ASTAR Operational Evaluation Final Report
Technical Documentation Volume III: Functional Description

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ASTAR OPERATIONAL EVALUATION
FINAL REPORT
VOLUME III: FUNCTIONAL DESCRIPTION

Final Report
CDRL A003

Michael Companion

April 13, 1990
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Prepared under Contract Number N61339-89-C-0029 for the
Naval Training Systems Center

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FOREWORD

The research report herein was conducted for the United States Navy by the University of Central Florida, Institute for Simulation and Training under Contract Number 61339-89-C-0029. The Naval Training Systems Center, Orlando, Florida, administered the contract which was sponsored by the Joint Service Committee on Manpower and Training Technology. The contract was to perform an ASTAR Phase III Test and Evaluation, and to produce a Final Report and Transition Plan. The research reported on in this report was performed between the period May 1989 and April 1990.

This functional description was developed to meet the format and content requirements of Data Item Description DI-E-30104B, Functional Description in compliance with CDRL A002.

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# FUNCTIONAL DESCRIPTION

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SECTION 1. GENERAL

1.1 PURPOSE OF FUNCTIONAL DESCRIPTION

This Functional Description for the enhancement of the Automated Simulator Test and Assessment Routine (ASTAR) is written to provide:

a. The reprogramming requirements that must be satisfied to enhance the functionality and user friendliness of the system. This will serve to increase the level of user acceptance.

b. Information on performance requirements, suggested redesign, user impacts, and cost estimates for the approach defined.

1.2 PROJECT REFERENCES

This section provides a general summary of ASTAR's approach and the identification of project sponsor, target users, and operating centers where the revised ASTAR program will be used. Additionally, a list of references which are applicable to the history and development of the ASTAR training device design aid is provided.

The ASTAR is an automated decision aid designed to assist an analyst in evaluating the effectiveness of a training device or method. ASTAR uses generally accepted training principles to evaluate the effectiveness of any training method that involves practice on job tasks. ASTAR helps the analyst evaluate a training approach by asking questions about the learning difficulty or transfer of training to the job environment. ASTAR then converts the judgments provided by the analyst about various facets of the training system into a forecast of the system's effectiveness. The analyst responds to a series of questions by assigning the training device under evaluation a subjective rating with a value of between zero and one hundred. This value represents the analysts' perceptions of the effectiveness of the training device on a percentage basis.

The history of ASTAR began in the late 1970s as a manual analysis technique developed by the American Institutes for Research (AIR) for the U. S. Army Research Institute (ARI). Around 1980, AIR was contracted to convert the manual technique to a computer based decision aid. The initial version of the program was sponsored by the ARI and was called the Device Effectiveness Forecasting Technique (DEFT). Early in the 1980s the program was picked up by the Naval Training Systems Center (NTSC). Around this time the name of the program was changed from DEFT to ASTAR.

The ASTAR and DEFT programs were subjected to a series of development and validation tests during the early to mid 1980s.
ASTAR was applied to several systems in various stages of the acquisition process to determine its effectiveness as a decision aid. During these tests, conducted by AIR under contract to NTSC, ASTAR was demonstrated to have a positive impact on the design process. ASTAR recommendations influenced the final design selection in the Precision Gunnery Trainer System (PGTS) and Combat Talon II Maintenance Trainer programs. Validity statistics were also established during several validation tests conducted in conjunction with NTSC. These validity statistics, summarized by Rose, Martin and Wheaton (1988) in "Forecasting Training System Effectiveness: Review and Analysis of ASTAR. Final Report" are provided below.

1). "A split-plot factorial ANOVA indicated that pretraining in Device 11G2 significantly reduced the amount of time to repair (TTR) malfunctions in the Phalanx \( p < .01 \) with the effect being greater for more difficult tasks and for certain subsystems (although interaction effects were not statistically significant). Estimated transfer ratio (TR) ranged from .00 to .63 with an average of .33," where

\[
TR = \frac{TTR \text{ (in 11G2)} - TTR \text{ (in Phalanx)}}{TTR \text{ (Historical Data)}}
\]

(Rose, Martin & Wheaton, 1988, p. 11)

2). "The ASTAR scale values for each factor were averaged (e.g., scales 1+ 5/2) to create three variables for predicting transfer ratios. These averages were compared to the empirically derived transfer ratio for each task using a regression analysis \( N = 16 \). The resulting multiple correlation \( r = .64 \) was described as expressing the goodness of fit between the modeled ASTAR data and the actual performance data." (Rose, Martin & Wheaton, 1988, p. 12)

3). "The transfer coefficients developed from ASTAR, FORTE, and field data were correlated two at a time to provide estimates of concurrent and convergent validity. Convergent validity of ASTAR and FORTE was estimated at \( r = .81 \) to .99 with a mean of .92. Concurrent validity of ASTAR prediction of transfer was estimated at \( r = .45 \) to .63 with a mean of .55." (Rose, Martin & Wheaton, 1988, p. 18)

The original validation tests were limited because analyses were predominantly conducted by the developer of the ASTAR, The American Institutes for Research (AIR). In 1989, the University of Central Florida Institute for Simulation and Training (UCF/IST) was placed under contract by NTSC to conduct an operational field test of ASTAR. The objective of this
evaluation was to determine whether operational analysts could learn and effectively use ASTAR. During the course of the evaluation it was determined that a number of problems existed in the current implementation of the program. The problems did not center on the concepts underlying ASTAR. Instead they were associated with the ease of use and user interface of ASTAR. Current software and human computer interface technology have progressed significantly since the effort to computerize ASTAR was initiated. Hence, user expectations of how the program should operate, based on the current state-of-the-art software, lead to the conclusion that ASTAR could not be implemented in its current form. This functional description addresses the changes that are needed to revise ASTAR to meet current software and interface standards and gain user acceptance. The recommended changes are based on the series of operational tests conducted by UCF/IST.

The intention of the ASTAR program is to develop a training effectiveness prediction decision support aid which could be implemented as a DoD standard analysis technique. ASTAR should be applicable to all government organizations and contractors involved in the development of training devices and training programs for the military.

The following list of references document the original development and test of the ASTAR technique and provide additional supporting data to this functional description. The references are organized alphabetically by author and in order of their publication date within author. Also included, are user manuals and other aids which can assist in the operation of ASTAR.

1.2.1 Technical Documentation


1.2.2 User Aids


1.2.3 Programming and Documentation Standards

Documentation should conform with the intent of DoD Manual 7935. Developers are encouraged to use computer based documentation for both documentation and code. This allows documentation to be archived along with the source code, providing better long term access.

The primary program documentation is the source code. Hence, it should be well documented. To the maximum extent possible, programmer documentation should be built into the source code. The following three items are recommended for inclusion in the program documentation.

1. Program Header - This section of the source code identifies the program's purpose and functions, version, related files/libraries needed for compilation or linking, and external file usage.

2. Module (Subroutine) Header - Where practical, each program module should contain a description of the module's function and methodology, description of the passed parameters, description of common blocks, and calls by information.

3. A list of modifications made since the previous
baseline.

A Software Development Folder should be established at the beginning of the program. All information concerning the development of the program should be included in the software development folder. The software development folder should also include the test plan and test results for the program. If practical, computer copies of the test input and output should be maintained with the source code. The software development folder provides an audit trail for the development and operational verification of the program.

1.2.3.2 Programming Conventions. The following practices are recommended:

Modular coding - Small single function modules are the biggest contributor to good program development.

Extensive use of internal documentation - This includes the module header information, as well as liberally applied in-line comments.

Off-the-Shelf Routines - To the extent possible available off-the-shelf routines should be used.

While ADA has been adopted as the DoD Standard Programming Language, it is recommended that this effort utilize the C programming language. The reasons for this recommendation are:

1. ASTAR is essentially a data base management system. ADA is not well suited to this type of application.

2. The availability of off-the-shelf C modules could be utilized to accomplish ASTAR functions thereby reducing development cost and time.

3. Most of the programs that ASTAR might be used in conjunction with, for import or export of data, are written in C. Therefore, use of the C programming language provides a common programming environment.

1.2.3.3 DoD and other Standards. The development of the revised ASTAR should meet the intent of DoD-STD-2167A, Defense System Software Development, and DoD-STD-2168, Defense System Software Quality Program. These standards should be tailored to meet the objectives of the ASTAR project. Tailoring shall follow the guidance of MIL-HDBK-287, Tailoring Guide to 2167A, and MIL-HDBK-286, Tailoring Guide to 2168.

1.2.3.4 User Documentation. Computer-based user documentation is strongly recommended. Not only is this form of documentation much easier to maintain, but in many cases, it is much easier to distribute. The user documentation should include the following information:

1. Where possible, discussion of program assumptions and limitations. This should include limits imposed by dimensioning and memory allocation.
2. Complete description of all user inputs and outputs.
3. List of all error messages, including recommended user actions.
4. Sample data sets and examples.

