotal	12.0				Subtotal	12.0						
C03: Restore the TSEC/KY-57	5.0	C	1		C03: Restore the TSEC/KY-57	5.0	C	1				
	.5	D	1			.5	D	1				
	11.5	PE1	2/3			11.5	PE1	2/3				
Subtotal	17.0				Subtotal	17.0						
C04: Performance Test	.2	C	1		C04: Performance Test	.2	C	1				
	5.8	E1	2			5.8	E1	2				
Subtotal	6.0				Subtotal	6.0						
C05: Connect the Wireline Adapter in a Back to Back Configuration	1.5	C	1		C05: Connect the Wireline Adapter in a Back to Back Configuration	1.5	C	1				
	.5	D	1			.5	D	1				
	3.0	PE1	2/3			3.0	PE1	2/3				
Subtotal	5.0				Subtotal	5.0						
C06: Restore the Wireline Adapter HYX-57/TSEC	2.0	C	1		C06: Restore the Wireline Adapter HYX-57/TSEC	2.0	C	1				
	.7	D	1			.7	D	1				
	4.3	PE1	2/3			4.3	PE1	2/3				
Subtotal	7.0				Subtotal	7 0						

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MIL CW 4

Table C1-7 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM: CE

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
C07: Performance Test	.2	C	1		C07: Performance Test	.2	C	1				
	4.8	E1	2			4.8	E1	2				
Subtotal	5.0				Subtotal	5.0						
C08-C10: TSEC/KY-58	2.7	C	1		C08-C10: TSEC/KY-58	2.7	C	1				
	1.5	D	1			1.5	D	1				
	7.0	PE1	2/3			7.0	PE1	2/3				
	4.8	E1	2			4.8	E1	2				
Subtotal	16.0				Subtotal	16.0						
Annex D: Speech Security Equipment TSEC/KY-8	4.6	C	1		Annex D: Speech Security Equipment TSEC/KY-8	4.6	C	1				
	1.0	D	1			1.0	D	1				
	55.0	PE1	2/3			55.0	PE1	2/3				
	9.4	E1	2			9.4	E1	2				
Subtotal	70.0				Subtotal	70.0						
Annex E: Speech Security Equipment TSEC/KY-38	6.6	C	1		Annex E: Speech Security Equipment TSEC/KY-38	6.6	C	1				
	2.0	D	1			2.0	D	1				
	31.0	PE1	2/3			31.0	PE1	2/3				
	9.4	E1	2			9.4	E1	2				
Subtotal	49.0				Subtotal	49.0						
Annex F: Speech Security Equipment TSEC/KY-28	2.9	C	1		Annex F: Speech Security Equipment TSEC/KY-28	2.9	C	1				
	1.0	D	1			1.0	D	1				
	44.5	PE1	2/3			44.5	PE1	2/3				
	5.6	E1	2			5.6	E1	2				
Subtotal	54.0				Subtotal	54.0						
Annex G: Electronic Tactical Teletypewriter TSEC/KW-7	1.0	C	1		Annex G: Electronic Tactical Teletypewriter TSEC/KW-7	1.0	C	1				
	62.0	PE1	2/3			62.0	PE1	2/3				
	7.0	E1	2			7.0	E1	2				
Subtotal	70.0				Subtotal	70.0						
Annex H: SINCGARS Related Systems H01: Boolean Algebra	.4	PM	1		Annex H: SINCGARS Related Systems H01: Boolean Algebra	.4	C	1				
	3.0	PE2	1			3.0	PE2	1				
	.6	E3	1			.6	E3	1				
Subtotal	4.0				Subtotal	4.0						

MIL CW-4

Table C1-7 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM. CE

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
H02: Biode Logic	.4	PM	1		H02: Biode Logic	.4	C	1				
	3.0	PE1	1			3.0	PE2	1				
	.6	E3	1			.6	E3	1				
Subtotal	4.0				Subtotal	4.0						
H03: SINCGARS ECCM Unit	5.8	PE1	2/3		H03: SINCGARS ECCM Unit	3.3	PE1	2/3				
Note: This is an estimate of the total training time spent on the A1, A5 A17 Circuit Card Assemblies in the ARC-114 10 MHZ oscillator and phase detector circuit in the ARC-114	.5	E1	2		The BCS time is reduced by 40%.	.5	E1	2				
Subtotal	6.3				Subtotal	3.8						
H04: SINCGARS Net Control Unit	1.7	C			H04: SINCGARS Net Control Control Unit	8.1	PE1	2/3				
	3.3	D			The BCS time is reduced by 40%.	1.0	E1	2				
	10.1	PE1										
Subtotal	15.1				Subtotal	9.1						
Annex I: COMSEC Systems Training	7.0	C	1		Annex I: COMSEC Systems Training	7.0	C	1				
	5.0	D	1			5.0	D	1				
	54.0	PE1	2/3			54.0	PE1	2/3				
	9.0	E1	2			9.0	E1	2				
Subtotal	75.0				Subtotal	75.0						
Annex J: Common Precision Soldering	1.6	TV	1		Annex J: Common Precision Soldering	1.6	TV	1				
	33.4	PE1	2/3			33.4	PE1	2/3				
	4.0	E1	2			4.0	E1	2				
Subtotal	36.6				Subtotal	36.6						
Total Academic Time	521.4				Total Academic Time	512.9						
Inprocessing	5.0				Inprocessing	5.0						
Outprocessing	8.0				Outprocessing	8.0						
Physical Conditioning	19.0				Physical Conditioning	19.0						
Total Nonacademic Time	32.0				Total Nonacademic Time	32.0						
Total Course Time	553.4				Total Course Time	544.9						

MIL CW 4

Table C1-7 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM: CE

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Instructional Breakdown:					Instructional Breakdown:							
C 54.3					C 53.4							
D 18.0					D 14.7							
TV 1.6					TV 1.6							
PM .8					PE1 226.7							
PE1 231.2					PE1 144.0							
PE1 144.0					PE2 6.0							
PE2 6.0					E1 65.3							
E1 64.3					E3 1.2							
E3 1.2					Total 512.9							
Total 521.4												

MIL CW-4

Table C1-8

COURSE MODIFICATION WORKSHEET

COURSE 160-31S10

SYSTEM. ITT

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A: Basic Electronics Training	5.4	C	1		Annex A: Basic Electronics Training	5.4	C	1				
	34.6	PE1	2/3			34.6	PE1	2/3				
	4.0	E1	2			4.0	E1	2				
Subtotal	44.0				Subtotal	44.0						
Annex B: Security Subjects	7.0	C	1		Annex B: Security Subjects	7.0	C	1				
	.5	D	1			.5	D	1				
	11.5	PE1	2/3			11.5	PE1	2/3				
Subtotal	19.0				Subtotal	19.0						
Annex C: Communications Security					Annex C: Communications Security							
C01: Operate Common Fill Devices	1.0	C	1		C01: Operate Common Fill Devices	1.0	C	1				
	1.0	D	1			1.0	D	1				
	2.0	PE1	2/3			2.0	PE1	2/3				
Subtotal	4.0				Subtotal	4.0						
C02: Connecting to TSEC/KY-57 in a Back to Back Configuration	5.5	C	1		C02: Connecting to TSEC/KY-57 in a Back to Back Configuration	5.5	C	1				
	1.0	D	1			1.0	D	1				
	5.5	PE1	2/3			5.5	PE1	2/3				
Subtotal	12.0				Subtotal	12.0						
C03: Restore the TSEC/KY-57	5.0	C	1		C03: Restore the TSEC/KY-57	5.0	C	1				
	.5	D	1			.5	D	1				
	11.5	PE1	2/3			11.5	PE1	2/3				
Subtotal	17.0				Subtotal	17.0						
C04: Performance Test	.2	C	1		C04: Performance Test	.2	C	1				
	5.8	E1	2			5.8	E1	2				
Subtotal	6.0				Subtotal	6.0						
C05: Connect the Wireline adapter in a Back to Back Configuration	1.5	C	1		C05: Connect the Wireline adapter in a Back to Back Configuration	1.5	C	1				
	.5	D	1			.5	D	1				
	3.0	PE1	2/3			3.0	PE1	2/3				
Subtotal	5.0				Subtotal	5.0						

