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# AIR FORCE HUMAN RESOURCES LABORATORY

# INTEGRATION AND APPLICATION OF HUMAN RESOURCE TECHNOLOGIES IN WEAPON SYSTEM DESIGN:

## CONSOLIDATED DATA BASE FUNCTIONAL SPECIFICATION


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AIR FORCE SYSTEMS COMMAND
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## NOTICE



This interim report was submitted by Dynamics Research Corporation, 60 Concord Street, Wilmington, Massachusetts 01887, under contract F33615-77-C-0016, project 1959, with Advanced Systems Division, Air Force Human Resources Laboratory (AFSC), Wright-Patterson Air Force Base, Ohio 45433. Dr. William B. Askren was the Work Unit Scientist.



This technical report has been reviewed and is approved for publication.

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Advanced Systems Division

DAN D. FULGHAM, Colonel, USAF
Commander

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The coordinated human resource technology (CHRT) includes the five human resource technologies of maintenance manpower modeling, instructional system development, job guide development, system ownership costing and human resources in design trade-offs.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

coordinated human resource technology
design option decision trees
human resource in design tradeoffs
instructional system development
job guide development
life cycle costing
maintenance manpower modeling
system ownership costing
task analysis
training (Over)

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

The consolidated data base required to support the application of the coordinated human resource technology (CHRT) on a weapon system acquisition program is described in this functional specification. The major categories of data stored in the consolidated data base relate to reliability, maintainability, maintenance manpower, operations manpower, training, and job guides for both maintenance and operations, and system ownership costs. The consolidated data base may also be used for operational and support planning after deployment. As developed for application, the consolidated data base is unique to each weapon system. It expands in detail with time as the weapon system acquisition cycle progresses. The consolidated data base is dynamic in nature representing alternatives being considered as well as baseline approaches. It has, therefore been designed for frequent update and

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expansion. This functional specification describes the content of the consolidated data base, and the processes for updating and expanding the data base.

SUMMARY

## PROBLEM AND OBJECTIVE

The five human resource technologies (HRT) are maintenance manpower modeling (MMM), instructional system development (ISD), job guide development (JGD), system ownership costing (SOC), and human resources in design tradeoffs (HRDT). Traditionally, they have been applied individually at various times during the weapon system acquisition process. Although one intuitively recognizes similarities in activities and data requirements among these technologies, these similarities had never been confirmed, explored, or exploited. Furthermore, it appears that exploitation of these similarities early in weapon system acquisition may allow human resource considerations to affect design.

The Advanced Systems Division of the Air Force Human Resources Laboratory (AFHRL) has, therefore, initiated a two-phase effort to integrate and apply the five HRTs to the weapon system acquisition process as the coordinated human resource technology (CHRT). This report is one of three which document the Phase I effort. The objective of this phase was twofold. One, to integrate and develop the interrelationships among the five technologies in order to create a totally-coordinated technology, CHRT, for application throughout the acquisition process. Two, to specifically determine the data input requirements and prepare a specification for a consolidated data base (CDB) which will support the integration and application of the CHRT in a weapon system acquisition program. The objective of Phase II is to apply the results of this study to a weapon system acquisition program.

The specific objective of this report is to functionally specify the CHRT consolidated data base (CDB) which is required to support the application of the coordinated human resource technology (CHRT) on a weapon system acquisition program. Since the consolidated data base expands in time with the weapon system acquisition cycle, this functional specification describes the processes for updating and expanding this data base as well as establishing it. Each data base, as developed, is unique to the weapon system it supports.

## APPROACH

The CHRT is a new technology based on the integration of five separate human resource technologies: maintenance manpower modeling (MMM), instructional system development (ISD), job guide

development (JGD), system ownership costing (SOC), and human resources in design tradeoffs (HRDT). The development of CHRT is described in AFHRL-TR-78-6(I), Coordination of Five Human Resource Technologies. Additionally, the application process for CHRT consists of four activities:

1. Development of a consolidated data base (CDB)
2. Performance of an integrated requirements and task analysis
3. Preparation of instructional system and job guide products
4. Performance of impact analysis

The application process and these four activities are detailed in AFHRL-TR-78-6(II), Processes for the Coordinated Application of Five Human Resource Technologies.

The approach taken in developing the consolidated data base functional specification was to perform an analysis of the content of the CHRT methodology and the four basic activities. The detailed steps required to develop and maintain the consolidated data base were identified as those required to provide the data necessary for the accomplishment of activities 2, 3, and 4. The output data from these activities also becomes part of the CDB.

## RESULTS AND CONCLUSIONS

This effort resulted in the specification of the consolidated data base and a description of the detailed steps necessary for its development and maintenance. The development of the consolidated data base consists of many steps, most of which it is significant to note are initial steps in the individual human resource technologies. Although these technologies have been integrated and will be applied in a coordinated manner, they retain their distinct identities and objectives. The coordinated application provides both additional and enhanced products.

Examples of some important steps in the consolidated data base development drawn from MMM are equipment identification, the comparability analysis, and the definition of maintenance action networks. Additionally the initial steps of HRDT which are development of the system design option decision tree, and the selection of critical subsystems are also part of the data base development. New procedures, however, were devised as necessary, especially to implement the interrelationships among the five technologies.

The major categories of data stored in the consolidated data base relate to reliability, maintainability, maintenance manpower, operations manpower, training and job guides for both maintenance and operations, and system ownership cost.

# PREFACE

The Advanced Systems Division of the Air Force Human Resources Laboratory has initiated project 1959, Advanced System for Human Resources Support of Weapon Systems Development, to demonstrate the technical feasibility of methodologies geared to reduce the system ownership cost of new weapon systems. The Advanced Medium STOL Transport (AMST) is being used as the test case. Project 1959 is divided into the following four work units.

01 - Analysis of Resource Utilization of a Present Operational System - Data related to human resource utilization and life cycle costing (LCC) on a similar past weapon system (the C-130E) is gathered and presented. Availability of such data is determined.

02 - Integration and Application of Human Resource Technologies in Weapon System Design - A methodology for integrating the five human resource technologies is developed and subsequently demonstrated on the AMST. The technologies are maintenance manpower modeling, instructional system development, job guide development, system ownership costing, and human resources in design trade-offs.

03 - Maintenance Personnel Availability Analysis - The development of a technique to estimate the availability of human resources over time and of procedures to align availability expectations with requirements. AMST requirements data will be considered.

04 - Personnel Subsystem Test, Evaluation, and Validation - The test, evaluation, and validation of the results of the studies conducted under work units 01, 02, and 03.

Although this total effort is presently directed toward demonstration on a specific weapon system, it is expected that it will be applicable to any system, military or non-military, and to major system modifications as well.

This study which represents work unit 02 was performed under contract F33615-77-C-0016 by the Systems Division of Dynamics Research Corporation, 60 Concord Street, Wilmington, Massachusetts 01887. Technical direction was provided by the Advanced Systems Division, Air Force Human Resources Laboratory (AFHRL), Wright-Patterson Air Force Base, Ohio. Appreciation is extended to Dr. Gordon A. Eckstrand, Director of the Advanced Systems Division and Dr. Ross L. Morgan, Chief of the Personnel and Training

Requirements Branch for their contributions and encouragement. Major Duncan L. Dieterly was the project director and Dr. William B. Askren was the work unit scientist on unit 02, Integration and Application of Human Resource Technologies in Weapon System Design.

Many individuals throughout the Department of Defense and industry contributed their ideas and opinions to this effort. Of special note, however, were the members of the Advanced Systems Division Advisory Team who contributed both in their specific areas of expertise and in the total development of CHRT. These individuals and their areas of expertise are Mr. Robert N. Deem, maintenance manpower modeling; Dr. Garry A. Klein, instructional system development; Dr. Donald L. Thomas, job guide development; Mr. Harry A. Baran, system ownership costing; Dr. William B. Askren, human resources in design trade-offs; and Dr. Lawrence E. Reed, consolidated data base. Major Robert J. Pucik of the AMST Program Office provided the interface with the AMST acquisition effort. Appreciation is also extended to Dr. John P. Foley, Jr., for sharing his view of job guide development and the instructional system/job guide relationship.

This report, consisting of three volumes, is the product of Phase I. The three volumes contain the rationale for integrating the human resources technologies and the methodology for applying them as CHRT. They show how CHRT can be used to influence design and the selection of maintenance, operations, and support alternatives. The evolution of CHRT from elements of existing technologies is discussed. Additionally, specific descriptions are provided of the CDB, the integrated requirements and task analysis (IRTA), the development of ISD and JGD products, and the impact analysis which allows the evaluation of alternative designs and the identification of excessive human resource utilization. The three volumes are:

> Integration and Application of Human Resource Technologies in Weapon System Design: Coordination of Five Human Resource Technologies for Application, AFHRL-TR-78-6, Vol. I;
>
> Integration and Application of Human Resource Technologies in Weapon System Design: Processes for the Coordinated Application of the Five Human Resource Technologies, AFHRL-TR-78-6, Vol. II;

Integration and Application of Human Resource Technologies in Weapon System Design: Consolidated Data Base Functional Specification, AFHRL-TR-78-6, Vol. III.

The first volume initially describes the basic weapon system acquisition process. It then discusses the human resource technologies as presently applied and their interfaces with each other. Next the potential for an expanded application of these technologies within the weapon system acquisition process is described. Finally, CHRT is described as an integration of the human resource technology elements and its proposed role in each acquisition phase is detailed.

The second volume describes the basic activities and associated data inherent in the CHRT methodology. This volume is a detailed expansion of the first. The major processes of CHRT are defined as the consolidated data base development, the integrated requirements and task analysis, product development, and the impact analysis.

The third volume specifies the requirements for the consolidated data base which supports CHRT. It describes the input and output data, the associated sources, the processes, and the interfaces of the CDB with the major process of CHRT.

It should be noted, however, that this total report is the product of the development phase and represents the CHRT methodology as conceived. The methodology will be demonstrated during Phase II and this report updated to reflect the results of the demonstration. The updated version therefore will describe a proven methodology which can be practically applied during system acquisition.

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## Section 1
## SCOPE

### 1.1 PURPOSE

The purpose of this volume is to functionally specify the consolidated data base (CDB) required to support the application of the coordinated human resource technology (CHRT) on a weapon system acquisition program. This CDB may also be used for operational and support planning after deployment. As developed, the consolidated data base is unique to each weapon system. It expands in detail with time as the weapon system acquisition cycle progresses. The CDB is dynamic in nature representing alternatives being considered as well as baseline approaches. It has, therefore, been designed for frequent update and expansion. This functional specification describes the processes for updating and expanding this data base as well as establishing it.

### 1.2 OVERVIEW

The CHRT is a new technology based on the integration of five separate human resource technologies: maintenance manpower modeling (MMM), instructional system development (ISD), job guide development (JGD), system ownership costing (SOC), and human resources in design tradeoffs (HRDT). The development of CHRT is described in AFHRL-TR-78-6(I), Coordination of Five Human Resource Technologies. Additionally, the application process for CHRT consists of four activities:

1. Development of a consolidated data base (CDB)
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The approach taken in developing this consolidated data base functional specification was to perform an analysis of the content of the CHRT methodology and the four basic activities. The detailed steps required to develop and maintain the consolidated data base were identified as those required to provide the data necessary for the accomplishment of activities 2, 3, and 4. The output data from these activities also becomes part of the CDB.

This functional specification for the consolidated data base describes its format, content, and the detailed steps necessary for its development, update, and maintenance. The development of the consolidated data base consists of many steps, most of which it is significant to note are initial steps in the individual human resource technologies. Although these technologies have been integrated and will be applied in a coordinated manner, they retain their distinct identities and objectives. The coordinated application provides both additional and enhanced products.