1.3 TERMS AND ABBREVIATIONS

This section provides a listing of terms, definitions and acronyms which are unique to this document. The list should provide users with a handy reference when these terms are encountered.

a. Acquisition Efficiency — the quality of training provided by the training device.
b. ASTAR — Automated Simulator Test and Assessment Routine.
c. DEFT — Device Effectiveness Forecasting Technique.
d. Transfer Efficiency — how well a training device promotes transfer of training to the operating equipment.
e. Transfer Problem — the deficiencies trainees have with respect to operational criterion.
f. Training Problem — the skill and knowledge deficiencies of trainees relative to criterion performance on a training device.
h. Commonality Analysis — the ASTAR process in which common tasks between a training device and the operational system are identified.
i. Similarity Analysis — the ASTAR process in which the common displays and controls for the training device and operational system are identified.
SECTION 2. SYSTEM SUMMARY

2.1 BACKGROUND

The primary goal of training system design methodologies is to produce training systems which maximize training effectiveness within the limitations of the acquisition process. Because of time and resource constraints inherent in the development of training systems many decisions regarding system design are based on analytic information rather than on empirical data from training system evaluations. There are few formalized techniques for analytic evaluations of training systems. As a result, design decisions are often based on the developer's best judgment. The ASTAR technique was developed to address the need for a systematic, analytical evaluation procedure for application during the training device design and development process.

ASTAR is a direct extension of an earlier procedure known as the DEFT. ASTAR is based on a multidimensional view of training system effectiveness that looks at the global training effort. It considers the trainee population capabilities and limitations, and stated training and performance objectives. It then determines how well the entire training system will promote the acquisition of the skills and knowledge required for proficiency on both the training device and operational hardware. This perspective is in contrast to other training effectiveness models that focus exclusively on transfer of training as the sole criterion of effectiveness. ASTAR examines not only what is trained, but also how well the device-based system is designed to promote effective and efficient training and transfer.

This functional description describes a redesign of ASTAR for the purpose of significantly improving the user friendliness. The redesign of ASTAR is based on user feedback gathered during the course of operational evaluation (Gibbons, Bird, and Companion, 1990; Companion & Bailey, 1990; Bradley and Companion, 1990; Gibbons & Companion, 1990). Hereafter in this document the revised ASTAR will be referred to as ASTAR II. The redesign will be structured to require fewer repetitive tasks and permit more flexibility in the entry and editing of data. It is expected that ASTAR II will be able to import or export data with the joint services ISD/LSAR DSS and have the ability to import data from standard data bases or word processing programs. This improvement in user friendliness should result in increased user acceptance and usability.

2.2 OBJECTIVES

ASTAR has been designed to forecast the effectiveness of device-based training systems. It has the ability to evaluate alternative design concepts for a training device in the early stages of acquisition or investigate which of several utilization patterns is most effective for an existing device. It compares the effectiveness of two training devices that are designed to
train the same tasks or evaluate the effectiveness of differing device configurations. New device based training system designs can be compared with training on the actual equipment or against existing training systems.

The ASTAR II will provide decision support to the training system designer, and will permit more efficient analyses of alternate training approaches to enhance system design. The updated decision support and data management features will allow the training system analyst to work more productively. The new ASTAR II is expected to increase the usability and user acceptance over the current implementation method.

2.3 EXISTING METHODS AND PROCEDURES

The ASTAR is an automated decision aid designed to assist an analyst in evaluating the relative effectiveness of training devices or methods. ASTAR uses generally accepted training principles to evaluate the effectiveness of any training method that involves practice on job tasks. ASTAR helps the analyst evaluate a training approach by asking questions about the learning difficulty or transfer of training to the job environment. ASTAR then converts the judgments provided by the analyst about various facets of the training system into a forecast of the system's effectiveness. The analyst responds to a series of questions by assigning the training device under evaluation a subjective rating with a value of between zero and one hundred. This value represents the analyst's perceptions of the effectiveness of the training device on a percentage basis.

Using the analyst's ratings, ASTAR computes several "effectiveness" scores which can be used to make comparisons among devices or methods. An "Acquisition Effectiveness" score and a "Transfer Effectiveness" score provide a basis for comparisons of what is learned on the device and what remains to be learned on the job. These scores can be combined to provide a summary score of Training Effectiveness.

Figure 1 depicts the data flow through ASTAR from data acquisition through its processing and eventual output.

2.3.1 Equipment Utilized

ASTAR is an interactive, menu-driven program written to run on an IBM PC, XT, AT, PS\2 or 100% compatible microcomputer equipped with either dual disk drives or a hard disk and one floppy disk drive. The ASTAR programs are contained on one floppy disk. Also required is a second formatted floppy disk on which to input the data base and ratings unique to the training systems being evaluated.

2.3.2 Operation Sequence

Figure 2 presents a overview of the operational flow of the current implementation of ASTAR, Version 2.0. It depicts the
Figure 1. Diagram of current ASTAR data flow.
Figure 2. Overview of operation flow in current ASTAR implementation.
interdependencies between the various ASTAR levels as they relate to the creation of the ASTAR data base. Detailed flow diagrams and the source code for the current version of ASTAR are provided in Appendices B and C respectively. The following paragraphs explain the sequence in which the operational functions are performed.

ASTAR begins operation by asking the user to execute the "BUILD" command. The BUILD command creates a directory on the data disk under the device name specified. Once this set of device files, created by the BUILD command, is constructed ASTAR will not allow the user to BUILD using the same device name. Once the directory containing the device files is established, program start up procedures can be initiated.

Once the decision is made of which ASTAR level of analysis is to be conducted, the data base management sequence is initiated. Building the ASTAR data base requires the entry of data into the ASTAR system, which in turn provides the basis for the effectiveness evaluation. The amount and level of detail of data required for inputting is dependent on the level of analysis to be conducted.

ASTAR Level 1 utilizes general ratings from the analyst without building a data base of tasks and subtasks as required for ASTAR Levels 2 and 3. The decision of which level to use depends upon the amount of information that the analyst has about the training device/method, the operational equipment and performance, the tasks to be trained, and the trainees themselves.

After completion of the data base maintenance routines, ASTAR ratings are performed; this task requires the user to assign a rating value to a series of questions. The number and kind of judgments the analyst must make vary as a function of the level of analysis that is chosen, i.e. Level 1 requires eight judgments, Level 2 requires 13 judgments per task, and Level 3 requires 35 different ratings for each task in the data base. Once all ratings are made, an evaluation summary screen is displayed.

The analyst is required to interpret ASTAR results in accordance with the unique training objectives of the evaluation. ASTAR provides a Summary of Results Table. Summary results are structured around the four basic components of ASTAR: the training problem, the acquisition efficiency, the transfer problem, and the transfer efficiency. This completes the operational flow from data acquisition through its processing and system outputs; the user now exits the ASTAR program.

2.3.3 Deficiencies

Deficiencies in the existing ASTAR system were determined from subjects' responses during three operational tests and a longitudinal test (Gibbons, Bird, and Companion, 1990; Companion
& Bailey, 1990; Bradley and Companion, 1990; Gibbons & Companion, 1990). Most deficiencies were noted in the area of user friendliness. A summary of the deficiencies in the current version of ASTAR is provided in Appendix A. Specific shortcomings cited by the users are as follows:

a. There exists no input/output capabilities for interfacing with other data base, word processing or spreadsheet programs.

b. Many desirable editing functions are absent or difficult to accomplish, i.e. adding, deleting, and revising task, control, and display data.

c. There is no capability for side-by-side comparison of two or more systems; the current procedure gives output sequentially from one trainer to the next.

d. The final ASTAR results summary screen is unclear. It lacks definition and has no documentation or screen helps to explain how to interpret the scores.

e. It is time consuming and redundant to enter almost identical lists of controls and displays and task lists for both the operational system and the training device.

f. Menu organization prevents easy access in and out of the ASTAR process. There is no capability to escape during program operations and return to that same point at a later time. Presently a lengthy and complex procedure must be followed, which is in itself variable depending on the location of the reenter point.

g. There is no capability to save data on both hard drive and floppy disks.

h. There is no mouse interface.

i. There are no graphics capabilities included for ASTAR outputs.

j. Trainer cost factors are not included in the ASTAR evaluation.

k. There is no capability to enter ratings for all training devices under consideration in parallel. The current system requires the user to run through the entire ASTAR routine one device at a time.

2.3.4 Computational Formulas

Table 1 presents the basic algorithms employed in ASTAR. These computational formulas represent the equations used directly in the ASTAR Level 1 computations. The ASTAR Level 2
**TABLE 1**

**BASIC ASTAR COMPUTATIONAL FORMULAS**

<table>
<thead>
<tr>
<th>Performance Deficit</th>
<th>: Performance Deficit Rating (R1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Difficulty</td>
<td>: Learning Difficulty Rating (R2)</td>
</tr>
<tr>
<td>Training Problem</td>
<td>: ((R1) \times (R2) / 100 = (S1))</td>
</tr>
<tr>
<td>Quality of Training - Acquisition</td>
<td>: Training Acquisition Rating (R3)</td>
</tr>
<tr>
<td>Acquisition Efficiency</td>
<td>: (\sqrt{(R3) / 100} = (S2))</td>
</tr>
<tr>
<td></td>
<td>: ((S1) / (S2) = (T1))</td>
</tr>
<tr>
<td>Residual Deficit</td>
<td>: Residual Deficit Rating (R4)</td>
</tr>
<tr>
<td>Residual Learning Difficulty</td>
<td>: Residual Learning Difficulty Rating (R5)</td>
</tr>
<tr>
<td>Physical Similarity</td>
<td>: Physical Similarity Rating (R6)</td>
</tr>
<tr>
<td>Functional Similarity</td>
<td>: Functional Similarity Rating (R7)</td>
</tr>
<tr>
<td>Transfer Problem</td>
<td>: (((R4) \times (R5)) / 100 + ((R6) - (R7)) = (S3))</td>
</tr>
<tr>
<td>Quality of Training - Transfer</td>
<td>: Training Transfer Rating (R8)</td>
</tr>
<tr>
<td>Transfer Efficiency</td>
<td>: (\sqrt{(R8) / 100} = (S4))</td>
</tr>
<tr>
<td></td>
<td>: ((S3) / (S4) = (T2))</td>
</tr>
<tr>
<td>Sum</td>
<td>: ((T1) + (T2))</td>
</tr>
</tbody>
</table>
formulas are functionally identical, but are composite averages across the ratings within each of the eight subject categories, where applicable, and across tasks or subtasks (see Table 2). In the ASTAR Level 3 formulas, Table 3, the ratings are also averaged across each common control and display within the functional and physical similarity categories. These formulas are greatly simplified. The details of the computational formulas can be derived from the ASTAR flow diagrams in Appendix D and the ASTAR 2.0 source code listings in Appendix B.