MIL CW-4

Table C1-8 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM: ITT

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
C06: Restore the Wireline Adapter HYX-57/TSEC	2.0	C	1		C06: Restore the Wireline Adapter HYX-57/TSEC	2.0	C	1				
	.7	D	1			.7	D	1				
	4.3	PE1	2/3			4.3	PE1	2/3				
Subtotal	70.0				Subtotal	70.0						
C07: Performance Test	.2	C	1		C07: Performance Test	.2	C	1				
	4.8	E1	2			4.8	E1	2				
Subtotal	5.0				Subtotal	5.0						
C08-C10: TSEC/KY-58	2.7	C	1		C08-C10: TSEC/KY-58	2.7	C	1				
	1.5	D	1			1.5	D	1				
	7.0	PE1	2/3			7.0	PE1	2/3				
	4.8	E1	2			4.8	E1	2				
Subtotal	16.0				Subtotal	16.0						
Annex D: Speech Security Equipment TSEC/KY-8	4.6	C	1		Annex D: Speech Security Equipment TSEC/KY-8	4.6	C	1				
	1.0	D	1			1.0	D	1				
	55.0	PE1	2/3			55.0	PE1	2/3				
	9.4	E1	2			9.4	E1	2				
Subtotal	70.0				Subtotal	70.0						
Annex E: Speech Security Equipment TSEC/KY-38	6.6	C	1		Annex E: Speech Security Equipment TSEC/KY-38	6.6	C	1				
	2.0	D	1			2.0	D	1				
	31.0	PE1	2/3			31.0	PE1	2/3				
	9.4	E1	2			9.3	E1	2				
Subtotal	49.0					49.0						
Annex F: Speech Security Equipment TSEC/KY-28	2.9	C	1		Annex F: Speech Security Equipment TSEC/KY-28	2.9	C	1				
	1.0	D	1			1.0	D	1				
	44.5	PE1	2/3			44.5	PE1	2/3				
	5.6	E1	2			5.6	E1	2				
Subtotal	54.0				Subtotal	54.0						

MIL CW-4

Table C1-8 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM: ITT

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex G:					Annex G:							
Electronic Tactical	1.0	C	1		Electronic Tactical	1.0	C	1				
Teletypewriter TSEC/KW-7	62.0	PE1	2/3		Teletypewriter TSEC/KW-7	62.0	PE1	2/3				
	7.0	E1	2			7.0	E1	2				
Subtotal	70.0				Subtotal	70.0						
Annex H:					Annex H:							
SINCGARS Related Systems					SINCGARS Related Systems							
H01: Boolean Algebra	.4	PM	1		H01: Boolean Algebra	.4	PM	1				
	3.0	PE2	1			3.0	PE2	1				
	.6	E3	1			.6	E3	1				
Subtotal	4.0				Subtotal	4.0						
H02: Biode Logic	.4	PM	1		H02: Biode Logic	.4	C	1				
	3.0	PE2	1			3.0	PE2	1				
	.6	E3	1			.6	E3	1				
Subtotal	4.0				Subtotal	4.0						
H03: SINCGARS ECCM Unit	5.8	PE1	2/3		H03: SINCGARS ECCM Unit	5.8	PE1	2/3				
	.5	E1	2			.5	E1	2				
Note: This is an estimate of the total time spent on the A1, A5, and A17 Circuit Card assemblies in the ARC-114 10 MHZ oscillator and phrase detector circuit in the ARC-114.					Subtotal	6.3						
Subtotal	6.3											
H04: SINCGARS Net Control Unit	1.7	C	1									
	3.3	D	1									
	10.1	PE1	2/3									
Subtotal	15.1											
Annex I:					Annex I:							
COMSEC Systems Training	7.0	C	1		COMSEC Systems Training	7.0	C	1				
	5.0	D	1			5.0	D	1				
	54.0	PE1	2/3			54.0	PE1	2/3				
	9.0	E1	2			9.0	E1	2				
Subtotal	75.0				Subtotal	75.0						

MIL CW-4

Table C1-8 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 160-31S10

SYSTEM. ITT

MOS 31S10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex J:					Annex J:							
Common Precision Soldering	1.6	TV	1		Common Precision Soldering	1.6	TV	1				
	33.4	PE1	2/3			33.4	PE1	2/3				
	4.0	E1	2			.0	E1	2				
Subtotal	39.0				Subtotal	39.0						
Total Academic Time	521.4				Total Academic Time	506.3						
Inprocessing	5.0				Inprocessing	5.0						
Outprocessing	8.0				Outprocessing	8.0						
Physical Conditioning	19.0				Physical Conditioning	19.0						
Total Nonacademic Time	32.0				Total Nonacademic Time	32.0						
Total Course Time	553.4				Total Course Time	538.3						
Instructional Breakdown:					Instructional Breakdown:							
C 54.3					C 52.6							
D 18.0					D 14.7							
TV 1.6					TV 1.6							
PM .8					PM .8							
PE1 231.2					PE1 221.1							
PE1 144.0					PE1 144.0							
PE2 6.0					PE2 6.0							
E1 64.3					E1 64.3							
E3 1.2					E3 1.2							
Total 521.4					Total 506.3							

MIL CW-4

Table C1-9

COURSE MODIFICATION WORKSHEET

COURSE 101-31V10

SYSTEM. BCS

MOS 31V10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A:					Annex A:							
Course Introduction	1.0	PE3	2		Course Introduction	1.0	PE3	2				
Subtotal	1.0				Subtotal	1.0						
Annex B	3.0	PE3	2		Annex B:	3.0	PE3	2				
Common Subjects	.5	E2	6		Common Subjects	.5	E2	6				
Subtotal	3.5				Subtotal	3.5						
Annex C:	29.2	PE1	6		Annex C:	29.2	PE1	6				
DC Circuits	2.3	E1	4		DC Circuits	2.3	E1	4				
Subtotal	31.5				Subtotal	31.5						
Annex D.	43.9	PE1	6		Annex D:	43.9	PE1	6				
AC Fundamentals	2.6	E1	4		AC Fundamentals	2.6	E1	4				
Subtotal	46.5				Subtotal	46.5						
Annex E.	20.4	PE1	6		Annex E:	20.4	PE1	6				
Receiver Maintenance	4.6	E1	4		Receiver Maintenance	4.6	E1	4				
Subtotal	25.0				Subtotal	25.0						
Annex F:	8.0	PE1	6		Annex F:	8.0	PE1	6				
Soldering	2.0	E1	4		Soldering	2.0	E1	4				
Subtotal	10.0				Subtotal	10.0						
Annex G.	23.1	PE1	6		Annex G:	23.1	PE1	6				
Transmitter Maintenance	4.9	E1	4		Transmitter Maintenance	4.9	E1	4				
Subtotal	28.0				Subtotal	28.0						
Annex H:	35.9	PE1	6									
Troubleshoot Medium-Powered	11.2	PE3	2									
FM Radio	6.5	E1	4									
Subtotal	53.6											
Annex I:	24.8	PE1	6		Annex H:	26.6	PE1	6	From: 101-31V10			
Troubleshoot Low-Powered	5.2	PE3	2		Troubleshoot Low-Powered	6.2	PE3	2	Annex H:			
FM Radio	33.5	E1	4		FM Radio	3.5	E1	4	CR26HA: FM Principles	.6	PE3	2
Subtotal	33.5				Subtotal	36.3			CR26HD: Radiotelephone	1.8	PE1	6
									Procedures	.4	PE3	2
									Subtotal	2.8		
Annex J.	23.0	PE1	6		Annex I:	23.0	PE1	6				
Troubleshoot Secured FM Radio	7.5	PE3	2		Troubleshoot Secured FM Radio	7.5	PE3	2				
	6.0	E1	4			6.0	E1	4				
Subtotal	36.5				Subtotal	36.5						