Examples of some important steps in the consolidated data base development drawn from MMM are equipment identification, the comparability analysis, and the definition of maintenance action networks. Additionally, development of the system design option decision tree and the selection of critical subsystems are examples of initial steps in HRDT which are included as part of data base deployment. New procedures, however, were devised as necessary, especially to implement the interrelationships among the five technologies.

The major categories of data stored in the consolidated data base relate to reliability, maintainability, maintenance manpower, operations manpower, training and job guides for both maintenance and operations, and system ownership cost. Much of this data is required by one or more technologies. Prior to CHRT, each of the five technologies required its own data base. This procedure was redundant and inefficient and often obscured or hindered the desired interface among the technologies. The consolidation of the data base requirements results in a more efficient data handling technique and ensures response of all five technologies to the same data set.

## 1.3 APPLICATION

This specification applies to any system/equipment acquisition program, or major modification program, from the early stages of the conceptual phase through deployment phase. It is intended that this specification be used by both contractor and Government activities in implementing CHRT and/or operational and support planning after deployment. As used in this specification, the term "contractor" includes any Government activity undertaking performance of a task on which this standard is invoked.

At the present time this specification is functional in nature. It contains the concept and basic rationale for the CDB. It does not, however, contain the final details required to establish, maintain, update, and operate the CDB. These details will be finalized during the course of the CHRT demonstration from 15 October 1977 to 15 May 1979.

## Section 2

## REFERENCES

### 2.1 DOCUMENTS

The following documents form a part of this specification to the extent specified herein.

Military Specifications

| | |
|---|---|
| MIL-H-46855 | Human Engineering Requirements for Military Systems, Equipment, and Facilities |

Military Standards

| | |
|---|---|
| MIL-STD-280 | Definition of Item Levels, Item Exchangeability, Models, and Related Terms |
| MIL-STD-470 | Maintainability Program Requirements (for Systems and Equipments) |
| MIL-STD-480 | Configuration Control-Engineering Changes, Deviations, and Waivers |
| MIL-STD-680 | Contractor Standardization Plans and Management |
| MIL-STD-721 | Definitions of Effectiveness Terms for Reliability, Maintainability, Human Factors, and Safety |
| MIL-STD-785 | Reliability Program for Systems and Equipment Development and Production |
| MIL-STD-881 | Work Breakdown Structures for Defense Material Items |
| MIL-STD-1388-1 | Logistic Support Analysis |
| MIL-STD-1388-2 | Logistic Support Analysis Data Element Definitions |

Guides

| | |
|---|---|
| DOD 4100.35-G | Integrated Logistic Support Planning Guide for DoD Systems and Equipment: Requirements For |

Other Publications

| | |
|---|---|
| AFHRL-TR-78-6(I) | The Integration and Application of Human Resource Technologies in Weapon System Design: Coordination of Five Human Resource Technologies |
| AFHRL-TR-78-6(II) | The Integration and Application of Human Resource Technologies in Weapon System Design: Processes for the Coordinated Application of the Five Human Resource Technologies |

| | |
|---|---|
| AFHRL-TR-73-43(I) | Fully Proceduralized Job Performance Aids: Draft Military Specification for Organizational and Intermediate Maintenance |
| Users Handbook | Air Force Logistics Command Logistic Support Cost Model |
| TM 38-710 | Integrated Logistic Support |
| NAVMAT P-4000 | Implementation Guide for DoD |
| AFP 800-7 | Systems and Equipment |

## 2.2 ABBREVIATIONS AND ACRONYMS

Abbreviations and acronyms are contained in Section 8 of this specification.

## 2.3 DEFINITIONS

Definitions contained in Section 8 are key terms and are not to be confused with definitions appearing in other documents. Definitions in Military Standards 280, 480, 721, 881, 1388-1, and 1388-2 shall apply except when in conflict with those herein.

## Section 3

## GENERAL REQUIREMENTS

### 3.1 BASIC GUIDANCE

The consolidated data base is the information source which directly supports the CHRT process. A CDB shall be established and maintained to support the application of CHRT during weapon system acquisition and may be used for operational and support planning after deployment. It shall contain the files and data elements necessary for: the determination of the human resource considerations related to specific designs and alternatives; the identification of designs and policies which create excessive HR demands, and the development of the instructional system development (ISD) and job guide development (JGD) products. The CDB shall also contain a system ownership cost (SOC) model and associated data which when coupled with the human resource parameters will provide representative system ownership cost predictions. The HR parameters determined through CHRT are: reliability ($\overline{R}$), maintainability ($\overline{M}$), maintenance manpower requirements, ISD/JGD scope and magnitude for maintenance, ISD scope and magnitude for operations, and operations manpower requirements.

The CDB shall initially be developed from historical and comparative data, and shall be updated with current acquisition information as it becomes available. Application of CHRT through the CDB results in a systematic rather than intuitive consideration of human resources in the design process. It also provides continuity of method throughout the acquisition process.

### 3.2 PLANNING GUIDANCE

CHRT through its CDB can contribute significantly to the logistic support analysis (LSA) of the integrated logistic support program (ILSP). The CDB can provide much of the information required to support the integrated logistics data file (ILDF) of the LSA. If the particular weapon system acquisition program does not call for an ILDF, then CHRT and its CDB can stand alone. In either context, CHRT results in more specific data derived through a rational process. Through CHRT, these data becomes available earlier in the acquisition process than has been possible with existing techniques.

## 3.3 IMPLEMENTATION GUIDANCE

The AFHRL-TR-78-6 reports entitled, "The Integration and Application of Human Resource Technologies in Weapon System Design"

- "I - Coordination of Five Human Resource Technologies"
- "II - Processes for the Coordinated Application of the Five Human Resource Technologies"

shall be consulted for more detailed guidance concerning the application of CHRT. These reports may be supplemented with the Integrated Logistic Support Implementation Guide for DOD Systems and Equipments and MIL-STD-1388-1. Both of these documents are further identified in paragraph 2.1 under other publications. The above documents may also be consulted for additional background data on system ownership cost, maintenance manpower modeling, instructional system development, job guide documentation, ILS interfaces, typical logistic support models, and the LSA process. The CDB shall be implemented in the initial stage of the conceptual phase and updated and maintained throughout the system acquisition process as described herein.

## 3.4 PRINCIPAL INTERACTIONS

The principal interactions of the CDB are within the CHRT process and are shown in the functional flow diagrams, Figures 4-1 and 4-2. A detailed description is provided in AFHRL-78-6(II) and will not be repeated here. These figures describe the CHRT process in the conceptual and validation phases and in the full scale development phase, respectively. All data on these figures are described within ellipses and are stored in the CDB. The elipses shown are the data which result from the CHRT activities. The principal interactions of the CDB with the CHRT process occur as an output or input to the activities within CHRT. These activities are:

- The CDB Development
- The Integrated Requirements and Task Analysis
- The ISD/JGD Product Development
- The Impact Analysis

The most significant of these is the CDB development activity which encompasses many of the initial steps found in the individual human resource technologies.