2.4 PROPOSED METHODS AND PROCEDURES

The main purpose of the redesign effort is not to change the functionality of ASTAR, but rather to increase the user friendliness. ASTAR II will still be an automated decision aid designed to assist an analyst in evaluating the effectiveness of a training device or method. The ASTAR II continues to help the analyst evaluate a training approach by asking questions about the learning difficulty or transfer of training to the job environment. The program converts the judgments provided by the analyst about various facets of the training system into a forecast of the system's effectiveness. The analyst will respond to the same series of questions, assigning the training device under evaluation a subjective rating with a value of between zero and one hundred. This value will represent the analysts' perceptions of the effectiveness of the training device on a percentage basis.

ASTAR II will have the same functional capabilities. It will use the analyst's ratings to compute "effectiveness" scores which can be used to make comparisons among devices or methods. An "Acquisition Effectiveness" score and a "Transfer Effectiveness" score will still provide a basis for comparisons of what is learned on the device and what remains to be learned on the job. The algorithms employed in the determination of these scores will remain unchanged (see Tables 1, 2 and 3). The structure of the ASTAR II program will permit easy modification of computational formulas if desired by configuration control.

Additionally ASTAR II will have the capability of interfacing with conventional off-the-shelf data bases and word processors capable of producing ASCII code. A method of interfacing with the existing data structures of the ISD/LSARDSS will also be provided.

ASTAR II will continue to be an interactive, menu-driven program designed to run on an IBM PC, XT, AT, and PS/2 Personal Computer or 100% compatibles.

2.4.1 Operation Sequence

The operational sequence for the ASTAR II is illustrated in the top level functional flow diagram depicted in Figure 3. ASTAR II is designed to provide a flexible flow through the program. Upon entering the ASTAR program, by typing "ASTAR"
# TABLE 2
ASTAR II COMPUTATIONAL FORMULAS

<table>
<thead>
<tr>
<th>Performance Deficit</th>
<th>Performance Deficit Rating ( R1 ) = ( \sum_{i=1}^{n} R1 ) / ( N )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Difficulty</td>
<td>Learning Difficulty Rating ( R2 ) = ( \sum_{i=1}^{n} R2 ) / ( N )</td>
</tr>
<tr>
<td>Training Problem</td>
<td>( (R1) \times (R2) ) / 100 = (51)</td>
</tr>
<tr>
<td>Quality of Training - Acquisition</td>
<td>Training Acquisition Rating ( R3 ) = ( \frac{\sum_{i=1}^{q} R3}{4} )</td>
</tr>
<tr>
<td>Acquisition - Efficiency</td>
<td>( \sqrt{(R3)} ) / 100 = (52)</td>
</tr>
<tr>
<td>Acquisition</td>
<td>( (51) \times (52) = (11) )</td>
</tr>
<tr>
<td>Residual Deficit</td>
<td>Residual Deficit Rating ( R4 ) = ( \sum_{i=1}^{n} R4 ) / ( N )</td>
</tr>
<tr>
<td>Residual Learning Difficulty</td>
<td>Residual Learning Difficulty Rating ( R5 ) = ( \sum_{i=1}^{n} R5 ) / ( N )</td>
</tr>
<tr>
<td>Physical Similarity</td>
<td>Physical Similarity Rating ( R6 ) = ( \sum_{i=1}^{n} R6 ) / ( N )</td>
</tr>
<tr>
<td>Functional Similarity</td>
<td>Functional Similarity Rating ( R7 ) = ( \sum_{i=1}^{n} R7 ) / ( N )</td>
</tr>
<tr>
<td>Transfer Problem</td>
<td>( \frac{(R4) \times (R5)}{100 \times (R6) - (R7)} = (53) )</td>
</tr>
<tr>
<td>Quality of Training - Transfer</td>
<td>Training Transfer Rating ( R8 ) = ( \frac{\sum_{i=1}^{q} R8}{3} )</td>
</tr>
<tr>
<td>Transfer Efficiency</td>
<td>( \sqrt{(R8)} ) / 100 = (54)</td>
</tr>
<tr>
<td>Transfer Sum</td>
<td>( (53) / (54) = (12) )</td>
</tr>
</tbody>
</table>

1 = task or subtask number
q = question number
### TABLE 3

**ASTAR III COMPUTATIONAL FORMULAS**

**NOTE:** These equations are simplified. See Appendices for details.

<table>
<thead>
<tr>
<th>Performance Deficit</th>
<th>Performance Deficit Rating ($R_{1tn}$) = $R_1$ for $t \rightarrow 1$ to $n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Difficulty</td>
<td>Learning Difficulty Rating ($R_{2tn}$) = $\sum_{q=1}^{q=n} R_2$ for $t \rightarrow 1$ to $n$</td>
</tr>
<tr>
<td>Training Problem</td>
<td>$\sum_{t=1}^{t=n} (R_{1tn}) \times (R_{2tn}) / 100 = (S1)$</td>
</tr>
<tr>
<td>Quality of Training - Acquisition</td>
<td>Training Acquisition Rating ($R_{3tn}$) = $\sum_{q=1}^{q=n} R_{3q}/11$ for $t \rightarrow 1$ to $n$</td>
</tr>
<tr>
<td>Acquisition - Efficiency</td>
<td>$\sum_{t=1}^{t=n} R_{3tn} / 100 = (S2)$</td>
</tr>
<tr>
<td></td>
<td>$(S1) / (S2) = (T1)$</td>
</tr>
<tr>
<td>Residual Deficit</td>
<td>Residual Deficit Rating ($R_{4tn}$) = $R_4$ for $t \rightarrow 1$ to $n$</td>
</tr>
<tr>
<td>Residual Learning Difficulty</td>
<td>Residual Learning Difficulty Rating ($R_{5tn}$) = $\sum_{q=1}^{q=n} R_5$ for $t \rightarrow 1$ to $n$</td>
</tr>
<tr>
<td>Physical Similarity</td>
<td>Physical Similarity Rating ($R_6$) = $\sum_{t=1}^{t=n} \sum_{c=1}^{c=n} R_{6} / (N(t) \cdot (N(c) \cdot (N(c)))$</td>
</tr>
<tr>
<td>Functional Similarity</td>
<td>Functional Similarity Rating ($R_7$) = $\sum_{t=1}^{t=n} \sum_{c=1}^{c=n} R_{7} / (N(t) \cdot (N(c) \cdot (N(c)))$</td>
</tr>
<tr>
<td>Transfer Problem</td>
<td>$\left[ \sum_{t=1}^{t=n} \sum_{c=1}^{c=n} ((R_{4tn} \times (R_{5tn})) / 100) \right] \times ((R_{6}) - (R_{7})) = (S3)$</td>
</tr>
<tr>
<td>Quality of Training - Transfer</td>
<td>Training Transfer Rating ($R_{8tn}$) = $\sum_{q=1}^{q=n} R_{8q}/3$ for $t \rightarrow 1$ to $n$</td>
</tr>
<tr>
<td>Transfer Efficiency</td>
<td>$\sqrt{(R_{8})} / 100 = (S4)$</td>
</tr>
<tr>
<td></td>
<td>$(S3) / (S4) = (T2)$</td>
</tr>
<tr>
<td></td>
<td>$(T1) \times (T2)$</td>
</tr>
</tbody>
</table>

$t = $ task or subtask number  
$q = $ question number
Figure 3. Operational Flow for ASTAR II.
<ENTER>, ASTAR II will take you to the main menu. At the same time the on-line help and audit trail facilities will be automatically activated. These two facilities remain active until ASTAR II is exited. If ASTAR II determines that this is floppy disk or hard disk. The ASTAR II manual can be printed as an option within the installation routine. After the installation it will automatically go into the set up utility where the user specifies monitor, printer and other relevant set up parameters. After the set up is completed the program will transition to the main menu.

ASTAR II provides a number of selections from the main menu. Menu selections include: conduct file operations; conduct an ASTAR Level 1, 2, or 3 analysis; or exit ASTAR II. Infrequent operations can be accessed via function keys rather than main menu selections. Function keys available on the main menu provide access to: help screens; the on-line tutorial; the set up routine; DOS; results analysis; and to a directory of existing data bases. Section 4.1.2 presents a discussion of all function key assignments. When ASTAR II enters the main menu, the "conduct analysis selections" are inactive. They become active only when a system name has been specified and ASTAR II determines that an associated data base exists. If ASTAR II determines that a data base does not exist for that system, it will automatically transition to the file operations menu. If ASTAR II determines that a data base does exist for the system, then it activates all main menu and function key options.