MIL CW-4

Table Cl-9 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 101-31V10

SYSTEM. BCS

MOS 31V10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
					Annex J: Troubleshoot Medium-Powered FM Radio				From: 101-31V10 Annex H: Troubleshoot Medium-Powered FM Radios			
					1. Application and Identification of SINCGARS	1.7	PE3	2	CR26HB: Application and Identification of AN/VRC-12 Series Radios	1.7	PE3	2
					2. Installation of SINCGARS	2.2	PE1	6	CR26HC: Installation of AN/VRC-12 Series Radios (AN/VRC-47)	2.2 .4	PE1 PE3	6 2
					3. Evaluate Operation of SINCGARS	3.8 .7	PE1 PE3	6 2	CR26HE: Evaluate Operation of AN/VRC-12 Series Radios	3.8 .7	PE1 PE3	6 2
					4. Troubleshoot SINCGARS to Defective Circuit	3.4 .6	PE1 PE3	6 2	CR26HF: Troubleshoot AN/VRC-12 Series Radios to Defective Circuit	3.4 .6	PE1 PE3	6 2
					5. Troubleshoot SINCGARS	4.5 .5	PE1 PE3	6 2	CR26HG: Troubleshoot AN/VRC-12 Series Radio Power Input Circuit	4.5 .5	PE1 PE3	6 2
					6. Troubleshoot Antenna Matching Unit Control Circuits	3.0	PE1	6	CR2HH: Troubleshoot Antenna Matching Unit Control Circuit	3.0	PE1	6
					7. Examination and Critique	2.0	E1	4	CR2617: Examination and Critique	2.0	E1	4
					8. Troubleshoot SINCGARS Keying Circuits	2.0 1.0	PE1 PE3	6 2	CR26HK: Troubleshoot AN/VRC-12 Radio Keying Circuits	2.0 1.0	PE1 PE3	6 2
					9. Examination and Critique	2.0	E1	4	CR2618: Examination and Critique	2.0	E1	4
					10. Troubleshoot RT Automatic Training	1.7 .5	PE1 PE3	6 2	CR26HN: Troubleshoot RT Automatic Training	1.7 .5	PE1 PE3	6 2
					11. Troubleshoot Intra-Vehicular Remote Control (IVRC)	2.8 .7	PE1 PE3	6 2	CR26HO: Troubleshoot C-2742 and C-2299	2.8 .7	PE1 PE3	6 2

Table C1-9 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 101-31V10

SYSTEM: BCS

MOS 31V10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
					12. Troubleshoot Net Control Unit (NCU)	1.6	D	1	From: 041-34Y10	1.7	PE1	
						5.1	PE1	6	TT76KG: DMD Manuals	1.6	D	
									TT76KH: DMD Operation	3.4	PE1	
					Subtotal	6.7			Subtotal	6.7		
					13. Troubleshoot Medium-Powered FM Radio Review	3.4	PE1	6	From: 101-31V10			
						.8	PE3	2	CR26HP: Troubleshoot Medium-Powered FM Radio Review	3.4	PE1	6
										.8	PE3	2
					14. Examination and Critique	2.5	E1	4	CR2619: Examination and Critique	2.5	E1	4
					Annex J: Summary	31.9	PE1					
						7.5	PE3					
						1.6	D					
						6.5	E1					
					Subtotal	47.5						
Annex K: Troubleshoot Intercommunications System	34.3	PE1	6		Annex K: Troubleshoot Intercommunications System	34.3	PE1	6				
	7.7	PE3	2			7.7	PE3	2				
	2.0	E1	4			2.0	E1	4				
Subtotal	44.0				Subtotal	44.0						
Annex L: Troubleshoot Single Sideband Radio Teletypewriter Sets	43.8	PE1	6		Annex L: Troubleshoot Single Sideband Radio Teletypewriter Sets	43.8	PE1	6				
	6.7	PE3	2			6.7	PE3	2				
	18.0	E1	4			18.0	E1	4				
Subtotal	68.5				Subtotal	68.5						

MIL CW-4

Table C1-9 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE: 101-31V10

SYSTEM: BCS

MOS 31V10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Total Academic Time	381.6				Total Academic Time	378.3						
Inprocessing	12.0				Inprocessing	12.0						
Outprocessing	8.0				Outprocessing	8.0						
Total Nonacademic Time	20.0				Total Nonacademic Time	20.0						
Total Course Time	401.6				Total Course Time	398.3						
Instructional Breakdown:					Instructional Breakdown:							
PE1 286.4					PE1 284.2							
PE2 42.3					PE2 39.6							
E1 52.4					E1 52.4							
E2 .5					E2 .5							
Total 381.6					D 1.6							
					Total 378.3							

Notes:

1. It was assumed that alternating current fundamentals will be taught using a component other than the AN/GRA-39.
2. Annex H of the existing course was deleted on the assumption that the AN/VRC-12 series radio will be replaced by SINCGARS. It is assumed that the new Annex J will support training for other medium-powered FM radios remaining in the inventory.

MIL CW-4

Table C1-10

COURSE MODIFICATION WORKSHEET

COURSE 160-32G10

SYSTEM: BCS

MOS 32G10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A:	7.3	C	1		Annex A:	7.3	C	1				
Solid State Power Supply Circuitry	42.7	PE1	2		Solid State Power Supply Circuitry	42.7	PE1	2				
	4.0	PE3	1			4.0	PE3	1				
	4.0	E1	2			4.0	E1	2				
Subtotal	58.0				Subtotal	58.0						
Annex B:	8.0	C	1		Annex B:	8.0	C	1				
Solid State Pulse Generator Circuitry	39.2	PE1	2		Solid State Pulse Generator Circuitry	39.2	PE1	2				
	1.8	PE3	1			1.8	PE3	1				
	4.0	E1	2			4.0	E1	2				
Subtotal	53.0				Subtotal	53.0						
Annex C:	5.7	C	1		Annex C:	5.7	C	1				
Solid State Logic Circuitry	29.3	PE1	2		Solid State Logic Circuitry	29.3	PE1	2				
	29.0	PE3	1			29.0	PE3	1				
	5.0	E1	2			5.0	E1	2				
Subtotal	69.0				Subtotal	69.0						
Annex D:	6.5	C	1		Annex D:	6.5	C	1				
Security Subjects	.5	D	1		Security Subjects	.5	D	1				
	.5	F	1			.5	F	1				
	1.5	PE1	2			1.5	PE1	2				
	25.0	PE3	1			25.0	PE3	1				
Subtotal	34.0				Subtotal	34.0						
Annex E:	4.0	C	1		Annex E:	4.0	C	1				
Teletypewriter Fundamentals	4.0	PE1	2		Teletypewriter Fundamentals	4.0	PE1	2				
Subtotal	8.0				Subtotal	8.0						
Annex F:	4.5	C	1		Annex F:	4.5	C	1				
Electronic Teletypewriter Security Equipment TSEC/KW-7	156.3	PE1	2		Electronic Teletypewriter Security Equipment TSEC/KW-7	156.3	PE1	2				
	69.2	PE3	1			69.2	PE3	1				
	32.0	E1	2			32.0	E1	2				
Subtotal	262.0				Subtotal	262.0						