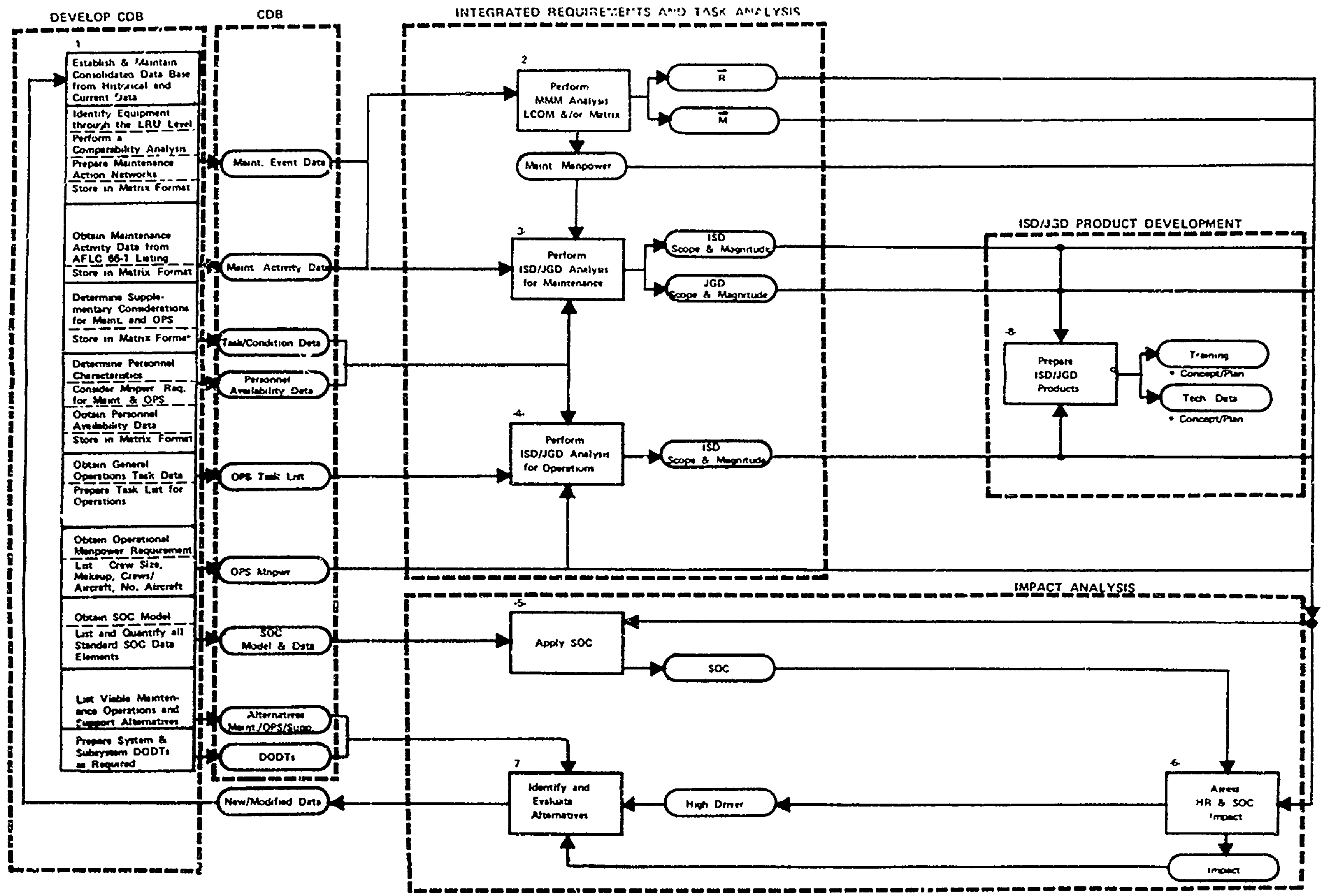


Figure 3-1 THE CHRT PROCESS — CONCEPTUAL AND VALIDATION PHASE

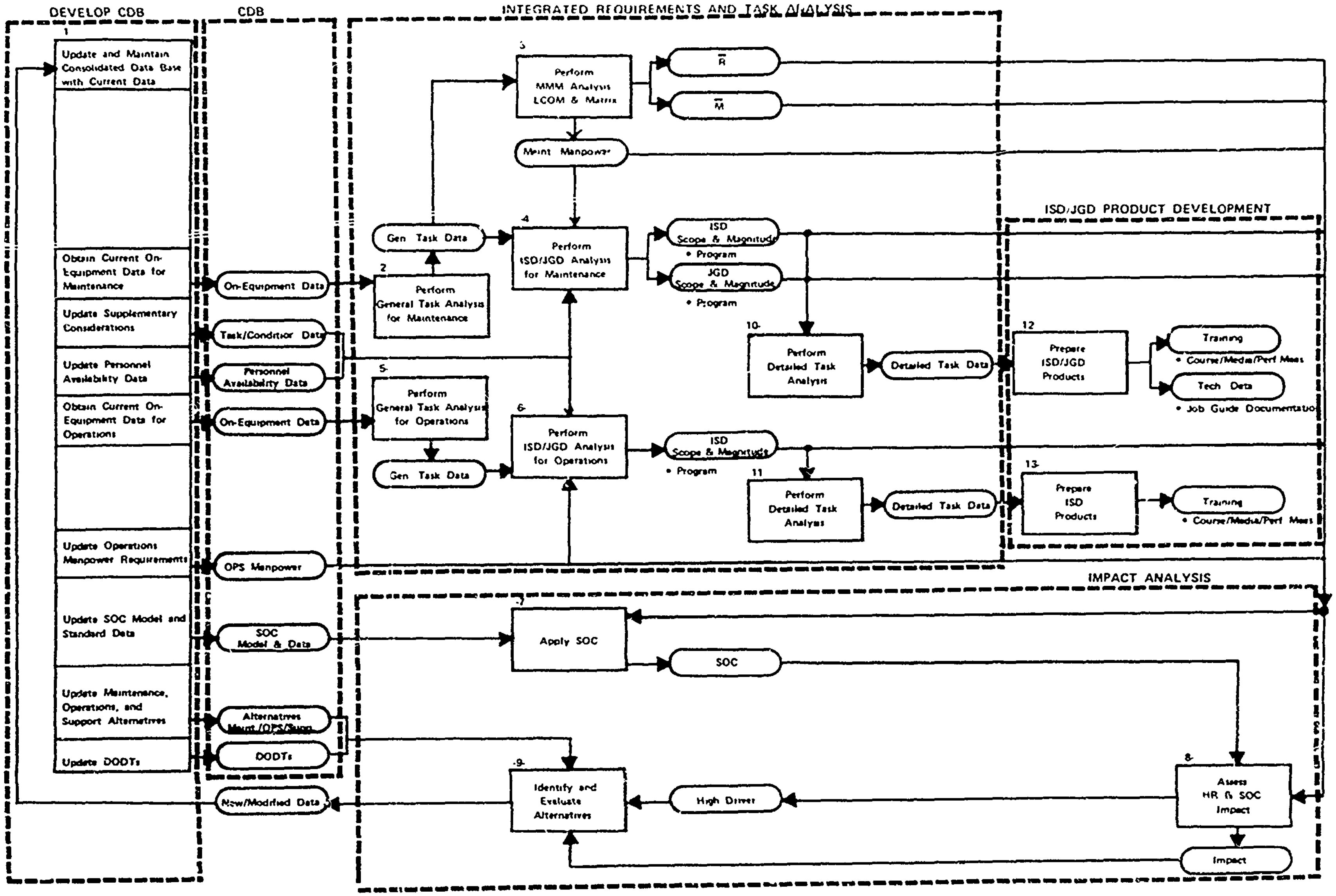


Figure 3-2 THE CHRT PROCESS — FULL SCALE DEVELOPMENT PHASE

Interactions among CHRT, the CDB, design, maintenance, operations, support and cost must also be considered and most importantly coordinated throughout all phases of the weapon system acquisition process. A continuous dialogue must be maintained between engineer, logistician, training representative, and human resource technologist as an inherent and integral part of system development.

## 3.5 WEAPON SYSTEM PROGRAM DATA

The total data available on any specific weapon system program shall be defined as background data. It ranges from general approaches and policies to specific data element values, and provides the design, maintenance, operations, support, and cost information from which the CHRT CDB is constructed. For instance, system/subsystem design option decision trees must be developed, the maintenance manpower modeling data must be evolved and the status and availability of training personnel, facilities, etc., must be established. The specific data element values required for the CDB are drawn and derived from this background data by the CDB development activity.

## 3.6 TYPES OF DATA APPLICABLE TO CHRT

Data applicable to the CHRT process are divided into four types: background, reference, baseline, and current.

### Background Data

Background data consist of all weapon system program data as discussed in paragraph 3.5 and are retained as a supplement to the CDB.

### Reference Data

Reference data applies to a reference weapon system. This can be a similar weapon system or a hypothetical weapon system. The hypothetical weapon system is comprised of similar systems, subsystems, and line replaceable units (LRU) from various weapon systems. The reference system is the one that the new acquisition will specifically replace and consequently must be shown to be less cost effective in the long run. Reference data are compiled in the conceptual phase and retained as a supplement to the CDB. Reference data would not be expected to change since it is normally derived from operations, performance, support, and cost information on existing systems. The data include that shown in Table 3-1.

Table 3-1 REFERENCE DATA EXAMPLES

| Operations | Performance | Support | Cost |
|---|---|---|---|
| Operations History<br><br>Contingency Plans | Technical Orders<br><br>Production Specifications<br>Work Unit Code Manuals | Technical Orders<br><br>Maintenance Data Collection System<br>Table of Allowances<br>Illustrated Parts Breakdown<br>Unit Detail Listing | Historical Logistic Data<br><br>Acquisition Data<br>General Accounting Office Records |

Baseline Data

Baseline data applies to the weapon system approved for further development at a Defense Systems Acquisition Review Council (DSARC) milestone. The baseline data established upon completion of a DSARC are not changed until completion of the next DSARC. Therefore, this baseline established during the conceptual phase is retained throughout validation; the validation baseline throughout full scale development; and so forth. There is no baseline for the conceptual phase. It is during this period that the first baseline, the validation phase baseline, is established. The specific baselines and the background data from which they are drawn and derived are shown below in Table 3-2.

Current Data

Current data applies to the accepted weapon system configuration at any specific time between the baseline of each phase. All manipulation of alternatives is done with the current data. It is the current data that are changed or expanded when an alternative design is selected.

Table 3-2 BASELINE DATA FILE

| Baseline | Data Category | | | |
|---|---|---|---|---|
| Phase | Operations | Performance | Support | Cost |
| Validation | Generalized Operational Requirement | Design Approach | Integrated Logistic Support (ILS) Concept | DSARC I |
| Full Scale Development | Operations Plan | System Specification | ILS Plan | DSARC II |
| Production | Operations Plan | System/ Subsystem Segment Specification | ILS Program | DSARC III |

## 3.7 CDB CONTENT OVERVIEW

The CDB contains only baseline and current system data stored as data elements under specific data files. The contents of the CDB result from actions within the four CHRT activities and normally provide the input to one or more other actions within the same or another CHRT activity. The data elements, their units, format and derivation will be discussed in the following sections. Table 3-3, however, presents an overview of the files contained in the CDB relative to the acquisition phase.

Table 3-3 DATA FILE/APPLICABILITY LIST

| Data File | C/V* | FSD** |
|---|---|---|
| Maintenance Event Data | X | |
| Maintenance Activity Data | X | |
| On-Equipment Data | | |
| Maintenance | | X |
| Operations | | X |
| Task/Condition Data | | |
| Maintenance | X | X |
| Operations | X | X |
| Personnel Availability Characteristics | | |
| Maintenance | X | X |
| Operations | X | X |
| Operations Task List | X | |
| Operations Manpower Requirements | X | X |
| SOC Model and Data | X | X |
| Alternatives List | X | X |
| Design Option Decision Trees | X | X |
| General Task Data | | |
| Maintenance | | X |
| Operations | | X |
| $\overline{R}$ | X | X |
| $\overline{M}$ | X | X |
| Maintenance Manpower Requirements | X | X |
| ISD Scope & Magnitude | | |
| Maintenance | X | X |
| Operations | X | X |
| JGD Scope & Magnitude | X | X |
| Detailed Task Data | | |
| Maintenance | X | X |
| Operations | X | X |
| Training Product | X | X |
| Tech Data Product | X | X |
| SOC Estimate | X | X |
| Impact | X | X |
| High Driver | X | X |
| New/Modified Data | X | X |

* C/V-Conceptual/Validation Phase

** FSD-Full Scale Development Phase

## Section 4

## DETAILED REQUIREMENTS

### 4.1 STRUCTURE

The CDB is structured into groups, subgroups, and files. The groups and subgroups simply allow for the consolidation of similar data. The files contain the data elements which may be values or descriptors. The CHRT CDB structure is shown in Figure 4-1.

### 4.2 FORMAT

Although the details will not be complete until after the demonstration of CHRT, the format of the files within the CDB and all applicable algorithms and processes will be compatible with the CDC 6600 computer. The CHRT CDB files have been listed in Table 3-3. With the exception of the design option decision trees (DODT), the SOC model and on-equipment data which will be treated in separate sections, all files are formatted as listings and matrices. Normally, all data files are cross-referenced by equipment to the LRU level. Alternative cross-references used are Air Force specialty codes and specific tasks.

### 4.3 CONTENT

The content of the CDB will be defined and described below and related directly to the CDB structure. File format is either a listing or matrix as indicated by the file name.

Maintenance Data Group (Task) (1.1)

The maintenance data group consists of task, manpower, and cost subgroups and contains the files listed and described below.

Maintenance Event Matrix (1.1.1)

Maintenance events are defined and coded as indicated in Table 4-1. Maintenance event data are derived directly from the logistic composite model (LCOM) maintenance action network and stored in matrix format. The maintenance events are qualified and/or quantified to the LRU level in the matrices as probability of occurrence, task time, Air Force specialty code (AFSC), skill level required, maintenance crew size and necessary support equipment. The matrix

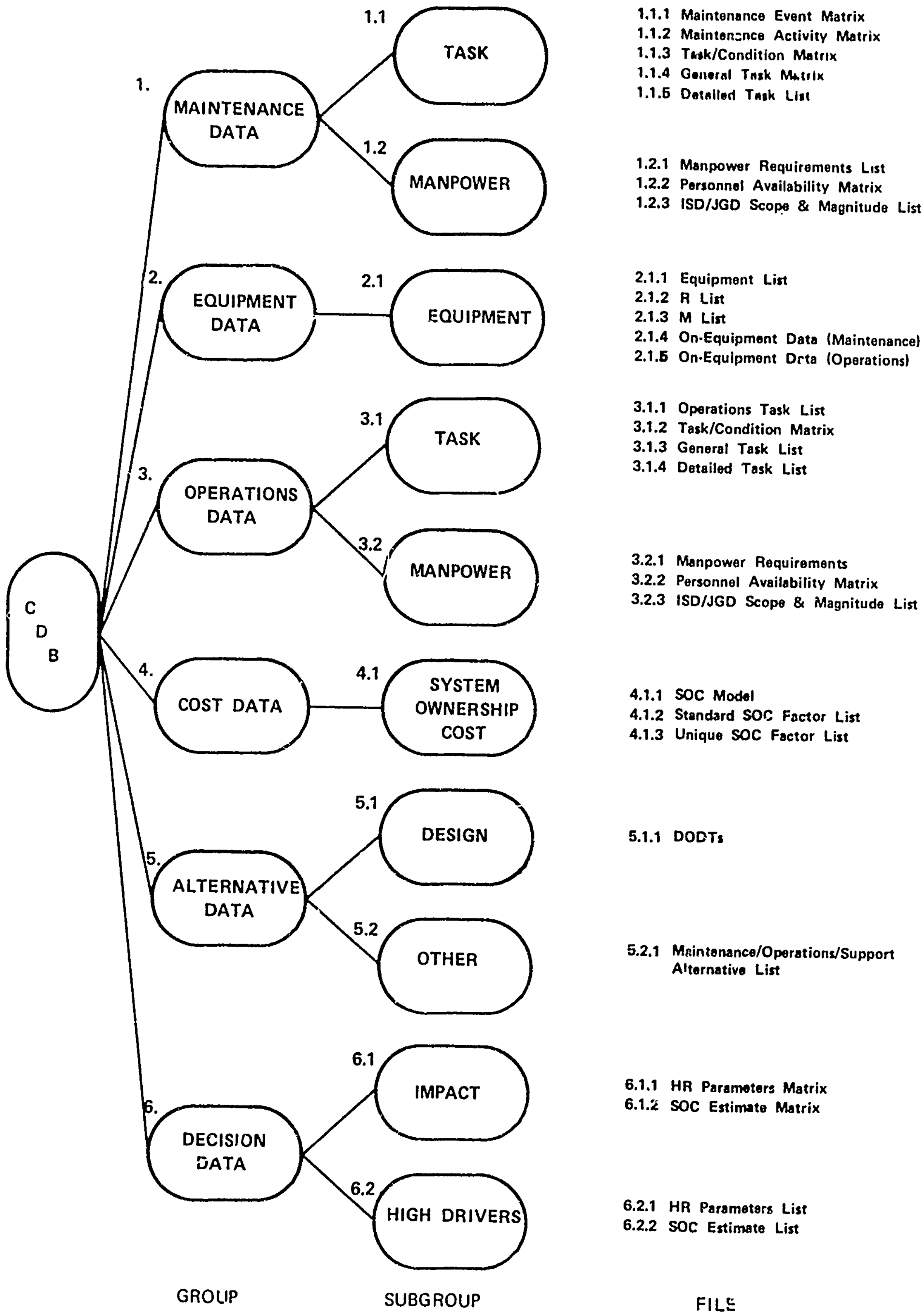


Figure 4-1 CDB STRUCTURE

format is shown in Figure 4-2. The cross-reference is equipment. These matrices are used in the MMM analysis with the R&M model or LCOM and directly in deriving data for the task/condition matrix.