The File Operations function encompasses the ASTAR II data base management utilities. A data base must be established prior to conducting any ASTAR II analysis. The file operation utilities permit a data base to be created or modified. Data bases may be created either through an internal data base program or by importing files from other modules. Other utilities provided under the file operation function include: exporting data; deleting and copying files; and printing reports.

The ASTAR II analysis function parallels the current ASTAR implementation. This function permits ASTAR II Level 1, 2 or 3 ratings to be input into the data base. The rating procedure is the same as for the current implementation of ASTAR. The primary functional difference is that ASTAR II permits multiple systems to be rated simultaneously. At the subfunction level, ASTAR II also provides extensive branching so that the program may be entered or exited randomly rather than in a sequential mode without data corruption. Upon entering the ratings, ASTAR II provides access to the analysis results. The results summaries are a subfunction of the ASTAR II analysis function.

The basic functional flow within ASTAR II is similar to the current implementation of ASTAR, but all functions are now internal to the main program. The build function is a separate program in the current ASTAR. Section 4.0 provides a detailed description of the operational sequence for ASTAR II.
2.4.2 Summary of Improvements

The following sections provide a summary of the improvements incorporate in the design of the ASTAR II. Each of the described areas responds to deficiencies identified during the operational tests conducted as part of the ASTAR Operational Evaluation.

2.4.2.1 Programming. The programming environment for ASTAR II will be the C programming language. This will provide a flexible software environment that should support the improved functionality summarized below. The use of the C programming language will also provide a reduced development time because of the availability of off-the-shelf routines. These routines should be used wherever possible; specifically for data base development, data import/export utilities, and graphic output routines.

2.4.2.2 Functionality. In the area of functionality, ASTAR II will exhibit the same baseline functionality present in the original ASTAR. The revision will reorganize the basic operation of all of the ASTAR functions and also improve the effectiveness of many baseline functions. New areas of functionality will include the following:

- import/export data base routines,
- on-line helps,
- hard copy outputs,
- graphics capability,
- the ability to evaluate multiple devices simultaneously,
- broader hardware capability,
- and a recommended on-line tutorial.

ASTAR II will upgrade the following ASTAR capabilities:

- internal data base routines
- user interface, and
- add a number of evaluation output options.

2.4.2.3 Compatibility. ASTAR II will be compatible with other software. It will retain its own internal data base development and management routine and also be able to import and export data to programs such as the joint services ISD/LSAR DSS and other standard data bases and word processors capable of generating and accepting ASCII code.

2.4.2.4 User Configuration. ASTAR II will be based on a single user configuration which provides a utility to merge and combine the ratings from different files (analysts). A system which automatically combines the ratings of multiple users, rating the identical training device design, would be more efficient for the method of group analysis employed by the present ASTAR system. This multiple user system is elegant but potentially increases the hardware requirements. Thus, an intermediate configuration based on the single user, but which provides a utility to merge
and combine ratings from different files (analysts), is proposed.

2.4.2.5 Help Options. ASTAR II will include a number of additional help features designed to provide the analyst with complete information required to complete an analysis. On-line help in the form of simple text messages will be accessible at critical instances of operation. Computational helps will provide information about the ASTAR equations; this is intended to help increase user understanding and acceptance. Assistance will be available when making ratings, i.e., providing additional anchor point examples. Query routines will be established which allow the user to access ratings from related questions or from a different ASTAR II analysis level. Prompts which clearly identify the source and type of errors will also be provided.

2.4.2.6 Data Base Management. The internal data base management function will include a utility module to handle the setup of the data base structure and configure the data base file formats. The list entry procedures for tasks, controls and displays will be upgraded and simplified. New data base management routines will provide a number of additional features. For example, data entry and editing routines will allow users to exit and move around freely within the system without disrupting the program, i.e., random access permitted. An automated replication procedure for control and display lists for each task will be provided. Non-appropriate controls and displays will be deleted by mouse or cursor highlighting within ASTAR II.

External data base management will provide an import/export capability to any source that can provide ASCII format information. Specific interfaces will be provided to ISD/LSAR DSS, standard word processing, spread sheets and other common data bases. The imported data must be modifiable so that as the ISD progresses and more data becomes available, data can be integrated into the imported file without having to recreate the entire file. Data items available in the ISD/LSAR DDS which correspond with ASTAR information requirements are as follows:

- weapon system name,
- subsystem name if applicable,
- task name,
- task ISD code,
- task element name (subtask),
- task element number (subtask),
- skill/knowledge name and number,
- and task criticality.

Use of text editors and word processors for the creation of data files or modifications of the data base items will be possible. This form of input will require a template to specify the correct data structure and format.

2.4.2.7 Ratings Entry. ASTAR II will permit ratings for multiple training devices to be entered on the same screen; permitting anchoring or reference across systems and removing the
repetitive aspects of the current model. Also a function key will be available to enter the same rating for all devices if appropriate.

ASTAR II will provide a consistent method of data entry. The <SHIFT-TAB> will be active and permit transition between data fields of multiple device designs. A standard three digit default value will be assigned to data fields. The <ENTER> command will signal that the data fields for the devices have been completed, and that the next query screen question to be answered is accessed.

2.4.2.8 Outputs. The number and types of ASTAR outputs will be increased, and existing outputs enhanced to provide more useful information to the user. The outputs will be available on screen, printer or disk. Screen based outputs will include: ratings; tabular scores; and graphics. The display of ratings made on tasks and subtasks will be available to the user in both tabular and graphic formats. Display of both summary task and subtask scores will be available in tabular and graphic formats of each measured parameter. All sub-scores presently available in ASTAR Level 1 will be included in Levels 2 and 3 analyses. Graphical output of scores will be available in the form of bar graphs and line charts. It would be desirable to have 3-D outputs available to provide for better visualization of problems.

The following outputs will be available via hard copy printouts: all ASTAR graphics and tabular outputs; task lists; and controls and display lists. Through a menu of print options the user will be able to print out an individual chart, a subset of charts, or a total output data package. Disk based outputs will be available for all ASTAR tabular outputs discussed above. A file structure will make available, as disk outputs, these reports and results for importing into documents or exporting to other programs such as the ISD/LSAR DSS.

2.4.2.9 User Interfaces. The user interface, cited as the major deficiency of the ASTAR program, will be significantly modified during this functional redesign effort. The user interface will be structured to require fewer repetitive tasks and provide flexible data entry and data management procedures. The interface will be menu driven and use cursor, mouse, and key letter strokes to select menu options. The interface of the ISD/LSAR DSS will be used as general guidance for the new ASTAR II integration. Key features design of the ASTAR II interface which will correct the deficiencies cited in Section 2.3.3. A summary list of these features is provided below:

a. On-line help;

b. Random access entry and exit;

c. Multiple system evaluations;
d. One time entry of task, control, and display lists;
e. On-screen task, control, and display list editing;
f. On-screen, cursor driven commonality and similarity matching;
g. Overall reduced keying requirements;
h. Data import and export capability;
i. Selection and deselection of tasks, controls, displays, etc. by mouse; and
j. Conduct of ASTAR II commonality and similarity analysis matching using a mouse.

2.4.2.10 Computational Formulas. Computational formulas will be available to the user in a read only manner. The ASTAR II program will be structured so that the computational formulas can be updated as new information becomes available. However, modification will be by DoD configuration control only. The computational formulas present in ASTAR will not be changed in ASTAR II. However, where necessary, basic subscores not currently computed in ASTAR Level 3 will be added.

2.4.2.11 Set up. A set up module will allow each user to specify the display configuration, number of analysts, data paths, etc. This will be used by the ASTAR II program to familiarize itself with the hardware configurations present in the host environment. It will also permit additional control of the analysis to be placed directly into the user's hands.

2.4.2.12 User Training. Existing training manuals will be updated and provided off line to the users. A desirable option available in the new system will be the addition of an on-line tutorial, supplemented by a disk based "read me" file which would provide supplemental hard copy material. The program would be self-contained on disk with no more than a single sheet of overview and installation procedures. All required training material and help features will be contained in the program as accessible hard copy printouts.

2.4.3 Summary of Impacts

The anticipated impacts of the ASTAR II system are discussed in the following sections.

2.4.3.1 User Organization Impacts. There are no organizational impacts anticipated. ASTAR has not been fielded as a standard tool and thus a change in its presentation format does not effect any existing organization.

2.4.3.2 User Operational Impacts. User operational impact will be minimal in terms of operational procedure changes. ASTAR
II should permit an easy transition from current procedures. The new features in ASTAR II are designed to minimize the operational impact by making ASTAR II user friendly. No new data requirements will be imposed by ASTAR II. ASTAR II should facilitate data retention because it is computer based.

2.4.3.3 User Development Impacts. There will be minimal user development impact in terms of effort required prior to implementation of the revised system. Training in the application of the technique will still be required. There will be changes in training content to accommodate new and revised procedures. The preferred method of training will be through an on-line tutorial, supplemented by a user's manual and general classroom training as necessary.