MIL CW-4

Table C1-10 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 160-32G10

SYSTEM BCS

MOS 32G 10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex G:	86.3	C	1		Annex G:	86.3	C	1				
Teletypewriter Security	216.7	PE1	2		Teletypewriter Security	216.7	PE1	2				
Equipment TSEC/KW-26	53.0	E1	2		Equipment TSEC/KW-26	53.0	E1	2				
Subtotal	356.0				Subtotal	356.0						
Annex H:	10.7	C	1		Annex H:	10.7	C	1				
Duplex Key Generator	123.1	PE1	2		Duplex Key Generator	123.1	PE1	2				
TSEC/KG-13	46.2	PE3	1		TSEC/KG-13	46.2	PE3	1				
	18.0	E1	2			18.0	E1	2				
Subtotal	198.0				Subtotal	198.0						
Annex I:	10.0	C	1		Annex I:	10.0	C	1				
Synchronizer SN394(V)/G	30.0	PE1	2		Synchronizer SN394(V)/G	30.0	PE1	2				
and Modem MD-674	23.0	PE3	1		and Modem MD-674	23.0	PE3	1				
(P)/G	8.0	E1	2		(P)/G	8.0	E1	2				
Subtotal	71.0				Subtotal	71.0						
Annex J:	5.0	C	1		Annex J:	5.0	C	1				
Systems Configuration of	26.0	PE1	2		Systems Configuration of	26.0	PE1	2				
TSEC/KW-26	8.0	E1	2		TSEC/KW-26	8.0	E1	2				
Subtotal	39.0				Subtotal	39.0						
					Annex K:				From: 160-32G10			
					SINCGARS Equipment				H11: KGS-4 Synchronizer	.2	C	
					K1: SINCGARS ECCM Unit	.7	C	1		3.8	PE1	
						34.8	PE1	2		4.0	PE3	
						5.5	PE3	2	Subtotal	8.0		
						41.0			H13: Troubleshooting	.5	C	
										31.0	PE1	
										1.5	PE3	
									Subtotal	33.0		

MIL CW-4

Table C1-10 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 160-32G10

SYSTEM: BCS

MOS 32G10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
									From: 041-34Y10			
					K2: SINCGARS Net Control Unit	1.7	C	1	TT76JF: Display Editor Troubleshooting	7.5	PE1	
						9.2	PE1	2	Subtotal	7.5		
						2.5	PE2	2				
						.5	E1	2				
					Subtotal	13.9			TT76JG: Alphanumeric Keyboard Troubleshooting	1.7	PE1	
									Subtotal	1.7		
									TT76IF: CPU Data Base	1.7	C	
									Subtotal	1.7		
									TT76IH: CPU Memory Interface Controller	2.5	PE1	
									Subtotal	2.5		
Annex K:					Annex L:							
Reinforcement Training and End of Course Test	40.0	PE1	2		Reinforcement Training and End of Course Test	40.0	PE1	2				
	10.0	E1	2			10.0	E1	2				
Subtotal	50.0				Subtotal	50.0						

MIL CW-4

Table C1-10 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 160-32G10

SYSTEM. BCS

MOS 32G 10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex L:					Annex M:							
Common Precision	1.2	TVR	1		Common Precision	1.2	TVR	1				
Soldering	27.8	PE1	2		Soldering	27.8	PE1	2				
	8.0	E1	2			8.0	E1	2				
Subtotal	37.0				Subtotal	37.0						
Total Academic Time	1200.0				Total Academic Time	1254.9						
Inprocessing	5.0				Inprocessing	5.0						
Outprocessing	8.0				Outprocessing	8.0						
Physical Conditioning	78.0				Physical Conditioning	78.0						
Total Nonacademic Time	91.0				Total Nonacademic Time	91.0						
Total Course Time	1291.0				Total Course Time	1345.9						
Instructional Breakdown					Instructional Breakdown							
C 148.0					C 150.4							
D .5					D .5							
F .5					F .5							
TV 1.2					TV 1.2							
PE1 701.6					PE1 745.6							
PE3 198.2					PE2 2.5							
E1 150.0					PE3 203.7							
Total 1200.0					E1 150.5							
					Total 1254.9							

MIL CW-4

Table C1-11

COURSE MODIFICATION WORKSHEET

COURSE 160-32G10

SYSTEM: CE

MOS 32G10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A:	7.3	C	1		Annex A:	7.3	C	1				
Solid State Power	42.7	PE1	2		Solid State Power	42.7	PE1	2				
Supply Circuitry	4.0	PE3	1		Supply Circuitry	4.0	PE3	1				
	4.0	E1	2			4.0	E1	2				
Subtotal	58.0				Subtotal	58.0						
Annex B:	8.0	C	1		Annex B:	8.0	C	1				
Solid State Pulse Generator	39.2	PE1	2		Solid State Pulse Generator	39.2	PE1	2				
Circuitry	1.8	PE3	1		Circuitry	1.8	PE3	1				
	4.0	E1	2			4.0	E1	2				
Subtotal	53.0				Subtotal	53.0						
Annex C:	5.7	C	1		Annex C:	5.7	C	1				
Solid State Logic	29.3	PE1	2		Solid State Logic	29.3	PE1	2				
Circuitry	29.0	PE3	1		Circuitry	29.0	PE3	1				
	5.0	E1	2			5.0	E1	2				
Subtotal	69.0				Subtotal	69.0						
Annex D:	6.5	C	1		Annex D:	6.5	C	1				
Security Subjects	.5	D	1		Security Subjects	.5	D	1				
	.5	F	1			.5	F	1				
	1.5	PE1	2			1.5	PE1	2				
	25.0	PE3	1			25.0	PE3	1				
Subtotal	34.0				Subtotal	34.0						
Annex E:	4.0	C	1		Annex E:	4.0	C	1				
Teletypewriter Fundamentals	4.0	PE1	2		Teletypewriter Fundamentals	4.0	PE1	2				
Subtotal	8.0				Subtotal	8.0						
Annex F:	4.5	C	1		Annex F:	4.5	C	1				
Electronic Teletypewriter	156.3	PE1	2		Electronic Teletypewriter	156.3	PE1	2				
Security Equipment	69.2	PE3	1		Security Equipment	69.2	PE3	1				
TSEC/KW-7	32.0	E1	2		TSEC/KW-7	32.0	E1	2				
Subtotal	262.0				Subtotal	262.0						

MIL CW-4

Table C1-11 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 160-32G10

SYSTEM CE

MOS 32G10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex G:	86.3	C	1		Annex G:	86.3	C	1				
Teletypewriter Security	216.7	PE1	2		Teletypewriter Security	216.7	PE1	2				
Equipment TSEC/KW-26	53.0	E1	2		Equipment TSEC/KW-26	53.0	E1	2				
Subtotal	356.0				Subtotal	356.0						
Annex H:	10.7	C	1		Annex H:	10.7	C	1				
Duplex Key Generator	123.1	PE1	2		Duplex Key Generator	123.1	PE1	2				
TSEC/KG-13	46.2	PE3	1		TSEC/KG-13	46.2	PE3	1				
	18.0	E1	2			18.0	E1	2				
Subtotal	198.0				Subtotal	198.0						
Annex I:	10.0	C	1		Annex I:	10.0	C	1				
Synchronizer SN394(V)/G	30.0	PE1	2		Synchronizer SN394(V)/G	30.0	PE1	2				
and Modum MD-674	23.0	PE3	1		and Modum MD-674	23.0	PE3	1				
(P)/G	8.0	E1	2		(P)/G	8.0	E1	2				
Subtotal	71.0				Subtotal	71.0						
Annex J:					Annex J:							
System Configurations of	5.0	C	1		System Configurations of	5.0	C	1				
TSEC/KW-26	26.0	PE1	2		TSEC/KW-26	26.0	PE1	2				
	8.0	E1	2			8.0	E1	2				
Subtotal	39.0				Subtotal	39.0						
Annex K:					Annex K:							
SINCGARS Equipment					SINCGARS Equipment							
K1: SINCGARS ECCM Unit	.7	C	1		K1: SINCGARS ECCM Unit	.7	C	1				
	34.8	PE1	2			10.3	PE1	2				
	5.5	PE3	2			1.0	E1	2				
Subtotal	41.0				Subtotal	12.0						