Table 4-1 MAINTENANCE EVENT LISTING

| Code | Maintenance Event |
|---|---|
| A | setup support equipment |
| T | troubleshoot on aircraft (A/C) |
| C | cannot duplicate (CND) on A/C |
| M | minor repair on A/C |
| R | remove and replace (R&R) |
| V | verification of R or M events |
| W | bench check and repair in shop |
| K | bench check and CND in shop |
| N | not repairable this station (NRTS) |
| H | scheduled checks, inspections, or service |

Maintenance Activity Matrix (1.1.2)

Maintenance activities are defined and coded as indicated in Table 4-2. Maintenance activity data are derived directly from the AFLC D056 data system; run D056B5504, Detail Shop Actions for Selected Work Unit Codes; "how malfunctioned" data. Maintenance activities are quantified from the 11-month summary of maintenance actions taken by the number of occurrences for each activity and total hours per activity for both subsystem and LRU. The subsystems and LRUs selected are the same used to develop the maintenance event data. For convenience and compatibility with MMM data, similar maintenance actions (this term is defined in any -06 Work Unit Code Manual) are grouped under the maintenance activities identified in the maintenance activity listing. The matrix format is shown in Figure 4-3. The cross-reference is equipment. These matrices are used in the ISD/JGD analysis for maintenance and also directly in deriving data for the task/condition matrix.

| EQUIPMENT | MAINTENANCE EVENTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Setup Support Equipment (SE) | Troubleshoot on Aircraft (A/C) | Can Not Duplicate on A/C | Repair on A/C | Remove & Replace | Verification | Check & Repair in Shop | Check & Cannot Duplicate in Shop | Not repairable this station (NRTS) |
| | | | | | | | | | |
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Figure 4-2 MAINTENANCE EVENT MATRIX

Table 4-2 MAINTENANCE ACTIVITY LISTING

| Action Taken Code | Maintenance Activity |
|---|---|
| LOO | Adjust/Align |
| JKO | Calibrate |
| VOO | Clean |
| RPQ | Remove & Replace |
| FOO | Repair |
| GOO | Repair and/or Remove Main Parts |
| YHO | Troubleshoot Cannot Duplicate (CND) |
| XOO | Test/Inspect/Service Shop |

Task/Condition Matrix (1.1.3)

The task/condition matrix provides six categories of information for each piece of equipment for use in projecting ISD/JGD requirements. This matrix is shown in Figure 4-4. The cross-reference is again equipment. These six categories are type of maintenance, time to train, information content, ISD/JGD status, criticality, and number of components.

Type of maintenance includes the time (in hours) and the probability of occurrence for both scheduled (S) and unscheduled (U) type maintenance. This information is presented for each maintenance activity to allow subjective judgements regarding behaviors. The data are obtained from the maintenance activity matrix.

Time to train is used to estimate course length, content, and cost. Time-to-train is obtained from existing course data and is measured in terms of the lecture/lab hours spent in task-oriented training.

Content and cost of job guide documentation uses the information content entries for each maintenance activity. These entries indicate the number of pages devoted in current manuals to the various activities and consequently can serve as one of the factors in estimating characteristics of the JGD products.

| | MAINTENANCE ACTIVITY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FLIGHTLINE | | | | | | | | SHOP |
| EQUIPMENT | ADJUST/ALIGN | CALIBRATE | CLEAN | REMOVE & REPLACE | REPAIR | REPAIR &/OR REMOVE MINOR PARTS | TROUBLESHOOT/CND | TEST/INSPECT/SERVICE | BENCH CHECK–REPAIR, CND, or NRTS |
| | | | | | | | | | |
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Figure 4-3 MAINTENANCE ACTIVITY MATRIX

Equipment:

Criticality:

Number of Components:

Conditions:

| | | | MAINTENANCE ACTIVITY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | FLIGHTLINE | | | | | | | | SHOP |
| | | | ADJUST/ALIGN | CALIBRATE | CLEAN | REMOVE & REPLACE | REPAIR | REPAIR &/OR REMOVE MINOR PARTS | TROUBLESHOOT/CND | TEST/INSPECT/SERVICE | BENCH CHECK–REPAIR, CND, or NRTS |
| Information Content | | | | | | | | | | | |
| Type Maint. | S | time | | | | | | | | | |
| | | prob. | | | | | | | | | |
| | U | time | | | | | | | | | |
| | | prob. | | | | | | | | | |
| Special Cases and Notes and Notes | | | | | | | | | | | |

| ISD/ JGD Status | | |
|---|---|---|
| Exists | | |
| To be Mod. | | |
| To be Dev. | | |

Time to Train:

Figure 4-4 TASK/CONDITION MATRIX

The ISD/JGD status is also indicated in the matrix in terms of whether they (1) already exist in the task-oriented form, (2) need only to be modified using existing manuals and task analyses, or (3) must be completely developed.

The criticality factor in the early phases of systems development is probably best indicated by the impact on operational readiness and the cost implications of resources consumed. Readiness is a function of first the probable flight hours between maintenance actions, and then the probable time spent in flightline maintenance before the weapon system is returned to a ready-for-operation condition. A suitable measure of resources consumed is the ratio of maintenance manhours per flight hour.

The number of components that could be causing the malfunction or that have to be serviced, is a reasonable indicator of difficulty. If the number of components is great, expecially in troubleshooting, proceduralized aids should be considered.

General Task Matrix (1.1.4)

The general task matrix replaces both the maintenance event and maintenance activity matrices in the full scale development phase. The general task matrix provides the same data in the same format as the maintenance event matrix and is used in the same manner. It is derived from on-equipment data through the General Task Analysis for maintenance.

Detailed Task List (1.1.5)

The detailed task list for maintenance is derived from the detailed task analysis during the full scale development phase. The content and format of this data is not fully determined. See AFHRL-TR-78-6(II) for additional information.

Maintenance Data Group (Manpower) (1.2)

Manpower Requirements List (1.2.1)

Maintenance manpower requirements are derived in the MMM analysis through either the LCOM simulation or the R&M model. This list presents maintenance manpower requirements in terms of skills and skill levels and number of each required. The cross-reference is equipment and skills.

Personnel Availability Matrix (1.2.2)

Maintenance personnel availability characteristics are presented in the personnel availability matrix shown in Figure 4-5. Personnel requirements are obtained from the manpower requirements list which identifies both the skills and skill levels needed. Background data are then predicted on the future availability of personnel with these skills and skill levels. Development of these data is a CDB activity. The data source is personnel files. With the Personnel Availability Model developed as part of Project 1959-003 (see Preface) or a similar model, one may obtain the data desired. Additionally, each characteristic may also be taken individually for a particular skill and level and a profile prepared for a specific time period. The cross-reference for the personnel availability matrix is skills.

ISD/JGD Scope and Magnitude List (1.2.3)

The ISD/JGD scope and magnitude list for maintenance is derived through the ISD/JGD analysis. During the conceptual and validation phases, the decision is based on comparable data. ISD scope is defined as the number of skills to be qualified by training and for which media will be required. ISD magnitude is time. It is derived for each skill from JGD degree of proceduralization and comparable course length. JGD scope is defined as the number of major subsystems, while magnitude is defined as content. It is derived over all subsystems. See AFHRL-TR-78-6(II) for a discussion of degree of proceduralization and format rating. These same definitions apply in full scale development to initially size the ISD/JGD program. After that time, estimates are based on the contractor developed training and tech data plan.

Equipment Data Group (Equipment) (2.1)

The equipment data group consists of only one subgroup at the present time. There are, however, five separate files.

Equipment List (2.1.1)

The equipment list is established in the CDB as one of the initial steps of MMM. This list is stored in the CDB as an indentured listing of the equipment configuration. It reflects the weapon system design in the same manner as an equipment drawing tree would. This list is used as both a reference and cross-reference and will contain the following:

| | PERSONNEL/SKILL CHARACTERISTICS (average) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Skill Category & Level | Years of Service | Grade | Labor Rate | Age | Scores | Retention | | |
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Figure 4-5 PERSONNEL AVAILABILITY MATRIX

- ID to Work Unit Code for each subsystem and LRU
- Weight per LRU
- National stock number
- AN nomenclature
- Manufacturer's part number
- # LRUs in a subsystem

Reliability ($\overline{R}$) List (2.1.2)

The $\overline{R}$ list is derived within the MMM analysis through the R&M model and is retained for each subsystem and LRU in terms of mean flight hours between maintenance actions (MFHBMA). The cross-reference is equipment and task.

Maintainability ($\overline{M}$) List (2.1.3)

The M list is derived within the MMM analysis through the R&M model and is retained for each subsystem and LRU in terms of mean time to repair per 1000 flight hours (MTTR/KFH).

On-Equipment Data (Maintenance and Operations) (2.1.4 & 2.1.5)

On-equipment data for maintenance and operations will be obtained early in the full scale development phase for use in the general task analysis. This will include an updated equipment listing and all available descriptive and test data. Further discussion of this file is provided in Section 5.

Operations Data Group (Task) (3.1)

The operations data group is very similar in content and use to the maintenance data group. The source of the data, however, is the significant difference. The operations data group consists of two sub-groups, task, and manpower. The files are described below. All are cross-referenced to crew position.

Operations Task List (3.1.1)

Operations task data accumulation is a CDB activity. The data are provided in a listing and are cross-referenced to crew position. The source data from which the data are obtained consist of the Generalized Operational Requirement (GOR) and information on the operation and application of similar systems. The list includes operational tasks such as landings and instrument operation and also the unique operations tasks peculiar to the specific weapon system. In the Advanced Medium Short Takeoff and Landing (STOL) Transport, for instance, assault landings and takeoffs are unique tasks. The operations task list is replaced with the general task data list in the full scale development phase.

Task/Condition Matrix (3.1.2)

The task/condition matrix for operations is similar to that used for maintenance except that unique operational activities are used in lieu of maintenance activities. Since training will be the method used to acquire qualified personnel, and since student personnel will have basically similar skills and levels, it is these unique operational activities that will determine the scope of training and training media in relation to similar training courses.

General Task List (3.1.3)

The general task list provides the same data in the same format as the operations task list and is used in the same manner. The general task list replaces the operations task list in the full scale development phase. It is derived from on-equipment data through the general task analysis for operations.

Detailed Task List (3.1.4)

The detailed task data for operations are derived from the detailed task analysis during the full scale development phase. The content and format of these data are not fully determined. See AFHRL-TR-78-6(II) for additional information.

Operations Data Group (Manpower) (3.2)

Manpower Requirements (3.2.1)

Operations manpower requirements are derived as part of the CDB development directly from the ROC and available operations plans. The former would indicate crew positions while the latter would indicate crew/aircraft ratio and numbers of aircraft.