2.5 ASSUMPTIONS AND CONSTRAINTS

Two primary assumptions are associated with the development of ASTAR II: (1) government and contractor personnel who are engaged in training effectiveness evaluations will have access to microcomputer systems capable of hosting ASTAR II; and (2) the potential user population possesses some degree of computer literacy.
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SECTION 3. DETAILED CHARACTERISTICS

3.1 PERFORMANCE REQUIREMENTS

The following paragraphs describe the performance goals and requirements for the ASTAR II program.

3.1.1 Accuracy and Validity

The primary accuracy requirements for ASTAR II concern the computational algorithms. The calculations for ASTAR II must be accurate to two decimal places, i.e., rounding occurs based on the third decimal point. The accuracy requirements for data input into ASTAR II are primarily a function of the user. The user shall be able to review and modify data as needed. The program must accept the keyed data without error. Data imported into ASTAR II is primarily text based information. This type of information must be imported with at least 98% accuracy. The exception is for the importing of rating data during a merge routine. In this case transmission accuracy must be 100%.

3.2 Timing

The timing within ASTAR II will vary as a function of the host hardware and the module. The basic timing requirements will comply with MIL-STD-1472C. These timing values will apply for a 80286 or higher microprocessor. For 8088 and 8086 microprocessor, the timing delay for queries shall not exceed 5 seconds. The output timing should not exceed 10 seconds from output request to presentation of output summary in either graphic or tabular format.

3.2 FUNCTIONAL AREA SYSTEM FUNCTIONS

There are nine major functional areas within ASTAR II. These functions were depicted previously in Figure 3. The following paragraphs describe the characteristics of each major function.

3.2.1 Installation

This function installs ASTAR II on either a floppy disk or hard disk drive as specified by the user. During the installation routine the user is given the option to print out a hard copy of the users manual, which is stored on the distribution disk.

3.2.2 Set Up

The set up function permits the user to specify the hardware configuration of the system ASTAR II is installed on. The user can select or change the monitor and printer configuration. The user also specifies whether a mouse is present in the system. Another subfunction that is recommended for ASTAR II and should be selected by the user through the set up utility is an automatic save feature, which will save all data in memory to
disk every fifteen minutes.

3.2.3 Select Option

The select option is the main menu function for ASTAR II. From the main menu, the user may select the level of ASTAR II analysis, select file operations or exit ASTAR II. Other subfunctions are provided via function keys. Sub-functions accessible through function keys are:

- the help routines,
- the on-line tutorial,
- the set up utility,
- jump to the view results routine,
- view a directory of existing data bases,
- escape to DOS and return, and
- quit.

3.2.4 File Operations

The file operation function is the data base creation and management function. Through this function the user creates a data base structure; sets the number of devices; names of the devices for evaluation; accesses data import and export utilities; merges data bases from multiple raters; copies and deletes data bases; manages the data base, which includes conducting similarity and commonality analyses; and requests reports of the data to be printed.

3.2.5 ASTAR II Analysis

The ASTAR II analysis function has two primary components; the rating subfunction and the results/output subfunction. The rating subfunction is used to assign ratings for each device based on ASTAR II evaluation categories. The number of ratings that are assigned is determined by the level of ASTAR II analysis. The results/output subfunction permits the user to view the results of the ASTAR II analysis. This subfunction permits the user to examine both raw data and ASTAR II assessments. ASTAR II assessments may access both summary and subscores to aid in interpretation. The results may be viewed in appropriate tabular or graphic formats.

3.2.6 On-line Help

The on-line help utility provides context dependent help at all points within ASTAR II. This function resides on-line while ASTAR II is active. It is always accessed by pressing the F1 function key. The on-line help provides brief text messages to clarify the operation of keys, option, or information relevant to the interpretation of ASTAR II scores.

3.2.7 Audit Trail Log

The audit trail log maintains a continuous time and date
tagged log of operations conducted on an ASTAR II data base. It logs day of creation, dates accessed, operations conducted, analyses conducted, notes if the data base was created by merging files, etc. This function should not be readily accessible to the user. The only access currently specified is a printout capability provided as part of the file operations report function.

3.2.8 On-Line Tutorial

The on-line tutorial is the primary training vehicle for ASTAR II. It is accessed through a function key on the main ASTAR II menu. It provides an interactive tutorial which describes and leads the user through exercises using ASTAR II.

3.2.9 Quit ASTAR

The quit function lets the user exit ASTAR II. The Quit function saves and closes all files as appropriate and downloads any memory resident routines. It also serves to deactivate and close the on-line help and audit trail log.

3.3 INPUTS - OUTPUTS

The following section describes each data element in the data inputs to and outputs from ASTAR II. Samples of suggested ASTAR II output formats are provided in Appendix F.

3.3.1 Inputs

1. Data Element Name: Task Number

   Definition: User assigned number identifying a unique task or subtask

   Format: #.#

   Input Medium: Keyboard, Disk

   Range of Values: 1.0 - 25.25

   Unit of Measurement: N/A

   Data Item Names: Task, Subtask

   Miscellaneous: When tasks/subtasks are imported from other programs, the range of values and number of levels may exceed the above specification. The import routine will need to permit the task numbers to be edited and/or automatically renumbered in the ASTAR II format. Only a maximum of four levels will be permitted after editing. ASTAR II will parse the data so that Level 1 task numbers, 1.0, 2.0, etc., will be treated as tasks, Level 2 task numbers, 1.1, 10.4, etc., will be treated as subtasks, Level 3 task numbers, 1.1.1, 3.2.6, etc., will be reidentified as
skills, and Level 4 task numbers, 1.3.5.6, etc., will be reidentified as knowledge.

2. Data Element Name: Task Name
   Input Medium: Keyboard, Disk
   Definition: Text label describing the task
   Format: Text String
   Range of Values: 1 to 50
   Unit of Measurement: Character
   Data Item Names: N/A
   Miscellaneous: See miscellaneous under task number

3. Data Element Name: Control Name
   Definition: Text description of device control
   Input Medium: Keyboard, Disk
   Format: Text
   Range of Values: 1 to 50
   Unit of Measurement: Character
   Data Item Names: N/A

4. Data Element Name: Display Name
   Definition: Text description of device display
   Input Medium: Keyboard, Disk
   Format: Text
   Range of Values: 1 to 50
   Unit of Measurement: Character
   Data Item Names: N/A

5. Data Element Name: Skill
   Definition: Text description of skill to be trained
   Input Medium: Keyboard, Disk
   Format: Text
Range of Values: 1 to 50
Unit of Measurement: Character
Data Item Names: N/A

Miscellaneous: When the task list is imported from another program, any subtask at the level three task number, e.g., 1.2.3, will be relabeled a skill.

6. Data Element Name: Knowledge
Definition: Text description of knowledge to be acquired
Input Medium: Keyboard, Disk
Format: Text
Range of Values: 1 to 50
Unit of Measurement: Character
Data Item Names: N/A

Miscellaneous: When the task list is imported from another program, any subtask at the level four task number, e.g., 1.2.3.4, will be relabeled a knowledge.

7. Data Element Name: Rating
Definition: User assigned rating to each device based on ASTAR II questions
Input Medium: Keyboard, Disk
Format: #
Range of Values: 0 to 100, default (no rating) = -999. On data items with a range of 0 - 100, a 0 rating is assigned an internal value of 1.
Unit of Measurement: digit
Data Item Names:

<table>
<thead>
<tr>
<th>ASTAR Level</th>
<th>Category</th>
<th>Question</th>
<th>Legal Values</th>
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<tbody>
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<td>0 - 100</td>
</tr>
</tbody>
</table>

Miscellaneous: For ASTAR Level 2, ratings for each data item are made on a task and subtask basis (for those tasks and subtasks matched on the commonality analysis). For ASTAR Level 3, ratings for each data item are made on a task and subtask basis (for those tasks and subtasks matched on.
the commonality analysis). For ASTAR Level 3, ratings for physical similarity are also made for those controls and displays matched during the similarity analysis.

8. Data Element Name: Device Name

   Definition: Text label for training device or operational system
   Input Medium: Keyboard, Disk
   Format: Text
   Range of Values: 1 to 20 devices
   1 to 50 characters per name
   Unit of Measurement: Character
   Data Item Names: N/A

3.3.2 Output

1. Data Element Name: Task List

   Output Medium: Screen, Disk, Printer
   Definition: List of tasks ordered by task/subtask number
   Format: # Text
   Range of Values: 0 - 50
   Unit of Measurement: N/A
   Data Item Names: Task Number, Task Name
   Miscellaneous: N/A

2. Data Element Name: Control List

   Output Medium: Screen, Disk, Printer
   Definition: List of controls ordered by control number
   Format: # Text
   Range of Values: 0 - 200
   Unit of Measurement: N/A
   Data Item Names: Control Number, Control Name
   Miscellaneous: N/A
3. Data Element Name: Display List
   Output Medium: Screen, Disk, Printer
   Definition: List of displays ordered by display number
   Format: D# Text
   Range of Values: 0 - 200
   Unit of Measurement: N/A
   Data Item Names: Display Number, Display Name
   Miscellaneous: N/A

4. Data Element Name: Skill List
   Output Medium: Screen, Disk, Printer
   Definition: List of skills ordered by skill number
   Format: S# Text
   Range of Values: 0 - 200
   Unit of Measurement: N/A
   Data Item Names: Skill Number, Skill Name
   Miscellaneous: N/A

5. Data Element Name: Knowledge List
   Output Medium: Screen, Disk, Printer
   Definition: List of knowledge items ordered by knowledge item number
   Format: K# Text
   Range of Values: 0 - 200
   Unit of Measurement: N/A
   Data Item Names: Knowledge Number, Knowledge Name
   Miscellaneous: N/A

6. Data Element Name: Ratings
   Output Medium: Screen, Printer
   Definition: Ratings assigned to each device based on ASTAR II questions
Format: ###, graphic

Range of Values: 0 - 100. For data items with a rating range of 0 - 100 a rating of 0 is assigned a value of 1.