MIL CW-4

Table C1-11 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 160-32G10

SYSTEM. CE

MOS 32G10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
K2: SINCGARS Net Control Unit	1.7	C	1		K2: SINCGARS Net Control Unit	1.7	C	1				
	9.2	PE1	2			11.7	PE1	2				
	2.5	PE2	2			.5	E1	2				
	.5	E1	2		Subtotal	13.9						
Subtotal	13.9											
Annex L:					Annex L:							
Reinforcement Training	40.0	PE1	2		Reinforcement Training	40.0	PE1	2				
and End of Course Test	10.0	E1	2		and End of Course Test	10.0	E1	2				
Subtotal	50.0				Subtotal	50.0						
Annex M:	1.2	TVR	1		Annex M:	1.2	TVR	1				
Common Precision	27.8	PE1	2		Common Precision	27.8	PE1	2				
Soldering	8.0	E1	2		Soldering	8.0	E1	2				
Subtotal	37.0				Subtotal	37.0						
Total Academic Time	1254.9				Total Academic Time	1225.9						
Inprocessing	5.0				Inprocessing	5.0						
Outprocessing	8.0				Outprocessing	8.0						
Physical Conditioning	18.0				Physical Conditioning	18.0						
Total Nonacademic Time	91.0				Total Nonacademic Time	91.0						
Total Course Time	1345.9				Total Course Time	1316.9						
Instructional Breakdown					Instructional Breakdown							
C 150.4					C 150.4							
D .5					D .5							
F .5					F .5							
TV 1.2					TV 1.2							
PE1 745.6					PE1 723.6							
PE2 2.5					PE3 198.2							
PE3 203.7					E1 151.5							
E1 150.5					Total 1225.9							
Total 1254.9												

MIL CW-4

Table C1-12

COURSE MODIFICATION WORKSHEET

COURSE 160-32G10

SYSTEM: ITT

MOS 32G 10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex A:	7.3	C	1		Annex A:	7.3	C	1				
Solid State Power	42.7	PE1	2		Solid State Power	42.7	PE1	2				
Supply Circuitry	4.0	PE3	1		Supply Circuitry	4.0	PE3	1				
	4.0	E1	2			4.0	E1	2				
Subtotal	58.0				Subtotal	58.0						
Annex B:	8.0	C	1		Annex B:	8.0	C	1				
Solid State Generator	39.2	PE1	2		Solid State Pulse Generator	39.2	PE1	2				
Circuitry	1.8	PE3	1		Circuitry	1.8	PE3	1				
	4.0	E1	2			4.0	E1	2				
Subtotal	53.0				Subtotal	53.0						
Annex C:	5.7	C	1		Annex C:	5.7	C	1				
Solid State Logic	29.3	PE1	2		Solid State Logic	29.3	PE1	2				
Circuitry	29.0	PE3	1		Circuitry	29.0	PE3	1				
	5.0	E1	2			5.0	E1	2				
Subtotal	69.0				Subtotal	69.0						
Annex D:	6.5	C	1		Annex D:	6.5	C	1				
Security Subjects	.5	D	1		Security Subjects	.5	D	1				
	.5	F	1			.5	F	1				
	1.5	PE1	2			1.5	PE1	2				
	25.0	PE3				25.0	PE3	1				
Subtotal	34.0				Subtotal	34.0						
Annex E:	4.0	C	1		Annex E:	4.0	C	1				
Teletypewriter Fundamentals	4.0	PE1	2		Teletypewriter Fundamentals	4.0	PE1	2				
Subtotal	8.0				Subtotal	8.0						
Annex F:	4.5	C	1		Annex F:	4.5	C	1				
Electronic Teletypewriter	156.3	PE1	2		Electronic Teletypewriter	156.3	PE1	2				
Security Equipment	69.2	PE3	1		Security Equipment	69.2	PE3	1				
TSEC/KW-7	32.0	E1	2		TSEC/KW-7	32.0	E1	2				
Subtotal	262.0				Subtotal	262.0						

MIL CW-4

Table C1-12 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 160-32G10

SYSTEM ITT

MOS 32G 10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
Annex G:	86.3	C	1		Annex G:	86.3	C	1				
Teletypewriter Security	216.7	PE1	2		Teletypewriter Security	216.7	PE1	2				
Equipment TSEC/KW-26	53.0	E1	2		Equipment TSEC/KW-26	53.0	E1	2				
Subtotal	356.0				Subtotal	356.0						
Annex H:	10.7	C	1		Annex H:	10.7	C	1				
Duplex Key Generator	123.1	PE1	2		Duplex Key Generator	123.1	PE1	2				
TSEC/KG-13	46.2	PE3	1		TSEC/KG-13	46.2	PE3	1				
	18.0	E1	2			18.0	E1	2				
Subtotal	198.0				Subtotal	198.0						
Annex I:	10.0	C	1		Annex I:	10.0	C	1				
Synchronizer SN394(V)/G	30.0	PE1	2		Synchronizer SN394(V)/G	30.0	PE1	2				
and Modem MD-674	23.0	PE3	1		and Modem MD-674	23.0	PE3	1				
(P)/G	8.0	E1	2		(P)/G	8.0	E1	2				
Subtotal	71.0				Subtotal	71.0						
Annex J:					Annex J:							
System Configurations of	5.0	C	1		System Configurations of	5.0	C	1				
TSEC/KW-26	26.0	PE1	2		TSEC/KW-26	26.0	PE1	2				
	8.0	E1	2			8.0	E1	2				
Subtotal	39.0				Subtotal	39.0						
Annex K:					Annex K:							
SINCGARS Equipment					SINCGARS Equipment							
K1: SINCGARS ECCM Unit	.7	C	1		K1: SINCGARS ECCM Unit	.7	C	1				
	34.8	PE1	2			18.3	PE1	2				
	5.5	PE3	2			1.0	E1	2				
Subtotal	41.0				Subtotal	20.0						

MIL CW-4

Table C1-12 (Continued)

COURSE MODIFICATION WORKSHEET

COURSE 160-32G10

SYSTEM ITT

MOS 32G10

EXISTING COURSE				NEW COURSE					COURSES USED TO PROJECT NEW INSTRUCTION			
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	TASK NUMBERS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	GROUPS
K2: SINCGARS Net Control Unit	1.7	C	1									
	9.2	PE1	2									
	2.5	PE2	2									
	.5	E1										
Subtotal	13.9											
Annex L:					Annex L:							
Reinforcement Training	40.0	PE1	2		Reinforcement Training	40.0	PE1	2				
and End of Course Test	10.0	E1	2		and End of Course Test	10.0	E1	2				
Subtotal	50.0				Subtotal	50.00						
Annex M:	1.2	TVR	1		Annex M:	1.2	TVR	1				
Common Precision	27.8	PE1	2		Common Precision	27.8	PE1	2				
Soldering	8.0	E1	1		Soldering	8.0	E1	1				
Subtotal	37.0				Subtotal	37.0						
Total Academic Time	1254.9				Total Academic Time	1220.0						
Inprocessing	5.0				Inprocessing	5.0						
Outprocessing	8.0				Outprocessing	8.0						
Physical Conditioning	18.0				Physical Conditioning	18.0						
Total Nonacademic Time	91.0				Total Nonacademic Time	91.0						
Total Course Time	1345.9				Total Course Time	1311.0						
Instructional Breakdown					Instructional Breakdown							
C 150.4					C 148.7							
D .5					D .5							
F .5					F .5							
TV 1.2					TV 1.2							
PE1 745.6					PE1 719.9							
PE2 2.5					PE3 198.2							
PE3 203.7					E1 151.0							
E1 150.5					Total 1220.0							
Total 1254.9												

MIL CW-4

Table C2-1 Detailed Course Resource Requirements

MOS: 101-31E10

ALTERNATIVE: REFERENCE

TRAINING COST PER GRADUATE

	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	795	1709			2504
FLYING HOURS					
OTHER	362	370			732
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			12		12
STUDENT PAY + ALLOWANCE		4970			4970
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	1157	7062	12		8230
BASE OPERATIONS	1411	412			1822
SUPPORT COSTS					
TRAINING AIDS	77	11			88
OTHER	343	356		1	700
TOTAL INDIRECT COST	1830	779		1	2610
TOTAL DIRECT AND INDIRECT COSTS	2987	7841	12	1	10840