Personnel Availability Matrix (3.2.2)

Personnel availability characteristics are presented in a matrix similar to that used for maintenance. These characteristics are also derived as part of the CDB development after a review of the operations manpower requirements. The operations personnel data must be obtained directly from Air Force personnel projections. For operations, the emphasis is on retention and turnover in order to adequately size the weapon system training course and determine any potential effect on basic operator training courses.

ISD/JGD Scope and Magnitude List (3.2.3)

The ISD/JGD scope and magnitude list for operations is derived through the ISD/JGD analysis. During the conceptual and validation phases, the decision is based on comparable data. ISD scope is defined as the number of skills to be qualified by training and for which media will be required. JGD scope for the operator (i.e., numbered type of aids) is determined through a judgemental process.

Cost Data Group (System Ownership Cost) (4.1)

The cost data group consists of one subgroup, system ownership cost: this subgroup contains the model and associated data necessary to provide a SOC estimate for any specific configuration. The files are described below and discussed in detail in Section 6.

SOC Model (4.1.1)

A system ownership cost model applicable to the weapon system being acquired shall be established with the CDB. The model consists of the components listed below:

- Support equipment
- Job guides
- LRU spares
- Aircrew
- Fuel
- Depot repair
- Facilities
- Inventory management
- Technical record data
- On-off equipment maintenance
- Personnel training

Standard SOC Factors List (4.1.2)

This list contains cost and cost-related factors required for the SOC model which can be obtained from standard government sources. See Section 6.

Unique SOC Factors List (4.1.3)

This list contains cost and cost-related factors required for the SOC model which are unique to the weapon system being acquired. See Section 6.

Alternative Data Group (5.)

This group identifies viable design, maintenance, operations, and support alternatives, and is separated into two subgroups, design and other. In the design group, points at which alternatives may or will be considered are also identified. The files are described below.

Alternative Data (Design) (5.1)

Design Option Decision Trees (5.1.1)

Design option decision trees are prepared as part of the CDB development activity on the system and selected subsystems. They are graphic in nature and not part of that portion of the CDB which may be computerized. DODTs are discussed in more detail in Section 7.

Alternative Data (Other) (5.2)

Maintenance/Operations/Support Alternative List (5.2.1)

This is a list of viable alternatives prepared during CDB development. Consideration of any one or more of these options will require a reevaluation of CDB contents and reiteration of some processes. These alternatives are in the form of descriptors, e.g., tow-man vs. three-man crew.

Decision Data Group (6.)

The decision data group is the output of the CHRT process and consists of two subgroups, impact and high drivers. Impact data represent the total HR and SOC estimate for any specific configuration. High driver data represent impact data screened for unacceptable HR or SOC estimates.

Decision Data (Impact) (6.1)

HR Parameters Matrix (6.1.1)

An HR parameter matrix is prepared for all baseline configurations and current system(s) considered for DSARC presentation. This matrix is prepared to the subsystem level. HR parameter matrices are also prepared to determine the relative effect of all design, maintenance, operations, or support alternatives considered. These matrices are prepared only to the depth of effect or level of interest, e.g., subsystem or system. This matrix is accomplished by a statement of configuration which includes appropriate design, maintenance, operations, and support descriptors. The HR parameters are presented as quantities and are listed below:

- $\overline{R}$
- $\overline{M}$
- Maintenance Manpower Requirements
- ISD/JGD Scope and Magnitude for Maintenance
- ISD Scope and Magnitude for Operations
- Operations Manpower Requirements

SOC Estimate Matrix (6.1.2)

A SOC estimate matrix is prepared for each HR parameter in the HR parameter matrix. This is in terms of annual cost.

Decision Data (High Drivers) (6.2)

HR Parameters List (6.2.1)

The HR parameters list results from a screening of the HR parameters matrices as they are evolved. The list reflects those HR parameters which are not acceptable or questionable. A notation is made as to the configuration they apply to, the screening level, and to any action taken. The HR parameters are presented as quantities.

SOC Estimate List (6.2.2)

A SOC estimate is provided for each of the system ownership cost components.

## Section 5

## ON-EQUIPMENT DATA

### 5.1 GENERAL

Within the equipment data group, two of the files are: on-equipment data (maintenance) and on-equipment data (operations). These files are created for the CDB early in full scale development and are used in the general task analyses. At the present time only the concept for these files exists which will be developed during the demonstration phase of the study. This section will be updated as the concept evolves.

### 5.2 FORMAT

On-equipment data will consist of both matrices and listings supplemented with physical file data. This is appropriate, since it will be used in judgemental processes, such as the general task analysis.

### 5.3 CONTENT

Although the specifics must be defined, on-equipment data will contain as a minimum:

- Detailed equipment listings
- Specified reliability and maintainability values
- Detailed support equipment listings
- Equipment specifications
- Test data

Additionally, information unique to either maintenance or operations will be retained with the appropriate file. On-equipment data must be adequate for use in the general task analyses maintenance action networks for the MMM analysis, and the ISD/JGD decision.

## Section 6

## COST DATA

### 6.1 GENERAL

System ownership cost is that portion of life cycle costs consisting of the support investment and operating and support costs. This is depicted in Figure 6-1. The addition of R&D and system acquisition costs to system ownership cost, therefore, presents a complete life cycle cost picture.

The CHRT cost data group consists of one subgroup, system ownership cost which contains the following files:

- SOC model
- Standard SOC factors list
- Unique SOC factors list

The SOC model is a series of weapon system dependent cost equations which can provide a SOC estimate to the subsystem level for any or all of the SOC components. The standard and unique SOC factors lists each provide numbers for the various data elements required for the SOC equations.

### 6.2 SOC MODEL

The SOC model is summarized in Figure 6-2 and consists of 11 equations as shown in Figures 6-3 through 6-13. These equations were derived partially by modifying existing equations and partially by generating entirely new equations. In particular, use has been made of the AFHRL and DRC work on the Digital Avionics Information System (DAIS) Life Cycle Cost Study and the existing Air Force Logistics Command (AFLC) Logistic Support Cost Model Users Handbook, dated June 1975. The cost component title, equation designation, and chart location are described below.

| | Cost Component | Equation Designation | Figure No. |
|---|---|---|---|
| 1 | Support Equipment | $C_{SE}$ | 6-2 |
| 2 | Job Guides | $C_{JG}$ | 6-3 |
| 3 | LRU Spares | $C_{LS}$ | 6-4 |
| 4 | Aircrew | $C_{AC}$ | 6-5 |
| 5 | Fuel | $C_{FL}$ | 6-6 |
| 6 | Depot Repair | $C_{DR}$ | 6-7 |

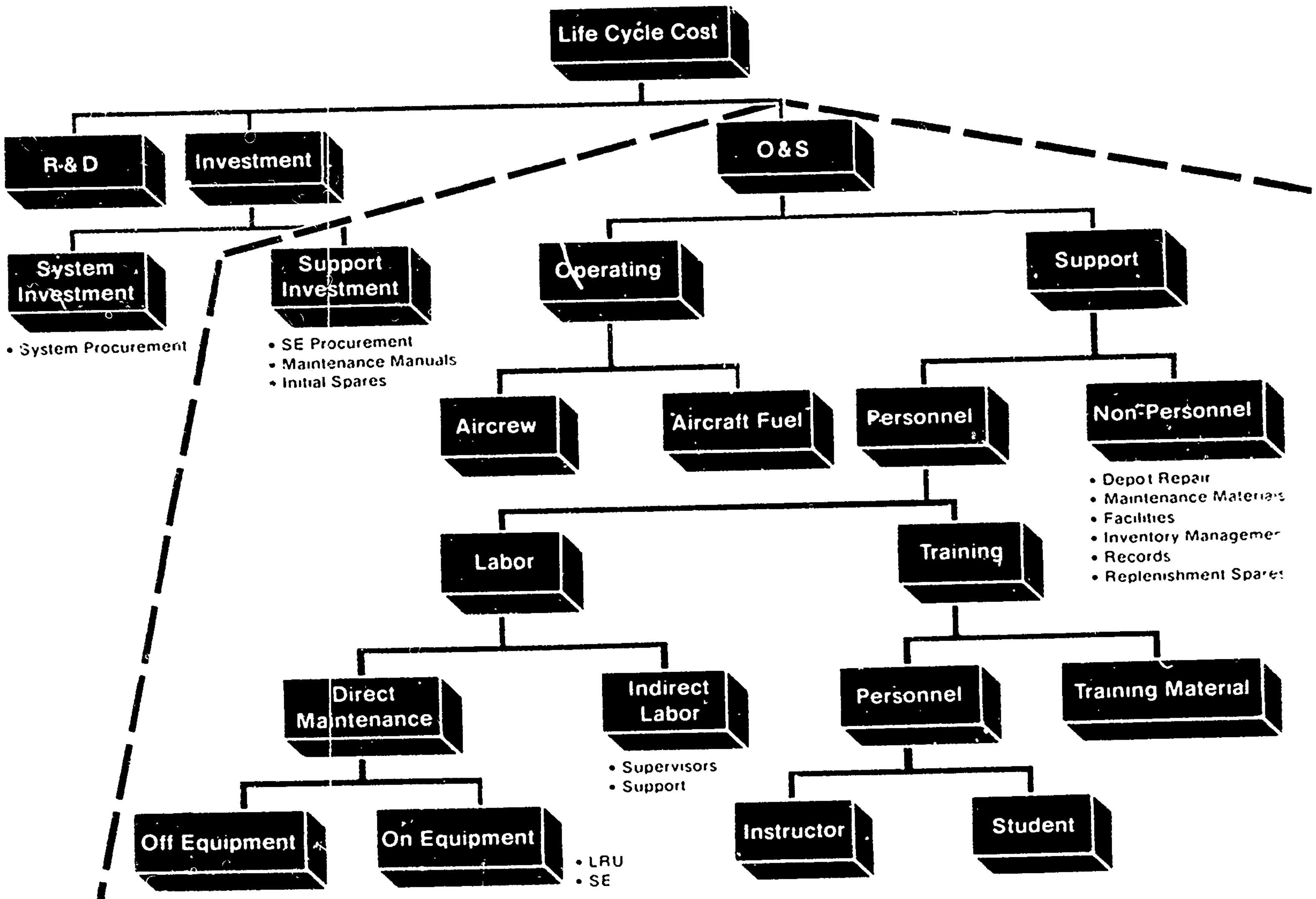



Figure 6-1 HIERARCHY OF LIFE CYCLE COST

SYSTEM OWNERSHIP COST* = SUPPORT INVESTMENT COSTS* + OPERATING COSTS* + SUPPORT COSTS*

SUPPORT INVESTMENT COSTS* = $C_{SE} + C_{JG} + C_{LS}$

$C_{SE}$ = COST OF SUPPORT EQUIPMENT
$C_{JG}$ = COST OF JOB GUIDES
$C_{LS}$ = COST OF LRU SPARES

O&S OPERATING COSTS = $C_{AC} + C_{FL}$

$C_{AC}$ = COST OF AIRCREW
$C_{FL}$ = COST OF FUEL

O&S SUPPORT COSTS = $C_{DR} + C_{FA} + C_{IM} + C_{TR} + C_{EM} + C_{PT}$

$C_{DR}$ = COST OF DEPOT REPAIRS

$C_{FA}$ = COST OF FACILITIES
$C_{IM}$ = COST OF INVENTORY MANAGEMENT
$C_{TR}$ = COST OF TECHNICAL RECORD DATA
$C_{EM}$ = COST OF ON-OFF EQUIPMENT MAINTENANCE
$C_{PT}$ = COST OF PERSONNEL TRAINING

*All costs expressed in annual dollars, i.e., dollars/year

Figure 6-2 THE SYSTEM OWNERSHIP COST MODEL FOR CHRT

| | | | |
|---|---|---|---|
| 7 | Facilities | $C_{FA}$ | 6-8 |
| 8 | Inventory Management | $C_{IM}$ | 6-9 |
| 9 | Technical Record Data | $C_{TR}$ | 6-10 |
| 10 | On-Off Equipment Maintenance | $C_{EM}$ | 6-11 |
| 11 | Personnel Training | $C_{PT}$ | 6-12 |

The SOC model must be reviewed for applicability to each weapon system with which it is used. Where necessary it must be tailored to fit a particular system. This is done in the conceptual phase. No further changes should be made to the model after it is initially established unless absolutely necessary. The principal advantage of the model, continuity throughout acquisition, and the ability to perceive relative differences is more important than absolute accuracy.