Unit of Measurement: N/A

Data Item Names:

<table>
<thead>
<tr>
<th>ASTAR Level</th>
<th>Category</th>
<th>Question</th>
<th>Legal Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Performance Deficit</td>
<td>1</td>
<td>0 - 100</td>
</tr>
<tr>
<td>1</td>
<td>Learning Difficulty</td>
<td>1</td>
<td>0 - 100</td>
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<td>Quality of Trng - Acq</td>
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<td>0 - 100</td>
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<td>Residual Deficit</td>
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</table>
Miscellaneous: For ASTAR II Level 2, ratings for each data item are made on a task and subtask basis (for those tasks and subtasks matched on the commonality analysis). For ASTAR II Level 3, ratings for each data item are made on a task and subtask basis (for those tasks and subtasks matched on the commonality analysis). For ASTAR II Level 3, ratings for physical similarity are also made for those controls and displays matched during the similarity analysis.

Numeric (tabular) outputs may be device (within or across devices) by ASTAR II level by data item, or device by ASTAR II level by data item question. Output may be average across tasks or subtasks, or for individual tasks or subtasks.

Graphic outputs may be device (within or across devices) by ASTAR II level by data item, or device by ASTAR II level by data item question averaged across tasks or subtasks. For individual tasks or subtasks, graphic outputs may be within a device for ASTAR II level by data item, or ASTAR II level by data item question. For individual tasks to subtasks, graphic outputs across devices may be for ASTAR II level, a range of tasks or subtasks, data items or data item questions.

7. Data Element Name: Analysis Scores

Output Medium: Screen, Disk, Printer

Definition: Computed scores and summary scores derived from ratings by ASTAR computational formulas

Format: Numeric, Tabular Numeric, Graphic

Range of Values: See Data Item Names:

Unit of Measurement: N/A
Data Item Names:

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<thead>
<tr>
<th>Data Item</th>
<th>Score Range</th>
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</table>

Miscellaneous: Output grouping can vary widely depending on user selected options. Tabular outputs may be across devices or for a single device. They may be at either the task or subtask level, and may be within a single level of ASTAR II analysis or across levels. They may also include all of the data items listed above or a specified subset. [Note: performance deficit, learning difficulty, residual deficit, and residual learning difficulty are not available as subscores in an ASTAR II Level 3 analysis.] The default tabular format is:

Performance Deficit
Learning Difficulty
Training Problem
Quality of Training - Acquisition
   Acquisition Efficiency
   Acquisition
Residual Deficit
Residual Learning Difficulty
Physical Similarity
Functional Similarity
   Transfer Problem
   Quality of Training - Transfer
   Transfer Efficiency
   Transfer
   Sum

Graphic outputs may only be displayed across devices within an ASTAR II level. Graphic outputs for a single device must be across ASTAR II levels. They may be at either the task or subtask level. They may also include all of the data items listed above or a specified subset. [Note: performance deficit, learning difficulty, residual deficit, and residual learning difficulty are not available as subscores in an ASTAR II Level 3 analysis.]
8. Data Element Name: Device Name

Output Medium: Screen, Disk, Printer

Definition: Label for Training Device or Operational System

Format: Text

Range of Values: 1 - 20 devices
1 - 50 characters per device

Unit of Measurement: N/A

Data Item Names: Training Device, Operational System

Miscellaneous: N/A

9. Data Element Name: Audit Trail Log

Output Medium: Printer

Definition: A time and date tagged listing of operations conducted within an ASTAR II data base.

Format: Text

Range of Values: TBD

Unit of Measurement: N/A

Data Item Names: N/A

Miscellaneous: N/A

3.4 DATA BASE CHARACTERISTICS

All data items described in section 3.3.1, Inputs, will be used in the ASTAR II data base. In addition to these externally entered items, ASTAR II will internally generate several items to be included in the data base. The internally generated items are identified below.

1. Data Element Name: Control Number

Definition: Internally generated sequential number assigned to control names

Input Medium: Internal

Format: "C"#

Range of Values: 1 to 200

Unit of Measurement: N/A
2. Data Element Name: Display Number

Definition: Internally generated sequential number assigned to display names

Input Medium: Internal

Format: "D"#

Range of Values: 1 to 200

Unit of Measurement: N/A

Data Item Names: N/A

Data Item Names: N/A

3. Data Element Name: Skill Number

Definition: Internally generated sequential number assigned to skill items

Input Medium: Internal

Format: "S"#

Range of Values: 1 to 200

Unit of Measurement: N/A

Data Item Names: N/A

Data Item Names: N/A

4. Data Element Name: Knowledge

Definition: Internally generated sequential number assigned to knowledge items

Input Medium: Internal

Format: "K"#

Range of Values: 1 to 200

Unit of Measurement: N/A

Data Item Names: N/A

Data Item Names: N/A

Miscellaneous:
5. Data Element Name: Audit Trail Log

Definition: A time and date tagged listing of operations conducted within an ASTAR data base.

Input Medium: Internal

Format: Test

Range of Values: TBD (maximum size of file)

Unit of Measurement: N/A

Data Item Names: Date, Time, ASTAR II operations

6. Data Element Name: Analysis Scores

Definition: Computed scores and summary scores derived from ratings by ASTAR II computational formulas

Input Medium: Internal

Format: Numeric (specific format depends on data item)

Range of Values: See Data Item Names:

Unit of Measurement: N/A

Data Item Names:

<table>
<thead>
<tr>
<th>Data Item</th>
<th>Score Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Deficit</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Learning Difficulty</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Quality of Training - Acquisition</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Residual Deficit</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Residual Learning Difficulty</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Physical Similarity</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Functional Similarity</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Quality of Training - Transfer</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Training Problem</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Acquisition Efficiency</td>
<td>0 - 1000</td>
</tr>
<tr>
<td>Acquisition</td>
<td>0 - 1000</td>
</tr>
<tr>
<td>Transfer Problem</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Transfer Efficiency</td>
<td>0.1 - 1.0</td>
</tr>
<tr>
<td>Transfer</td>
<td>0 - 1000</td>
</tr>
<tr>
<td>Sum</td>
<td>0 - 2000</td>
</tr>
</tbody>
</table>

3.5 FAILURE CONTINGENCIES

Backup disks of the ASTAR II software and data bases should be kept available in the unlikely event of a software failure. A hardware failure can be overcome by using another IBM or IBM compatible PC. If both software and system hardware failures are encountered, users would be instructed to return to manual methods.
3.6 SECURITY

ASTAR II itself will require no special security provisions. However, in some instances, classified task, control and display information might be entered into the ASTAR II data base. In such instances, normal national security regulations regarding "need to know" and levels of user clearance would prevail. The highest, most restrictive level of classification would be applied to the ASTAR disk holding the classified data base.

If data is exported to another program, such as ISD/LSAR DSS, special provisions should be observed. To maintain the integrity of the data base, it is important that the importing of data be limited to those users of an appropriate level of responsibility.
SECTION 4. DESIGN DETAILS

The section of the functional description provides a description of the ASTAR II system and identifies the ASTAR II system functions. A demonstration disk of the ASTAR II user interface is attached to the inside back cover of this document. This demonstration disk illustrates the ASTAR screen formats and flow of functions. A set of hard copy printouts of the ASTAR II screens shown in the demonstration disk is provided in Appendix E.

4.1 SYSTEM DESCRIPTION

4.1.1 System Functional Features

The following paragraphs summarize the design features of ASTAR II. As applicable, the design features address the comments, suggestions and problems with the current ASTAR that were derived during the various operational tests. A summary of these comments is provided in Appendix A. Following each design feature, the item(s) in Appendix A addressed by that feature are identified by number(s). A demonstration disk of the ASTAR II user interface is provided with the final version of the Functional Description.

4.1.1.1 Programming Environment. ASTAR II should be programmed in C. This provides a flexible software environment which should support the functionality envisioned for ASTAR II. The utilization of C also provides a reduced development time because of the availability of off-the-shelf C routines. Off-the-shelf routines should be used wherever possible; specifically for data base development, data import/export utilities, and graphic output routines.

4.1.1.2 Compatibility. ASTAR II should be data compatible to other data bases, word processors, spreadsheets, ISD/LSAR DSS, etc. (3)

The recommendation is for ASTAR II to be data compatible with other software. ASTAR II should retain an internal data base development and management routine, but it should also be able to import and export data to other programs. The ASTAR II should be able to import data from standard data bases, word processors or spreadsheets. Standard word processors could be used as editors during the import/export of data. This option requires specification of a template for the ASTAR data base. ASTAR should also be able to import/export data to the joint services ISD/LSAR DSS. Initially, this would require passing data in ASCII format.