	POI	ANNUAL
MAN-DAYS	2653	6296758
CONTACT HOURS	2097	8292577
INSTRUCTORS	2	6828
COST	216806	514512791

CLASS FREQUENCY	3955
NO# OF GRADUATES	47463
CLASS LENGTH	100

Table C2-2 Detailed Course Resource Requirements

MOS: 101-31E10

ALTERNATIVE: CE

	TRAINING COST PER GRADUATE				
	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	950	2110			3060
FLYING HOURS					
OTHER	521	563			1084
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			535		535
STUDENT PAY + ALLOWANCE		4815			4815
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	1471	7500	535		9506
BASE OPERATIONS	2570	703			3274
SUPPORT COSTS					
TRAINING AIDS	140	19			159
OTHER	624	609		37	1270
TOTAL INDIRECT COST	3335	1331		37	4703
TOTAL DIRECT AND INDIRECT COSTS	4806	8831	535	37	14209

	POI	ANNUAL
MAN-DAYS	2571	137659
CONTACT HOURS	2040	182097
INSTRUCTORS	2	150
COST	284182	15217955

CLASS FREQUENCY	89
NO# OF GRADUATES	1071
CLASS LENGTH	96

Table C2-3 Detailed Course Resource Requirements

MOS: 101-31E10

ALTERNATIVE: ITT

	TRAINING COST PER GRADUATE				
	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	980	2177			3156
FLYING HOURS					
OTHER	540	584			1124
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			559		559
STUDENT PAY + ALLOWANCE		4970			4970
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	1520	7742	559		9822
BASE OPERATIONS	2670	730			3400
SUPPORT COSTS					
TRAINING AIDS	146	20			165
OTHER	648	632		39	1319
TOTAL INDIRECT COST	3464	1382		39	4885
TOTAL DIRECT AND INDIRECT COSTS	4984	9125	559	39	14707

	POI	ANNUAL
MAN-DAYS	2653	135851
CONTACT HOURS	2097	178910
INSTRUCTORS	2	148
COST	294130	15059467

CLASS FREQUENCY	85
NO# OF GRADUATES	1024
CLASS LENGTH	100

Table C2-4 Detailed Course Resource Requirements

MOS: 160-31S10

ALTERNATIVE: REFERENCE

	TRAINING COST PER GRADUATE				
	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	584	1084			1668
FLYING HOURS					
OTHER	258	265			523
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			9		9
STUDENT PAY + ALLOWANCE		3456			3456
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	842	4816	9		5668
BASE OPERATIONS	1028	297			1325
SUPPORT COSTS					
TRAINING AIDS	56	8			64
OTHER	250	257		2	509
TOTAL INDIRECT COST	1333	562		2	1898
TOTAL DIRECT AND INDIRECT COSTS	2175	5379	9	2	7566

	POI	ANNUAL
MAN-DAYS	940	961198
CONTACT HOURS	1105	1429494
INSTRUCTORS	1	880
COST	90788	92792857
CLASS FREQUENCY	1294	
NO# OF GRADUATES	12265	
CLASS LENGTH	69	

Table C2-5 Detailed Course Resource Requirements

MOS: 160-31S10

ALTERNATIVE: CE

	TRAINING COST PER GRADUATE				
	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	620	1163			1783
FLYING HOURS					
OTHER	283	295			578
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			36		36
STUDENT PAY + ALLOWANCE		3403			3403
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	902	4873	36		5810
BASE OPERATIONS	1213	343			1557
SUPPORT COSTS					
TRAINING AIDS	66	9			75
OTHER	295	298		8	600
TOTAL INDIRECT COST	1574	650		8	2232
TOTAL DIRECT AND INDIRECT COSTS	2476	5523	36	8	8043

	POI	ANNUAL
MAN-DAYS	926	245386
CONTACT HOURS	1093	366606
INSTRUCTORS	1	249
COST	96512	25575696

CLASS FREQUENCY	335
NO# OF GRADUATES	3180
CLASS LENGTH	68

Table C2-6 Detailed Course Resource Requirements

MOS: 160-31S10

ALTERNATIVE: ITT

TRAINING COST PER GRADUATE

	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	565	1046			1610
FLYING HOURS					
OTHER	247	253			500
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			5		5
STUDENT PAY + ALLOWANCE		3361			3361
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	811	4672	5		5488
BASE OPERATIONS	971	282			1252
SUPPORT COSTS					
TRAINING AIDS	53	8			60
OTHER	236	244		1	481
TOTAL INDIRECT COST	1259	533		1	1793
TOTAL DIRECT AND INDIRECT COSTS	2071	5205	5	1	7282

	POI	ANNUAL
MAN-DAYS	915	1682489
CONTACT HOURS	1080	2513719
INSTRUCTORS	1	1518
COST	87381	160716102

CLASS FREQUENCY	2328
NO# OF GRADUATES	22071
CLASS LENGTH	67

Table C2-7 Detailed Course Resource Requirements

MOS: 101-31V10

ALTERNATIVE: REFERENCE

	TRAINING COST PER GRADUATE				
	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	351	792			1143
FLYING HOURS					
OTHER	343	394			737
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			7		7
STUDENT PAY + ALLOWANCE		2219			2219
TRAVEL PAY AT COURSE	158				158
PER DIEM AT COURSE	559				559
TOTAL DIRECT COST	1411	3405	7		4823
BASE OPERATIONS	915	218			1133
SUPPORT COSTS					
TRAINING AIDS	46	3			49
OTHER	127	104		1	233
TOTAL INDIRECT COST	1088	325		1	1414
TOTAL DIRECT AND INDIRECT COSTS	2499	3730	7	1	6237

	POI	ANNUAL
MAN-DAYS	1873	2672634
CONTACT HOURS	1999	3278426
INSTRUCTORS	1	1967
COST	218307	311548798
CLASS FREQUENCY	1640	
NO# OF GRADUATES	49949	
CLASS LENGTH	50	

Table C2-8 Detailed Course Resource Requirements

MOS: 101-31V10

ALTERNATIVE: CE

TRAINING COST PER GRADUATE

	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	469	1205			1675
FLYING HOURS					
OTHER	485	647			1133
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			209		209
STUDENT PAY + ALLOWANCE		2114			2114
TRAVEL PAY AT COURSE	158				158
PER DIEM AT COURSE	532				532
TOTAL DIRECT COST	1645	3966	209		5820
BASE OPERATIONS	1167	371			1538
SUPPORT COSTS					
TRAINING AIDS	58	5			63
OTHER	163	176		37	376
TOTAL INDIRECT COST	1388	552		37	1977
TOTAL DIRECT AND INDIRECT COSTS	3033	4518	209	37	7797

	POI	ANNUAL
MAN-DAYS	1783	87489
CONTACT HOURS	1895	106832
INSTRUCTORS	1	83
COST	272894	13387420

CLASS FREQUENCY	56
NO# OF GRADUATES	1717
CLASS LENGTH	47

Table C2-9 Detailed Course Resource Requirements

MOS: 101-31V10

ALTERNATIVE: ITT

TRAINING COST PER GRADUATE

	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	422	1047			1469
FLYING HOURS					
OTHER	430	552			982
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			139		139
STUDENT PAY + ALLOWANCE		2114			2114
TRAVEL PAY AT COURSE	158				158
PER DIEM AT COURSE	532				532
TOTAL DIRECT COST	1542	3713	139		5394
BASE OPERATIONS	1064	314			1378
SUPPORT COSTS					
TRAINING AIDS	53	4			57
OTHER	148	149		24	322
TOTAL INDIRECT COST	1265	468		24	1757
TOTAL DIRECT AND INDIRECT COSTS	2808	4181	139	24	7151

	POI	ANNUAL
MAN-DAYS	1783	131922
CONTACT HOURS	1895	161088
INSTRUCTORS	1	120
COST	250293	18514529

CLASS FREQUENCY	85
NO# OF GRADUATES	2589
CLASS LENGTH	47

Table C2-10 Detailed Course Resource Requirements

MOS: 160-32G10

ALTERNATIVE: REFERENCE

TRAINING COST PER GRADUATE

	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	1358	2543			3901
FLYING HOURS					
OTHER	630	654			1284
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			136		136
STUDENT PAY + ALLOWANCE		8404			8404
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	1988	11612	136		13736
BASE OPERATIONS	2629	750			3380
SUPPORT COSTS					
TRAINING AIDS	143	20			163
OTHER	638	650		13	1302
TOTAL INDIRECT COST	3411	1421		13	4845
TOTAL DIRECT AND INDIRECT COSTS	5399	13033	136	13	18581