The SOC model describes a process and is not a file. It is stored with the CDB and called upon when necessary. To provide a cost estimate, the SOC model requires numerical data to satisfy each data element. Table 6-1 lists all data elements in the basic SOC equations, their units, the equations they are used in, qualifies them as standard or unique and will identify for the appropriate acquisition phase the source of the numerical value.

## 6.3 STANDARD SOC FACTOR LIST

The base for these data elements consists of many standard Government sources such as pay and allowance tables, AFM 137-10, etc. The standard SOC factor list contains the cost and cost related data elements required to operate the SOC model. In many cases these data elements themselves are the product of some sub-operation. The standard data elements are listed in Table 6-1 without an asterisk. Sub-operations will be detailed and sources not indicated will be identified in the final report.

## 6.4 UNIQUE SOC FACTOR LIST

The base for these data elements consists of data unique to the weapon system being acquired such as operation plans, specifications, comparability analyses, etc. The unique SOC factor list contains the cost and cost related data elements required to operate the SOC model. In many cases these data elements, also, are the product of some sub-operation. The unique data elements are listed in Table 6-1 with an asterisk preceeding them. Sub-operations will be detailed and sources not indicated will be identified in the final report.

$$C_{SE} = \sum_{j=1}^{K} \underbrace{(NSER_j)(UCSE_j)\left[\frac{1}{PIUP} + MSE_j\right]}_{\text{cost per unit of SE}} + \underbrace{\frac{M[BCA + BPA + FLA] + CS + IH}{PIUP}}_{\text{other base-level SE costs}}$$

$NSER_j$ = number of peculiar support equipment required

UCSE = unit cost of peculiar SE at base level

PIUP = operational service life of the weapon system (Program Inventory Usage Period)

MSE = factor, as a fraction of SE unit cost, representing annual non-personnel cost of maintaining SE

M = number of operating base locations

BCA = total cost of additional items of common base shop support equipment per base required for the system

BPA = total cost of peculiar base shop support equipment per base required for the system which is not directly related to repair of specific LRUs or when the quantity required is independent of the anticipated workload (such as: overhead cranes and shop fixtures)

FLA = total cost of peculiar flightline support equipment and additional items of common flightline support equipment per base required for the system

CS = cost of software to utilize existing Automatic Test Equipment for the system

IH = cost of interconnection hardware to utilize existing Automatic Test Equipment for the system

j = subscript identifying $j^{th}$ group of peculiar support equipment (where 1, 2, 3, . . . j . . . K)

K = number of units of peculiar support equipment for supporting LRUs

Figure 6-3 ANNUAL COST OF SUPPORT EQUIPMENT, $C_{SE}$

$$C_{JG} = \frac{1 + FJG}{PIUP} \left[ \sum_{m=1}^{z} \overbrace{[(NLRU_m)(CTF) + (NMFF_m)(CNTF) + COGF]}^{\text{Cost of flightline job guide}} + \sum_{i=1}^{N} \overbrace{[(NSRU_i)(CTS) + (NMTF_i)(CNTS) + COGS]}^{\text{Cost of shop job guide}} \right]$$

PIUP = operational service life of the weapon system (Program Inventory Usage Period)

FJG = factor, as a fraction of job guide costs, representing cost of general material found in job guide

NLRU = number of LRUs in $m^{th}$ subsystem

CTF = cost per LRU for flightline troubleshooting maintenance job guide

NMFF = number of flightline non-troubleshooting maintenance functions

CNTF = cost per maintenance function for flightline non-troubleshooting job guide

COGF = cost of graphics for flightline non-troubleshooting job guide

NSRU = number of SRUs in $i^{th}$ LRU

CTS = cost per SRU for shop troubleshooting maintenance job guide

NMFS = number of shop non-troubleshooting maintenance functions

CNTS = cost per maintenance function for shop non-troubleshooting job guide

COGS = cost of graphics for shop non-troubleshooting job guide (zero if the number of SRUs equal zero)

i = subscript identifying $i^{th}$ LRU (where 1, 2, 3, . . . i . . . N)

N = number of different LRUs within the system

m = subscript identifying $m^{th}$ subsystem (where 1, 2, 3, . . . m . . . Z)

Z = number of different subsystems in the system

Figure 6-4 ANNUAL COST OF JOB GUIDES, $C_{JG}$

$$C_{LS} = \frac{M}{PIUP} \sum_{i=1}^{N} \overbrace{(STK_i)(UC_i)}^{\text{cost of pipeline spares}} + \sum_{i=1}^{N} \frac{\overbrace{(AFH)(QPA_i)(UF_i)(COND_i)(UC_i)}^{\text{cost of replacement spares}}}{MTBMA_i}$$

M = number of operating base locations

PIUP = operational service life of the weapon system in years (Program Inventory Usage Period)

STK = number of spares of LRU required for each base to fill the base repair pipelines including a safety stock to protect against random fluctuations in demand

UC = expected unit cost of the LRU at the time of initial provisioning

AFH = average force flying hours on an annual basis

QPA = quantity of like LRUs within the parent sytem (quantity per application)

UF = ratio of operating hours to flying hours for the LRU (use factor)

COND = fraction of removed LRUs expected to result in condemnation at base level

MTBMA = mean time between maintenance actions

i = subscript identifying $i^{th}$ LRU (where 1, 2, . . . i . . . N)

N = number of different LRUs within the system

Figure 6-5 ANNUAL COST OF LRU SPARES, $C_{LS}$

$$C_{AC} = \overbrace{(CPA)(OA)}^{\text{no. of crews}} \sum_{p=1}^{P} \overbrace{(ABPR_p + YOSR_p + BAQ_p + ACI_p + BAS_p)}^{\text{cost of aircrewman}}$$

ABPR = annual base pay rate

YOSR = years of service pay adder

BAQ = basic allowance for quarters

ACI = aviation career incentive pay

BAS = basic allowance for subsistance

CPA = number of crews per aircraft

OA = number of operational aircraft in fleet

p = subscript identifying the $p^{th}$ member of the aircrew

P = number of members in aircrew

Figure 6-6 ANNUAL COST OF AIRCREW, $C_{AC}$

$$C_{FL} = \overbrace{(AFH)(EPA)(FR)}^{\text{fuel consumed}}(FC)$$

AFH = annual force flying hours

EPA = number of engines per aircraft

FR = fuel consumption rate of one engine in gallons per flying hour

FC = fuel cost per gallon

Figure 6-7 ANNUAL COST OF FUEL, $C_{FL}$

$$C_{DR} = \sum_{i=1}^{N} \frac{\overbrace{(AFH)(QPA_i)(UF_i)(NRTS_i)}^{\text{number of depot repairs}}}{MTBMA_i} DC_i$$

AFH = annual force flying hours

QPA = quantity of like LRUs within parent system (quantity per application)

NRTS = fraction of removed LRUs expected to be returned to depot for repair

UF = ratio of operating hours to flying hours for the LRU (use factor)

MTBMA = mean time between maintenance action

DC = depot repair cost for LRU or its SRUs

i = subscript identifying $i^{th}$ LRU (where 1, 2, . . . i , . . . N)

N = number of different LRUs within the system

Figure 6-8 ANNUAL COST OF DEPOT REPAIR, $C_{DR}$

$$C_{FA} = \frac{(M)(FB)}{PIUP}$$

M = number of operating base locations

FB = total cost of new base facilities

PIUP = operational service life of the weapon system in years (Program Inventory Usage Period)

Figure 6-9 ANNUAL COST OF FACILITIES, $C_{FA}$

$$C_{IM} = \left(\frac{IMC}{PIUP} + RMC\right)\left[\sum_{i=1}^{N} \overbrace{(1 + PA_i + PP_i)}^{\text{new USAF inventory items}} + (M)(SA)\sum_{i=1}^{N} \overbrace{(1 + PA_i + PP_i + SP_i)}^{\text{base-level inventory items}}\right]$$

IMC = initial management cost to introduce a new line item of supply (assembly or piece part) into the Air Force inventory

PIUP = operational service life of the weapon system in years (program inventory usage period)

RMC = annual management cost to maintain a line item of supply (assembly or piece part) in the wholesale inventory system

PA = number of new "p" coded repairable assemblies within the LRU

PP = number of new "p" coded consumable items within the LRU

M = number of operating base locations

SA = annual base supply line item inventory management cost

SP = number of standard (already stock-numbered) parts within the LRU which will be managed for the first time at bases where this system is deployed

i = subscript identifying $i^{th}$ LRU (where 1, 2, . . . i, . . . N)

N = number of different LRUs within the system

Figure 6-10 ANNUAL COST OF INVENTORY MANAGEMENT, $C_{IM}$

$$C_{TR} = BLR \left\{ \sum_{m=1}^{Z} \overbrace{\frac{(AFH)(UF_m)}{MTBMA_m} \left[ MRO + LRF_m(MRF + SR + TR) \right]}^{\text{manhours for unscheduled maintenance records}} + \overbrace{\frac{AFH}{SMI} \left[ MRO + PRSM(SR + TR) \right]}^{\text{manhours for scheduled maintenance records}} \right\}$$

BLR = average base labor rate

AFH = annual force flying hours

UF = ratio of operating hours to flying hours (use factor)

MTBMA = mean time between maintenance actions

MRO = average manhours per failure to complete on-equipment maintenance records

LRF = probability of a LRU removal on the flightline

MRF = average manhours per failure to complete off-equipment maintenance records

SR = average manhours per failure to complete supply transaction records

TR = average manhours per failure to complete transportation transaction forms

SMI = flying hour interval between scheduled periodic or phased inspections on the system

PRSM = probability of a repair action resulting from an unscheduled maintenance action

m = subscript identifying $m^{th}$ subsystem (where 1, 2, 3, . . . m . . . Z)

Z = number of different subsystems in the system

Figure 6-11 ANNUAL COST OF TECHNICAL RECORD DATA, $C_{TR}$

$$C_{EM} = \sum_{n=1}^{Y} \sum_{m=1}^{Z} \frac{(AFH)(MMH_{mn})}{EFF} [DLR_n + ILR_n] + (AFH)(MAT)(m)$$

EFF = percentage of maintenance manhours devoted to direct labor

AFH = annual force flying hours

MMH = maintenance manhours per flight hour

DLR = direct labor rate

ILR = indirect labor rate

MAT = material costs

m = subscript identifying $m^{th}$ group of identical subsystems (where 1, 2, 3, . . . m . . . Z)

Z = number of different subsystems in the system

n = subscript identifying $n^{th}$ particular skill category and level (where 1, 2, . . . n . . . Y)

Y = number of different skill categories and levels

Figure 6-12 ANNUAL COST OF ON-OFF EQUIPMENT MAINTENANCE, $C_{EM}$

$$C_{PT} = \sum_{n=1}^{Y} \sum_{m=1}^{Z} \left(\frac{1}{PIUP} + TRS_n\right) \overbrace{\frac{(AFH)(MMH_{mn})}{PMB}}^{\text{manpower utilization}} TCS_n + \overbrace{\frac{NRTC}{PIUP}}^{\text{nonrecurring training}}$$

PIUP = operational service life of the weapon system in years (Program Inventory Usage Period)