4.1.1.3 User Configuration. ASTAR II should be a single user system. To accommodate multiple analysts ASTAR II will provide a utility to merge and combine the ratings from different files or analysts. (1,5)
4.1.1.4 Help. ASTAR II will include a number of new help features as described in the following paragraphs.

4.1.1.4.1 On Line Help. The ASTAR II will incorporate on-line facilities. They should be simple text messages. They will be context dependent as appropriate. (10,11)

4.1.1.4.2 Computational Formula Help. The help information will provide information about the ASTAR II computational formulas to aid the user in interpreting the ASTAR II analyses. (9)

4.1.1.4.3 Rating Help.
- Examples: The help function will provide additional examples and/or examples of anchor points for the rating scales. (2)
- Query: The help will include a query routine which permits the user to access ratings from related questions or a different level of ASTAR II analysis, skills and knowledge lists, or other data. (35)
- Monitoring: The help routine will monitor the ratings for ASTAR II Levels 2 and 3 and compare the average for each index to the ASTAR II Level 1 ratings. Large discrepancies (TBD %) between the ratings will be flagged to the user. (28,34,35)

4.1.1.4.4 Prompts. Error prompts will conform to current standards for human computer interface design. Error messages will identify the source/type of error. (27,36)

4.1.1.5 Data Base. The data base is one of the key areas identified for enhancement within ASTAR II. There will be both internal data base capability and the ability to import data from external sources.

4.1.1.5.1 Internal Data Base Management.
- Utilities: A utility will be available within the internal data base module. The utilities should handle the setup of the data base structure and configure the data base file formats. The functions should include:
  - name file and devices
  - specify number of devices to be included
  - data path
  - merge ratings from multiple analysts
  - copy and delete files
(2,4,5)
4.1.1.5.2 External Data Base Management.

- Interfaces: Import/export capability will be provided to any source which can provide ASCII format information. Specific interfaces should be provided to ILS/LSAR DSS, standard word processing, spreadsheets and other common data bases. The word processors could be used as an editor for import of data from external sources. It should be possible to designate portions of the task list for ASTAR II analysis. A renumbering routine to be more compatible with ASTAR II formats will be provided. (3)

- ILS/LSAR DSS. Several items should be accessible from the ILS/LSAR DSS. These include:
  - weapon system name
  - subsystem name if applicable
  - task name
  - task ISD code (task number)
  - task element name (subtask)
  - task element number (subtask)
  - skill/knowledge number
  - skill/knowledge name

The imported data must be modifiable so that as the ISD process progresses and more data becomes available it can be integrated into the imported file without having to recreate the entire file. This also is required as you progress from ASTAR II Level 1 to ASTAR II Level 3.
Other Sources: Text editors, i.e., word processors, should be usable for the creation of data files or the modification of data from data bases. This form of input will require a template to specify the correct data structure/format. (3)

4.1.1.6 Entry of Ratings.

4.1.1.6.1 Multiple Systems. ASTAR II will permit ratings for each training device to be entered on the same screen. This permits reference or anchoring across systems and removes the repetitive aspects of the current system. A function key should be available to enter the same rating for all training devices if appropriate. (7)

4.1.1.6.2 Query. ASTAR II will permit on-line query of ratings on related questions or a different level of ASTAR II. It is desirable to provide the ASTAR II Level 1 ratings automatically as a reference. (35)

4.1.1.6.3 Consistent Entry. ASTAR will provide a consistent method of entry. The <ENTER> command will be used when all entries have been made on the page. The TAB key should be used to shift between the data field for each training device. The <SHIFT-TAB> should also be active to permit transition between data fields in either direction. A standard 3 digit default value should be assigned to each field until data is actually entered. (12)

4.1.1.7 Outputs. The outputs from ASTAR should be available on screen, by printer or on disk.

4.1.1.7.1 Screen Based Outputs. An enhanced set of screen based outputs will be available within ASTAR II. The outputs should include both tabular and graphic formats.

- Ratings: Display of the ratings on a task and subtask basis should be available to the user. These ratings should be available in either tabular or graphic format. (12,37,38,39)

- ASTAR II Scores: Display of both summary and subtask scores will be available to the user. The scores will be available by task or subtask and by performance category in either tabular or graphic format. All sub scores available in ASTAR II Level 1 will be available for Levels 2 and 3, if available. (12,37,38,39)

- Graphic Outputs: Graphic outputs of scores should be available in the form of bar graph or line charts. It
is desirable for 3-D outputs to be available to provide for visualization of problems. 3-D graphics provide significantly improved outputs over 2-D graphics. (8,12,37,38,39)

4.1.1.7.2 Printer Based Outputs. All ASTAR II outputs, both graphics and tabular will be available in hard copy format. Hard copy of the tasks, control, display, skill, knowledge lists will be available. It will also be possible to obtain hard copy of the rating information and the audit trail log. The user should be able to print out an individual chart, a subset of charts, or a total data output package.

4.1.1.7.3 Disk Based Outputs. All ASTAR II tabular outputs should be available as disk outputs, either floppy or hard disk. The disk based outputs would be used to import the results into documents or export to other programs such as ILS/LSAR DSS. (14)

4.1.1.8 User Interface. The user interface will be significantly modified to improve the user friendliness of ASTAR II. The design will be structured to provide less repetitive tasks and permit more flexible and editable data entry. The interface will be menu driven using either cursor or mouse selection.

Key features of the interface will include:

- on line help
- random access entry/exit
- multiple system evaluations
- one time entry of task list
- on screen task list editing
- on screen, cursor driven
  commonality/similarity matching
- overall reduced keying requirements
- data import/export
- function key access
(1,3,5,6,7,8,11,12,13,25,26,27,28,33,34,35,36)

Several advanced features should be examined as part of the design effort. These features include a flow diagram type of menu interface with "click-on" direct access to various ASTAR II functions: commonality and similarity analysis matching by mouse selections of items; selection/deselection of tasks by mouse; and query of 3-D graphs by mouse.

4.1.1.9 Computational Formulas.

4.1.1.9.1 Availability of Formulas. The computational formulas should be available to the user in a "read only" manner. (9)

4.1.1.9.2 Modifiability of Formulas. The program should be structured so that the computational formulas can be updated as new information becomes available, but modification will be by the DoD configuration control only.
4.1.1.9.3 Display of Contributions. The contribution of the various indexes within the formulas will be computed and displayed to the user. (9,37,38)

4.1.1.10 Setup. A set up module should be provided which can be used to specify the display configuration, printer, data paths, etc.

4.1.1.11 Training Materials. The training materials will be provided in the form of manuals and as an on-line tutorial. The manual will be delivered on the distribution disk and printed out during the installation routine. The program will be self-contained on disk with no more than a single sheet of overview and installation instructions. (29,21,32)

4.1.2 Function Key Assignments

ASTAR II will utilize function keys to access operations and access utilities. The function keys utilities are designed to make the user interface more flexible and informative. The active function keys for each screen will be displayed on the bottom two lines of the display. Table 4 summarizes the function key assignments for ASTAR II. It identifies the operations assigned to each key. The function numbers refer to the functional flow numbering scheme described in Section 4.2. A brief description of the function key operations is provided below.