	POI	ANNUAL
MAN-DAYS	2287	301526
CONTACT HOURS	2153	359371
INSTRUCTORS	1	244
COST	222968	29394580

CLASS FREQUENCY	167
NO# OF GRADUATES	1582
CLASS LENGTH	168

Table C2-11 Detailed Course Resource Requirements

MOS: 160-32G10

ALTERNATIVE: CE

	TRAINING COST PER GRADUATE				
	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	4839	10105			14944
FLYING HOURS					
OTHER	2673	3103			5775
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			4667		4667
STUDENT PAY + ALLOWANCE		8225			8225
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	7512	21444	4667		33623
BASE OPERATIONS	17103	4416			21519
SUPPORT COSTS					
TRAINING AIDS	932	119			1050
OTHER	4153	3828		449	8430
TOTAL INDIRECT COST	22187	8363		449	30999
TOTAL DIRECT AND INDIRECT COSTS	29699	29807	4667	449	64622

	POI	ANNUAL
MAN-DAYS	2239	8581
CONTACT HOURS	2101	10197
INSTRUCTORS	2	9
COST	775467	2972622

CLASS FREQUENCY	5
NO# OF GRADUATES	46
CLASS LENGTH	165

Table C2-12. Detailed Course Resource Requirements

MOS: 160-32G10

ALTERNATIVE: ITT

TRAINING COST PER GRADUATE

	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	1362	2565			3927
FLYING HOURS.					
OTHER	639	667			1307
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			189		189
STUDENT PAY + ALLOWANCE		8186			8186
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	2002	11430	189		13620
BASE OPERATIONS	2742	777			3519
SUPPORT COSTS					
TRAINING AIDS	149	21			170
OTHER	666	673		18	1357
TOTAL INDIRECT COST	3557	1471		18	5046
TOTAL DIRECT AND INDIRECT COSTS	5559	12901	189	18	18666

	POI	ANNUAL
MAN-DAYS	2228	211276
CONTACT HOURS	2091	250996
INSTRUCTORS	1	177
COST	223996	21242313

CLASS FREQUENCY	120
NO# OF GRADUATES	1138
CLASS LENGTH	164

Table C2-13 Detailed Course Resource Requirements

MOS: XXX-35C10

ALTERNATIVE: REFERENCE

TRAINING COST PER GRADUATE

	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	724	1352			2076
FLYING HOURS					
OTHER	348	359			707
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			152		152
STUDENT PAY + ALLOWANCE		4782			4782
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	1072	6505	152		7729
BASE OPERATIONS	1423	408			1831
SUPPORT COSTS					
TRAINING AIDS	77	11			88
OTHER	345	354		5	705
TOTAL INDIRECT COST	1846	773		5	2624
TOTAL DIRECT AND INDIRECT COSTS	2918	7278	152	5	10353

	POI	ANNUAL
MAN-DAYS	1301	428695
CONTACT HOURS	1172	488913
INSTRUCTORS	1	323
COST	124232	40924216

CLASS FREQUENCY	417
NO# OF GRADUATES	3953
CLASS LENGTH	96

Table C2-14 Detailed Course Resource Requirements

MOS: XXX-35C10

ALTERNATIVE: CE

	TRAINING COST PER GRADUATE				
	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	1768	3523			5291
FLYING HOURS					
OTHER	789	888			1677
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			2871		2871
STUDENT PAY + ALLOWANCE		4782			4782
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	2557	9205	2871		14633
BASE OPERATIONS	4540	1198			5738
SUPPORT COSTS					
TRAINING AIDS	247	32			280
OTHER	1102	1039		99	2240
TOTAL INDIRECT COST	5890	2269		99	8258
TOTAL DIRECT AND INDIRECT COSTS	8447	11474	2871	99	22891

	POI	ANNUAL
MAN-DAYS	1301	22666
CONTACT HOURS	1671	36840
INSTRUCTORS	1	32
COST	274690	4784185

CLASS FREQUENCY	22
NO# OF GRADUATES	209
CLASS LENGTH	96

Table C2-15 Detailed Course Resource Requirements

MOS: XXX-35C10

ALTERNATIVE: ITT

	TRAINING COST PER GRADUATE				
	OMA	MPA	PA	FHMA	TOTAL
DIRECT MISSION					
INSTRUCIONAL DEPT.	1054	1974			3028
FLYING HOURS					
OTHER	371	387			759
TROOP SUPPORT					
P8					
P2/3					
AMMUNITION					
EQUIPMENT DEPRECIATION			296		296
STUDENT PAY + ALLOWANCE		4782			4782
TRAVEL PAY AT COURSE		12			12
PER DIEM AT COURSE					
TOTAL DIRECT COST	1425	7155	296		8876
BASE OPERATIONS	1588	450			2038
SUPPORT COSTS					
TRAINING AIDS	86	12			99
OTHER	385	390		10	786
TOTAL INDIRECT COST	2060	852		10	2922
TOTAL DIRECT AND INDIRECT COSTS	3485	8008	296	10	11798

	POI	ANNUAL
MAN-DAYS	1301	220041
CONTACT HOURS	1671	357643
INSTRUCTORS	1	243
COST	141582	23939124

CLASS FREQUENCY	214
NO# OF GRADUATES	2029
CLASS LENGTH	96

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APPENDIX D

PERSONNEL ANALYSIS

This appendix includes the detailed results of the Personnel Requirements Analysis. The contents of Appendix D1 are the personnel flow rates; (1) attrition; (2) promotion; and (3) TTHS overhead percentages. The variation of rates among MOSs and paygrades may be a result of Career Management Field (CMF) structure differences, bonus levels, internal or external policy changes. The importance in measuring these above loss rates is to estimate the quantities and qualities of personnel replacements needed to support present or future system-specific manpower requirements.

Appendix D2 contains the personnel requirements for the reference system and baseline systems by MOS/paygrade. Personnel requirement structures will vary according to input rates and the level and quantity of manpower requirements within each MOS. Table 3.4-4 is an example of the impact of personnel structures given equal quantities of manpower requirements distributed at different skill levels.

Table D1 Personnel Flow Rates

MOS = 11B

PAYGRADE	MANPOWER	ATTRITION	UPGRADE	TTHS
E-1	0.	0.440	1.489	0.
E-2	0.	0.287	1.934	0.070
E-3	8591.0	0.213	0.752	0.061
E-4	8591.0	0.301	0.399	0.060

MOS = 19E

PAYGRADE	MANPOWER	ATTRITION	UPGRADE	TTHS
E-1	0.	1.059	1.183	0.
E-2	0.	0.408	2.117	0.040
E-3	8591.0	0.231	0.946	0.038
E-4	8591.0	0.279	0.305	0.056

MOS = 31S

PAYGRADE	MANPOWER	ATTRITION	UPGRADE	TTHS
E-1	0.	0.560	1.440	0.
E-2	0.	0.471	1.176	0.170
E-3	4902.0	0.357	0.786	0.169
E-4	4901.0	0.642	0.350	0.110

MOS = 31V

PAYGRADE	MANPOWER	ATTRITION	UPGRADE	TTHS
E-1	0.	0.444	1.400	0.
E-2	0.	0.329	2.241	0.080
E-3	0.	0.266	0.874	0.070
E-4	0.	0.447	0.057	0.062

MOS = 32G

PAYGRADE	MANPOWER	ATTRITION	UPGRADE	TTHS
E-1	0.	0.137	0.855	0.
E-2	0.	0.135	0.794	0.100
E-3	842.0	0.096	0.759	0.100
E-4	841.0	0.192	0.396	0.094
E-5	479.0	0.275	0.164	0.073

MOS = 35C

PAYGRADE	MANPOWER	ATTRITION	UPGRADE	TTHS
E-1	0.	0.137	0.855	0.
E-2	0.	0.135	0.794	0.100
E-3	338.0	0.096	0.759	0.100
E-4	337.0	0.192	0.396	0.094
E-5	3696.0	0.275	0.164	0.073