TRS = annual turnover rate of airmen in each skill category and level

AFH = annual force flying hours

MMH = maintenance manhours per flight hour

PMB = direct productive manhours per man per year at base level

TCS = cost of training an airman for each skill category and level

NRTC = non-recurring training costs

m = subscript identifying the $m^{th}$ subsystem (where 1, 2, 3, . . . m, . . . Z)

Z = number of different subsystems in the system

n = subscript identifying $n^{th}$ particular skill category and level (where 1, 2, . . . n, . . . Y)

Y = number of different skill categories and levels

Figure 6-13 ANNUAL COST OF PERSONNEL TRAINING, $C_{PT}$

| Data Element (Units) | SOC Equation | | | | | | | | | | | Data Source | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $C_{AC}$ | $C_{FL}$ | $C_{DR}$ | $C_{EM}$ | $C_{FA}$ | $C_{IM}$ | $C_{LS}$ | $C_{JG}$ | $C_{PT}$ | $C_{SE}$ | $C_{TR}$ | Conceptual/ Validation Phase | Full Scale Development Phase |
| ABPR (dollars/year)<br>Annual Base Pay Rate | x | | | | | | | | | | | | |
| ACI (dollars/year)<br>Aviation Career Incentive Pay | x | | | | | | | | | | | | |
| *AFH (hours/year)<br>Annual Force Flying Hours | | x | x | x | | | x | | x | | x | | |
| BAQ (dollars/year)<br>Basic Allowance for Quarters | x | | | | | | | | | | | | |
| BAS (dollars/year)<br>Basic Allowance for Subsistance | x | | | | | | | | | | | | |
| *BCA (dollars/base)<br>Total cost of additional items of common base shop support equipment per base required for the system | | | | | | | | | | x | | | |
| *BLR (dollars/hour)<br>Base Labor Rate | | | | | | | | | | | | | |
| *BPA (dollars/base)<br>Total cost of peculiar base shop support equipment per base required for the system which is not directly related to repair of specific LRUs or when the quantity required is independent of the anticipated workload (such as: overhead cranes and shop fixtures) | | | | | | | | | | x | | | |

*unique

Table 6-1 STANDARD AND UNIQUE SOC DATA ELEMENTS

| Data Element (Units) | SOC Equation | | | | | | | | | | | Data Source | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $C_{AC}$ | $C_{FL}$ | $C_{DR}$ | $C_{EM}$ | $C_{FA}$ | $C_{IM}$ | $C_{LS}$ | $C_{JG}$ | $C_{PT}$ | $C_{SE}$ | $C_{TR}$ | Conceptual/ Validation Phase | Full Scale Development Phase |
| CNTF (dollars/function) Cost per maintenance function for flightline non-troubleshooting manual | | | | | | | | x | | | | | |
| CNTS (dollars/function) Cost per maintenance function for shop non-troubleshooting manual | | | | | | | | x | | | | | |
| COGF (dollars) Cost of graphics for flightline non-troubleshooting job guide | | | | | | | | x | | | | | |
| COGS (dollars) Cost of graphics for shop non-troubleshooting job guide | | | | | | | | x | | | | | |
| COND Fraction of removed LRUs expected to result in condemnation at base level | | | | | | | x | | | | | | |
| *CPA Number of crews per aircraft | x | | | | | | | | | | | | |
| *CS (dollars) Cost of software to utilize existing automatic test equipment for the system | | | | | | | | | | x | | | |
| CTF (dollars/LRU) Cost per LRU for flightline troubleshooting manual | | | | | | | | x | | | | | |

*unique

Table 6-1 (continued)

| Data Element (Units) | SOC Equation | | | | | | | | | | | Data Source | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $C_{AC}$ | $C_{FL}$ | $C_{DR}$ | $C_{EM}$ | $C_{FA}$ | $C_{IM}$ | $C_{LS}$ | $C_{JG}$ | $C_{PT}$ | $C_{SE}$ | $C_{TR}$ | Conceptual/ Validation Phase | Full Scale Development Phase |
| DC (dollars/LRU) Depot repair cost for LRU or its SRUs (loaded, including shipping) | | | x | | | | | | | | | | |
| *DLR (dollars/hour) Direct Labor Rate | | | | x | | | | | | | | | |
| EBO Established standard for expected backorders | | | | | | | x | | | | | | |
| *EFA Number of engines per aircraft | | x | | | | | | | | | | | |
| *FB (dollars/base) Total cost of new base facilities | | | | | x | | | | | | | | |
| FC (dollars/gallon) Fuel cost per gallon | | x | | | | | | | | | | | |
| FJG Factor, as a fraction of job guide costs, representing cost of general material found in job guide | | | | | | | | x | | | | | |
| *FLA (dollars/base) Total cost of peculiar flightline support equipment and additional items of common flightline support equipment per base required for the system | | | | | | | | | | x | | | |

*unique

Table 6-1 (continued)

| Data Element (Units) | SOC Equation | | | | | | | | | | | Data Source | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $C_{AC}$ | $C_{FL}$ | $C_{DR}$ | $C_{EM}$ | $C_{FA}$ | $C_{IM}$ | $C_{LS}$ | $C_{JG}$ | $C_{PT}$ | $C_{SE}$ | $C_{TR}$ | Conceptual/ Validation Phase | Full Scale Development Phase |
| *FR<br>Fuel consumption rate of one engine in gallons per flying hour | | x | | | | | | | | | | | |
| *IH (dollars)<br>Cost of interconnection hardware to utilize existing Automatic Test Equipment for the system | | | | | | | | | | x | | | |
| *ILR (dollars/hour)<br>Indirect Labor Rate | | | | x | | | | | | | | | |
| IMC (dollars/assembly)<br>Initial management cost to introduce a new line item of supply (assembly or piece part) into the Air Force Inventory | | | | | | x | | | | | | | |
| *K<br>Number of items of peculiar shop equipment for supporting LRUs | | | | | | | | | | x | | | |
| LRF<br>Probability of LRU removal on the flightline per maintenance action | | | | | | | | | | | x | | |
| *M (bases)<br>Number of operating base locations | | | | | x | x | x | | | x | | | |
| *MAT (dollars/hour)<br>Material costs | | | | | | | | | | | | | |

*unique

Table 6-1 (continued)

| Data Element (Units) | SOC Equation | | | | | | | | | | | Data Source | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $C_{AC}$ | $C_{FL}$ | $C_{DR}$ | $C_{EM}$ | $C_{FA}$ | $C_{IM}$ | $C_{LS}$ | $C_{JG}$ | $C_{PT}$ | $C_{SE}$ | $C_{TR}$ | Conceptual/ Validation Phase | Full Scale Development Phase |
| *MMH Maintenance manhours per maintenance action | | | | | x | | | | x | | | | |
| *MRF (hours/failure) Average manhours per failure to complete off-equipment | | | | | | | | | | | x | | |
| MRO (hours/failure) Average manhours per failure to complete on-equipment maintenance records | | | | | | | | | | | x | | |
| *MSE Annual cost factor (fraction of UCSE) to operate + maintain support equipment | | | | | | | | | | x | | | |
| *MTBMA (hours/action) Mean time between maintenance action | | | x | | | | x | | | | x | | |
| *NLRU Number of LRUs in $m^{th}$ subsystem | | | | | | | | | x | | | | |
| NMFF Number of flightline non-troubleshooting functions | | | | | | | | | | | | | |
| *NMFS Number of shop non-troubleshooting functions | | | | | | | | x | | | | | |
| *NRTC (dollars) Non-recurring training costs | | | | | | | | | x | | | | |

*unique

Table 6-1 (continued)

| Data Element (Units) | SOC Equation | | | | | | | | | | | Data Source | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $C_{AC}$ | $C_{FL}$ | $C_{DR}$ | $C_{EM}$ | $C_{FA}$ | $C_{IM}$ | $C_{LS}$ | $C_{JG}$ | $C_{PT}$ | $C_{SE}$ | $C_{TR}$ | Conceptual/ Validation Phase | Full Scale Development Phase |
| *NRTS<br>Fraction of removed LRUs expected to be returned to the depot for repair | | | x | | | | | | | | | | |
| *NSER<br>Number of peculiar support equipment required | | | | | | | | | | x | | | |
| *NSRU<br>Number of SRUs in the ith LRU | | | | | | | | | x | | | | |
| *OA<br>Number of operation aircraft in fleet | x | | | | | | | | | | | | |
| *PA<br>Number of new "p" coded repairable assemblies within the LRU | | | | | | x | | | | | | | |
| *PIUP<br>Operational service life of the weapon system in years (program inventory usage period) | | | | | x | x | | x | x | x | | | |
| PMB (hours/man(years))<br>Direct productive manhours per man per year at base level (includes "touch time" and transportation time) | | | | | | | | | x | | | | |
| *PP<br>Number of new "p" coded consumable items within the LRU | | | | | | x | | | | | | | |

*unique

Table 6-1 (continued)

| Data Element (Units) | SOC Equation | | | | | | | | | | | Data Source | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $C_{AC}$ | $C_{FL}$ | $C_{DR}$ | $C_{EM}$ | $C_{FA}$ | $C_{IM}$ | $C_{LS}$ | $C_{JG}$ | $C_{PT}$ | $C_{SE}$ | $C_{TR}$ | *Conceptual/ Validation Phase* | *Full Scale* Development Phase |
| *PRSM<br>Probability of a repair action resulting from an unscheduled maintenance action | | | | | | | | | | | x | | |
| *QPA<br>Quantity of like LRUs within present system | | | x | | | | x | | x | | | | |
| *RMC (dollars year (assembly))*<br>Recurring management cost to maintain a line item of supply (assembly or piece part) in the wholesale inventory system | | | | | | x | | | | | | | |
| *SA (dollars/year)/(base)/ (assembly)*<br>Annual base supply line item inventory management cost | | | | | | x | | | | | | | |
| *SKI<br>Number of spares of LRU required for each base to fill the base repair pipelines including a safety stock to protect against random fluctuations in demand (see below for calculation of $STK_i$) | | | | | | | x | | | | | | |
| *SMI (hours/failure)<br>Flying hour interval between scheduled periodic or phased inspections on the system | | | | | | | | | | | x | | |

**unique*

Table 6-1 (continued)

| Data Element (Units) | SOC Equation | | | | | | | | | | | Data Source | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $C_{AC}$ | $C_{FL}$ | $C_{DR}$ | $C_{EM}$ | $C_{FA}$ | $C_{IM}$ | $C_{LS}$ | $C_{JG}$ | $C_{PT}$ | $C_{SE}$ | $C_{TR}$ | Conceptual/ Validation Phase | Full Scale Development Phase |
| *SP<br>Number of standard (already stock-numbered) parts within the LRU which will be managed for the first time at bases where this system is deployed | | | | | | x | | | | | | | |
| SR (hours/failure)<br>Average manhours per failure to complete supply transaction records | | | | | | | | | | | x | | |
| TCS (dollars/airman)<br>Cost of training an airman for each skill category and level | | | | | | | | | x | | | | |
| TR (hours/failure)<br>Average manhours per failure to complete transportation transaction forms | | | | | | | | | | | x | | |
| TRS (factor/year)<br>Annual turnover rate of airman for each skill category and level | | | | | | | | | x | | | | |
| *UC (dollars/LRU)<br>Expected unit cost of the LRU at the time of initial provisioning | | | | | | | x | | | | | | |
| *UCSE (dollars/SE)<br>Unit cost of a peculiar SE at base | | | | | | | | | | x | | | |
| *UF<br>Ratio of operating hours to flying hours for the LRU (use factor) | | | x | | | | x | | | | x | | |

*unique

Table 6-1 (continued)

| Data Element (Units) | SOC Equation | | | | | | | | | | | Data Source | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $C_{AC}$ | $C_{FL}$ | $C_{DR}$ | $C_{EM}$ | $C_{FA}$ | $C_{IM}$ | $C_{LS}$ | $C_{JG}$ | $C_{PT}$ | $C_{SE}$ | $C_{TR}$ | Conceptual/ Validation Phase | Full Scale Development Phase |
| YOSR (dollars/year)<br>Years of service pay adder | x | | | | | | | | | | | | |

Table 6-1 (continued)

## Section 7

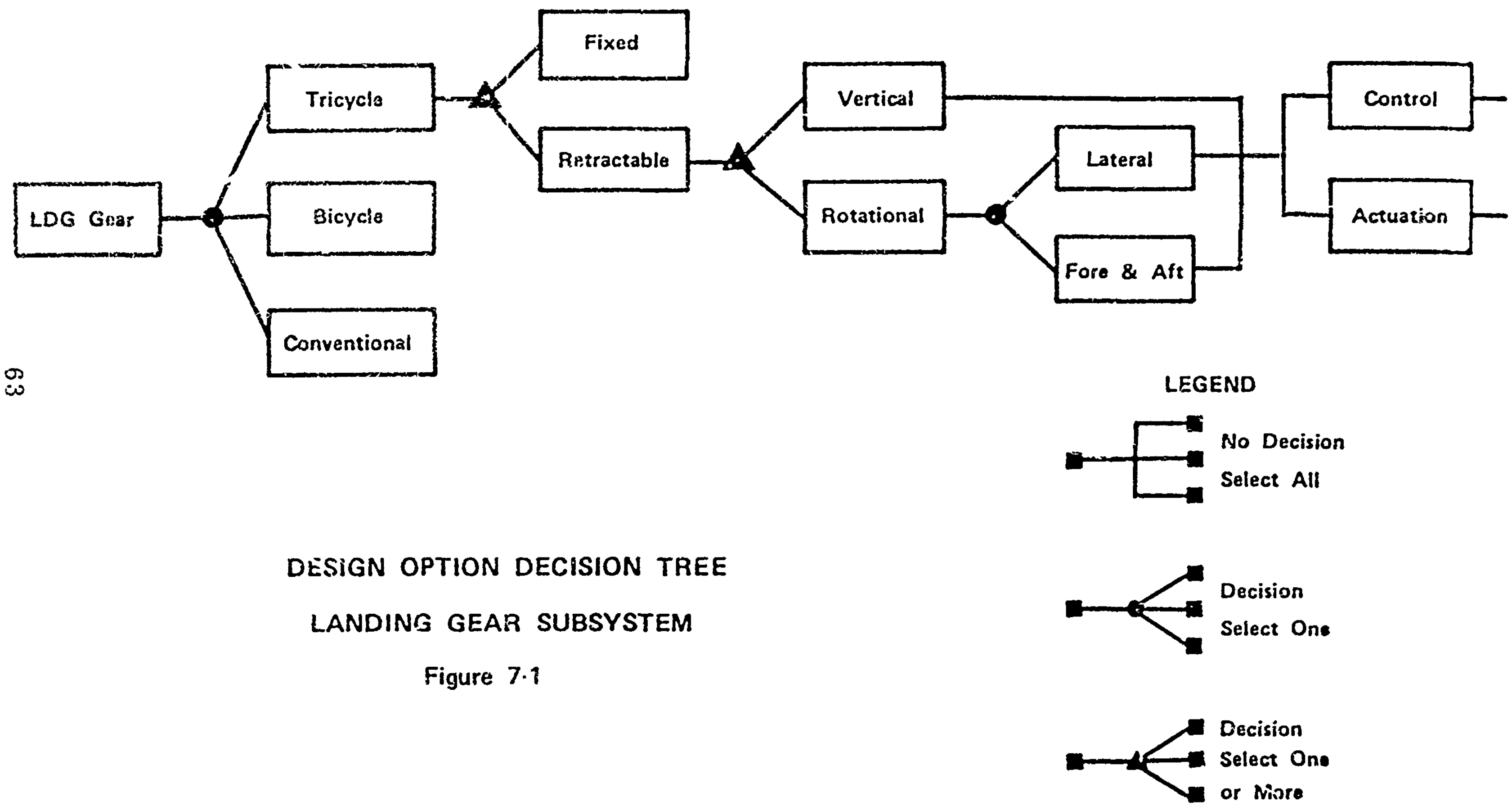
## DESIGN OPTION DECISION TREES

### 7.1 GENERAL

Design option decision trees (DODT) are used as a method of documenting a design to show where alternatives have been or will be considered. A sample DODT is shown in Figure 7-1 for a simplified landing gear subsystem. Design option decision trees are prepared as part of the CDB development activity on the weapon system and maintained to reflect the current design status. Design option decision trees are also prepared on selected subsystems. Subsystems are selected on the basis of high hardware risk, human resource dependency, or simply many potential alternatives. DODTs are graphic in nature and will not normally be part of a computerized data base although the technology to do so does exist. They will normally be stored in a physical file.

As a current data source, DODTs will indicate where options have been identified and/or selected. With this knowledge one may exercise the CHRT process to determine the effect of the various design alternatives on human resources and cost. As an historical data source, DODTs may be used to trace trade-offs that have been made and record the various alternatives.

This section will be expanded as experience with DODTs increases.




DESIGN OPTION DECISION TREE

LANDING GEAR SUBSYSTEM

Figure 7-1

Section 8

## NOTES

### 8.1 ABBREVIATIONS AND ACRONYMS

The following abbreviations and acronyms are used with the CHRT.

| | |
|---|---|
| A | availability |
| A/C | aircraft |
| AFHRL | Air Force Human Resources Laboratory |
| AFSC | Air Force specialty code |
| AMST | Advanced Medium STOL Transport |
| ATIM | annotated task identification matrix |
| CDB | consolidated data base |
| CND | cannot duplicate |
| CHRT | coordinated human resource technology |
| DSARC | Defense Systems Acquisition Review Council |
| FOMM | functionally organized maintenance manuals |
| FPJPA | fully proceduralized job performance aids |
| HRDT | human resources in design tradeoffs |
| ILS | integrated logistic support |
| ILSP | integrated logistic support plan |
| IRTA | integrated requirements and task analysis |
| ISD | instructional system development |
| JGD | job guide development |
| JPA | job performance aid |
| LCC | life cycle cost |
| LCOM | logistic composite model |
| LSA | logistic support analysis |
| LSAR | logistic support analysis record |
| $\overline{M}$ | maintainability |
| MFHBMA | mean flight hours between maintenance actions |
| MMH/FH | maintenance man hours/flight hour |
| MMM | maintenance manpower modeling |
| MTTR | mean time to repair |
| NRTS | not repairable this station |
| PTIM | preliminary task identification matrix |
| $\overline{R}$ | reliability |
| ROC | required operational capability |
| SIMM | symbolic integrated maintenance manuals |
| SOC | system ownership cost |
| STOL | short field takeoff and landing |

## 8.2 DEFINITIONS

The following definitions are applicable to CHRT.

algorithms - mathematical formulas and procedures, pre-programmed into the system, which will translate data from base files and/or sub-files into data elements which quantify human resource requirements and ownership cost.

baseline data - data which reflects the weapon system approved for further development at a DSARC milestone.

background data - all weapon system program data from which CDB data is drawn.

behavior - any human action generally defined by a stimulus (cue) and response. A basic stimulus-organism-response constituent of behavior comprising the smallest logically defineable set of perceptions, decisions, and responses required to complete a task. Involves, for example, identifying a specific signal on a specific display, deciding on a single action, activating a specific control, and noting the feedback signals of response adequacy.

cue - a stimulus to a response. For example, a cue could consist of a meter reading, physical appearance, flashing light, etc. Responses to cues consist of such activities as turning a knob, setting a switch, reading a value on a display, etc. Often a response can be a cue for a succeeding response.

current data - data which reflects the updated and accepted weapon system configuration at any specific time between the baseline of each phase.

data base - a grouping of base files by category (or defined set) representing all the basic data for a specific generation of equipment.

data element - a grouping of information and units which has a unique meaning and which may have subcategories (data items) of distinct units or values.

data element definition - a narrative definition of the data element in sufficient detail to present a clear and complete understanding of the precise data or element of information that the data element represents.

detailed task data - task statements to the level required to make the final ISD/JGD decision, to make tradeoffs within the instructional system itself and finally to develop the products; course, media, performance measurement, and job guide documentation.

extended -11 file - the format used by the Logistics Composite Model (LCOM) to identify the maintenance tasks and the order in which they are to be done, along with the time and resources needed to accomplish each task.

file - a grouping of one type of input variable or a derived quantity thereof for a particular ID. All of the input data items are grouped for a comparable level (e.g., flightline, shop).

job - a group of tasks performed by a specific individual.

general task data - task statements to the level required to make a basic decision regarding manpower requirements and the applicability of training courses, media, performance measurement and job guides documentation (i.e., the ISD/JGD decision). For maintenance, the task level would be to the LRU (e.g., repair LRU) but would not include development of the specific task statements that encompassed the task.

line replaceable unit (LRU) - a combination of parts, subassemblies, and assemblies mounted together, normally capable of independent operation in a variety of situations. An LRU is normally directly accessible and can be removed without prior disassembly of the equipment or group. (MIL-STD-280). The LRU is the first level of assembly below the subsystem that is carried as a line item of supply at the base level and is usually the highest level of assembly that is removed and replaced, as a unit, on the flightline.

maintenance event - consists of one or more maintenance functions. These maintenance events are specifically symbolized and identified as:

- A - setup support equipment
- T - troubleshoot on aircraft (A/C)
- C - cannot duplicate (CND) on A/C
- M - minor repair on A/C
- R - remove & replace (R&R)
- V - verification of $\overline{R}$ or $\overline{M}$ events
- W - bench check and repair in shop
- K - bench check and CND in shop
- N - not repairable this station (NRTS)
- H - scheduled checks, inspections, or service

maintenance function - a behavioral term associated with a task. Specifically: adjust, align, calibrate, checkout, troubleshoot, clean, disassemble/assemble, inspect, lubricate, operate, remove/install, repair, service are maintenance functions (ref. AFHRL-TR-73-43(II)).

reference data - data which reflects a reference weapon system. The reference system is the system(s) that the new acquisition will specifically replace and consequently must be shown to be less cost/effective in the long run. Reference data is compiled in the conceptual phase and retained as a supplement to the CDB. It would not be expected to change since it is normally derived from operations, performance, support, and cost information on existing systems. In some cases there may be no reference system(s).

shop replaceable unit (SRU) - the SRU is a lower level assembly or subassembly within an LRU normally formed together to perform a specific function. An SRU is normally repaired or replaced only within the base (intermediate level) shops rather than on the flight line.

skill level - the fourth number within an AFSC identifying a level of aptitude, training, experience, knowledge, skills, and responsibility.

subsystem - a set or combination of LRUs and/or assemblies generally physically separated when in operation connected together or used in association to perform an operational function within the system. It is the level of equipment identified by three characters in the work unit code structure (e.g., 7]B TACAN set) or as a four-digit ID number (e.g., AN/2 TACAN).

system - a major subset of a weapon system comprised of individual functional groupings and their integration within the weapon system (e.g., avionics, landing gear, electrical, etc.).

task - a composite of related activities (behaviors) performed by an individual and directed toward accomplishing a specific amount of work within a specific work context. These activities usually occur in temporal proximity with the same displays and controls and have a common purpose. Each task has a goal.

task analysis - an analytic process employed to determine the specific behaviors required of a human component in a man-machine system. It involves determining, usually on a time basis, the detailed performance required of men, the nature and extent of their interactions with the machine and the effects of environmental conditions and malfunctions. It is the breakdown of behaviors into simple elements of perceptions, decisions, memory storage, motor output, etc.

task statement - a statement of the behavioral elements (in action verb form), the cues, and equipment description involved in a task.

weapon system - a complete system including all equipment, related facilities, material software, services, and personnel required for its operation and support to the degree that it can be considered a self-sufficient unit in its intended operational environment (AFSC DH1-1 pg. 7, Section 25).

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