Table D2-1 Reference

MOS = 11B   RECRUITS PER YEAR = 1750.2

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	907.3	0.	0.	1750.2	0.	1750.2
E-2	608.3	0.	0.	1351.0	0.	1351.0
E-3	1219.1	1149.0	1219.1	1176.4	1176.4	0.0
E-4	1309.7	1149.0	1217.9	916.8	852.6	64.2

MOS = 19E   RECRUITS PER YEAR = 20552.0

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	9166.8	0.	0.	20552.0	0.	20552.0
E-2	4294.8	0.	0.	10844.4	0.	10844.4
E-3	7724.8	7442.0	7724.8	9092.1	9092.1	0.0
E-4	12513.1	7442.0	7858.8	7307.7	4589.5	2718.1

MOS = 31E   RECRUITS PER YEAR = 47462.6

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	29118.2	0.	0.	47462.6	0.	47462.6
E-2	9998.3	0.	0.	17267.1	0.	17267.1
E-3	13514.8	12056.0	13514.8	15447.4	15447.4	0.0
E-4	19763.5	12056.0	12803.5	12866.1	8335.1	4531.0

MOS = 31S   RECRUITS PER YEAR = 15265.0

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	7632.5	0.	0.	15265.0	0.	15265.0
E-2	6673.2	0.	0.	10990.8	0.	10990.8
E-3	6865.9	4902.0	5730.4	7847.7	6549.9	1297.8
E-4	5440.1	4901.0	5440.1	5396.6	5396.6	0.0

Table D2-1 (continued)

MOS = 31V RECRUITS PER YEAR = 49948.9

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	27087.3	0.	0.	49949.0	0.	49949.0
E-2	14755.7	0.	0.	37922.2	0.	37922.2
E-3	29006.6	27109.0	29006.6	33067.6	33067.6	0.0
E-4	50301.2	27109.0	28789.8	25351.8	14510.0	10841.8

MOS = 32G RECRUITS PER YEAR = 1581.9

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	1594.7	0.	0.	1581.9	0.	1581.9
E-2	1467.7	0.	0.	1363.5	0.	1363.5
E-3	1362.9	642.0	926.2	1165.3	791.9	373.4
E-4	1759.3	841.0	920.1	1034.5	541.0	493.5
E-5	1587.0	1479.0	1587.0	696.7	696.7	0.0

MOS = 35C RECRUITS PER YEAR = 3953.2

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	3985.0	0.	0.	3953.2	0.	3953.2
E-2	3667.6	0.	0.	3407.2	0.	3407.2
E-3	3406.0	338.0	371.8	2912.1	317.9	2594.2
E-4	4396.5	337.0	368.7	2585.1	216.8	2368.3
E-5	3965.8	3696.0	3965.8	1741.0	1741.0	0.0

Table D2-2 C.E.

MOS = 11B RECRUITS PER YEAR = 961.2

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	498.3	0.	0.	961.2	0.	961.2
E-2	334.1	0.	0.	741.9	0.	741.9
E-3	669.5	631.0	669.5	646.1	646.1	0.0
E-4	719.2	631.0	668.9	503.5	468.2	35.3

MOS = 19E RECRUITS PER YEAR = 3639.8

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	1623.5	0.	0.	3639.8	0.	3639.8
E-2	760.6	0.	0.	1920.6	0.	1920.6
E-3	1368.1	1318.0	1368.1	1610.2	1610.2	0.0
E-4	2216.1	1318.0	1391.8	1294.2	812.8	481.4

MOS = 31E RECRUITS PER YEAR = 1070.8

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	656.9	0.	0.	1070.8	0.	1070.8
E-2	225.6	0.	0.	389.6	0.	389.6
E-3	304.9	272.0	304.9	348.5	348.5	0.0
E-4	445.9	272.0	288.9	290.3	188.1	102.2

MOS = 31S RECRUITS PER YEAR = 3180.1

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	1590.0	0.	0.	3180.1	0.	3180.1
E-2	1390.2	0.	0.	2289.7	0.	2289.7
E-3	1430.3	1021.0	1193.5	1634.9	1364.2	270.6
E-4	1133.3	1021.0	1133.3	1124.2	1124.2	0.0

Table D2-2 (continued)

MOS = 31V   RECRUITS PER YEAR = 1717.2

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	931.3	0.	0.	1717.2	0.	1717.2
E-2	507.3	0.	0.	1303.8	0.	1303.8
E-3	997.2	932.0	997.2	1136.9	1136.9	0.0
E-4	1729.3	932.0	989.8	871.6	498.9	372.7

MOS = 32G   RECRUITS PER YEAR = 46.0

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	46.4	0.	0.	46.0	0.	46.0
E-2	42.7	0.	0.	39.7	0.	39.7
E-3	39.6	12.0	13.2	33.9	11.3	22.6
E-4	51.2	11.0	12.0	30.1	7.1	23.0
E-5	46.2	43.0	46.1	20.3	20.3	0.0

MOS = 35L   RECRUITS PER YEAR = 208.6

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	210.3	0.	0.	208.6	0.	208.6
E-2	193.5	0.	0.	179.8	0.	179.8
E-3	179.7	43.0	47.3	153.7	40.4	113.2
E-4	232.0	42.0	45.9	136.4	27.0	109.4
E-5	209.3	195.0	209.2	91.9	91.9	0.0

MOS = 11B   RECRUITS PER YEAR = 3814.2

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	1977.3	0.	0.	3814.2	0.	3814.2
E-2	1325.6	0.	0.	2944.2	0.	2944.2
E-3	2656.7	2504.0	2656.7	2563.8	2563.8	0.0
E-4	2854.1	2504.0	2654.2	1997.9	1858.0	139.9

MOS = 19E   RECRUITS PER YEAR = 13874.4

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	6188.4	0.	0.	13874.4	0.	13874.4
E-2	2899.4	0.	0.	7320.9	0.	7320.9
E-3	5214.9	5024.0	5214.9	6138.0	6138.0	0.0
E-4	8447.4	5024.0	5305.3	4933.3	3098.3	1835.0

MOS = 31E   RECRUITS PER YEAR = 1023.5

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	628.0	0.	0.	1023.6	0.	1023.6
E-2	215.6	0.	0.	372.4	0.	372.4
E-3	291.5	260.0	291.5	333.1	333.1	0.0
E-4	426.2	260.0	276.1	277.5	179.8	97.7

MOS = 31S   RECRUITS PER YEAR = 22070.5

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	11035.3	0.	0.	22070.6	0.	22070.6
E-2	9648.3	0.	0.	15890.8	0.	15890.8
E-3	9926.9	7087.0	8284.7	11346.4	9469.4	1877.0
E-4	7865.5	7086.0	7865.5	7802.5	7802.5	0.0

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Table D2-3 (continued)

MOS = 31V RECRUITS PER YEAR = 2588.7

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	1403.9	0.	0.	2588.7	0.	2588.7
E-2	764.8	0.	0.	1965.4	0.	1965.4
E-3	1503.4	1405.0	1503.4	1713.8	1713.8	0.0
E-4	2607.0	1404.0	1491.0	1313.9	751.5	562.4

MOS = 32G RECRUITS PER YEAR = 1138.0

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	1147.2	0.	0.	1138.0	0.	1138.0
E-2	1055.8	0.	0.	980.9	0.	980.9
E-3	980.5	528.0	580.8	838.3	496.6	341.8
E-4	1265.7	527.0	576.5	744.2	339.0	405.2
E-5	1141.7	1064.0	1141.7	501.2	501.2	0.0

MOS = 35C RECRUITS PER YEAR = 2029.0

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	2045.4	0.	0.	2029.0	0.	2029.0
E-2	1882.4	0.	0.	1748.8	0.	1748.8
E-3	1748.1	684.0	752.4	1494.7	643.3	851.4
E-4	2256.5	683.0	747.2	1326.8	439.4	887.5
E-5	2035.5	1897.0	2035.5	893.6	893.6	0.0

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