<table>
<thead>
<tr>
<th>FUNCTION KEY</th>
<th>OPERATION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>HELP</td>
<td>Dedicated key to accesses the on-line help routine.</td>
</tr>
<tr>
<td>F2</td>
<td>TUTORIAL</td>
<td>On the main menu, the F2 key is used to access the on-line tutorial.</td>
</tr>
<tr>
<td></td>
<td>FIND</td>
<td>During the ASTAR II rating process, F2 accesses a utility that permits you to find and jump to a specific point in the data base, e.g., go to task 2.0, quality of transfer question 6. This permits the user to jump randomly from point to point in the rating data base.</td>
</tr>
<tr>
<td></td>
<td>INSERT</td>
<td>During the data base editing routines, pressing F2 puts the edit routine in an insert mode.</td>
</tr>
<tr>
<td>F3</td>
<td>QUERY</td>
<td>During the ASTAR II rating operation, F3 permits the user to query the data base for information on related ASTAR II rating.</td>
</tr>
<tr>
<td>FUNCTION</td>
<td>F1</td>
<td>F2</td>
</tr>
<tr>
<td>----------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>1.0 (NONE)</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>2.0</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>3.0</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>3.1</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>4.0</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>5.0</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>5.1</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>5.2</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>5.3</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>5.4</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>5.5</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>5.6</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>5.7</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>5.8</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>5.9</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>6.0</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>6.1</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>6.2</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>6.3</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>6.4</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>6.5</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>6.6</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>6.7</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>6.8</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>6.9</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>7.0 (NONE)</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>7.1</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>7.2</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>7.3</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>7.4</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>7.5</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>7.6</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>7.7</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>7.8</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>7.9</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>8.0 (NONE)</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>8.1</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>8.2</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>8.3</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>8.4</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>8.5</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>8.6</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>8.7</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>8.8</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>8.9</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>9.0 (NONE)</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>9.1</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>9.2</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>9.3</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>9.4</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>9.5</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>9.6</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>9.7</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>9.8</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>9.9</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>10.0</td>
<td>HELP</td>
<td>TUTORIAL</td>
</tr>
<tr>
<td>FUNCTION</td>
<td>OPERATION</td>
<td>DESCRIPTION</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>MODIFY</td>
<td>During the data base editing routines, pressing F3 puts the edit routine in an modify mode.</td>
<td></td>
</tr>
<tr>
<td><strong>F4</strong> SET UP</td>
<td>From the main menu, pressing F4 accesses the set up function.</td>
<td></td>
</tr>
<tr>
<td>REPEAT RATING</td>
<td>During the ASTAR II rating operation, pressing F4 inserts the same assigned rating for all training devices.</td>
<td></td>
</tr>
<tr>
<td>DELETE</td>
<td>During the data base editing routines, pressing F4 puts the edit routine in a delete mode.</td>
<td></td>
</tr>
<tr>
<td><strong>F5</strong> RESULTS</td>
<td>On the main menu, the F5 key permits the user to jump to the output options for ASTAR II. This is used when the data base already exists and the user simply wants to view the output of the ASTAR II analysis.</td>
<td></td>
</tr>
<tr>
<td>ANALYSIS</td>
<td>When viewing outputs from the ASTAR II analysis, either tabular or graphic, pressing F5 returns the user to the ASTAR II rating operation.</td>
<td></td>
</tr>
<tr>
<td><strong>F6</strong> PRINT MANUAL</td>
<td>During the installation routine, pressing F6 will print a copy of the ASTAR II manual from disk.</td>
<td></td>
</tr>
<tr>
<td>DIRECTORY</td>
<td>On the main and file operation menus, pressing F6 permits the user to access a listing of available ASTAR II data bases.</td>
<td></td>
</tr>
<tr>
<td>TASK/SUBTASK</td>
<td>While in the ASTAR II rating operation, pressing F6 permits the user to toggle between the task and subtask level of analysis.</td>
<td></td>
</tr>
<tr>
<td>PRINT</td>
<td>On the screen and printer output menus, pressing F6 sends the selected data to the printer.</td>
<td></td>
</tr>
<tr>
<td><strong>F7</strong> SAVE</td>
<td>F7 is used to save the data files without exiting ASTAR II.</td>
<td></td>
</tr>
<tr>
<td><strong>F8</strong> MAIN MENU</td>
<td>F8 is used to jump to the main menu from any point within ASTAR II without loss of data.</td>
<td></td>
</tr>
</tbody>
</table>
4.1.3 Color Usage

The following chart describes the preliminary color usage scheme for ASTAR II. The reader is directed to the available demonstration disk of the ASTAR II interface for a detailed example of the ASTAR II screen formats and color codes.

<table>
<thead>
<tr>
<th>USAGE</th>
<th>TEXT/CHARACTER</th>
<th>BACKGROUND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Bright White</td>
<td>Medium Blue</td>
</tr>
<tr>
<td>Highlight</td>
<td>Bright Yellow</td>
<td>Medium Blue</td>
</tr>
<tr>
<td>Inverse</td>
<td>Dark Blue</td>
<td>Light Gray</td>
</tr>
<tr>
<td>Inverse Highlight</td>
<td>Bright Yellow</td>
<td>Light Gray</td>
</tr>
<tr>
<td>Function Keys</td>
<td>Dark Blue</td>
<td>Light Gray</td>
</tr>
<tr>
<td>Query</td>
<td>Bright White</td>
<td>Cyan</td>
</tr>
<tr>
<td>Help</td>
<td>Bright Yellow</td>
<td>Cyan</td>
</tr>
<tr>
<td>Data Entry</td>
<td>Bright White</td>
<td>Light Gray</td>
</tr>
<tr>
<td>Bar Cursor</td>
<td>(See Inverse/Inverse Highlight)</td>
<td>(See Inverse/Inverse Highlight)</td>
</tr>
<tr>
<td>Blinking Line Cursor</td>
<td>Bright White</td>
<td>Bright White</td>
</tr>
<tr>
<td>Error Message</td>
<td>Bright White</td>
<td>Red</td>
</tr>
<tr>
<td>Error Label</td>
<td>Bright White (blinking)</td>
<td>Red</td>
</tr>
</tbody>
</table>

4.2 System Functions

The following section delineates the functions and subfunctions within ASTAR II. A description of the top level functions is provided, accompanied by a functional flow diagram depicting subfunction breakdown and the sequencing of operations. Detailed functional flow diagrams are provided for subfunctions as necessary to illustrate the functional operation of ASTAR II. The level of detail to which the functional flow diagrams are developed reflects the complexity within the function or subfunction. The functional flow diagrams are developed to the minimum level of detail required to describe the basic functionality within ASTAR II. Figure 4 identifies the symbology utilized in the development of the functional flow diagrams.

4.2.1 Functional Descriptions

4.2.1.1 Top Level Functional Description. The top level functional flow diagram illustrates the overall design of ASTAR
Figure 4. Functional Flow Diagram Symbology.
II. There are nine top level functions in the ASTAR design as described below. (Function 1.0 is a decision to install ASTAR II and is not described below.)

2.0 Installation
This function installs ASTAR II on either a floppy disk or hard disk as specified by the user. During the installation routine, the user is given the option to print out a hard copy of the users manual, which is stored on the distribution disk.

3.0 Select Option
The select option is the main menu function for ASTAR II. From the main menu, the user may select the level of ASTAR subfunctions are provided via function keys. Sub-functions accessible through function keys are:

- the help routines,
- the on-line tutorial,
- the set up utility,
- jump to the view results routine,
- view a directory of existing data bases,
- escape to DOS and return, and
- quit.

4.0 Set Up
The set up function permits the user to specify the hardware configuration of the system ASTAR II is installed on. The user can select or change the monitor and printer configuration. The user also specifies whether a mouse is present in the system. Another subfunction that is provided in ASTAR II, selectable through the set up utility, is an automatic save feature. This feature will save all data in memory to disk every fifteen minutes.

5.0 ASTAR II Analysis
The ASTAR II analysis function has two primary components; the rating subfunction and the results/output subfunction. The rating subfunction is used to assign ratings for each device based on ASTAR II evaluation categories. The number of ratings that are assigned is determined by the level of ASTAR II analysis. The results/output subfunction permits the user to view the results of the ASTAR II analysis. This subfunction permits the user to examine both raw data and ASTAR II assessments. ASTAR assessments may access both summary and subscores to aid in interpretation. The results may be viewed in either a tabular or graphic format as appropriate.

6.0 File Operations
The file operation function is the data base creation and management function. Through this function the user creates a data base structure; sets the number of devices; names the devices for evaluation; accesses data import and export utilities; merges data bases from multiple raters; copies
and deletes data bases; manages the data base, which includes conducting similarity and commonality analyses; and requests reports of the data.

7.0 Quit ASTAR II
The quit function lets the user exit ASTAR II. It saves and closes all files as appropriate and downloads any memory resident routines. It also serves to deactivate and close the on-line help and audit trail log.

8.0 On-line Help
The on-line help utility provides context dependent help at all points within ASTAR II. This function resides on-line while ASTAR is active. It is always accessed by pressing the F1 function key. The on-line help provides brief text messages to clarify the operation of keys, option, or information relevant to the interpretation of ASTAR scores.

9.0 Audit Trail Log
The audit trail log maintains a continuous time and date tagged log of operations conducted on an ASTAR II data base. It logs day of creation, dates accessed, operations conducted, analyses conducted, notes if the data base was created by merging files, etc. This function should not be readily accessible to the user. The only access currently specified is a printout capability provided as part of the report function under file operations.

10.0 On-Line Tutorial
The on-line tutorial is the primary training vehicle for ASTAR II. It is accessed through a function key on the main ASTAR II menu. It provides an interactive tutorial which describes and leads the user through exercises using ASTAR II.

4.2.1.2 ASTAR II Functional Flow Diagrams. The following functional flow diagrams provide a more detailed breakdown of the top level functions described above. The level of breakdown varies across function and subfunction sufficient to depict the full functionality with ASTAR II. The level of detail beyond that provided involves implementation decisions and will be completed during the ASTAR II development effort.

4.2.2 Accuracy and Validity
The requirements for accuracy and validity for data and calculations are as specified in Section 3.1.1.

4.2.3 Timing
The ASTAR II requirements for timing are as specified in Section 3.1.2.
Level 1 ASTAR II
Function 2.0
Level 2 ASTAR II
Sub-Functions 2.1 and 2.2
Level 1 ASTAR II
Function 3.0
Level 2 ASTAR II
Sub-Function 3.1
Level 1 ASTAR II
Function 4.0
Level 2 ASTAR II
Sub-Functions 4.1 and 4.2
Level 1 ASTAR II
Function 5.0
Level 2 ASTAR II
Sub-Function 5.7
Level 1 ASTAR II
Function 6.0
Level 2 ASTAR II
Sub-Function 6.2
Level 2 ASTAR II
Sub-Functions 6.3 and 6.4
Level 2 ASTAR II
Sub-Functions 6.5, 6.6 and 6.7
Level 2 ASTAR II
Sub-Function 6.8
Level 3 ASTAR II
Sub-Function 6.8.1
Level 3 ASTAR II
Sub-Functions 6.8.2 and 6.8.3
Level 3 Revised ASTAR
Sub-Functions 6.8.4 and 6.8.5
Level 3 ASTAR II
Sub-Function 6.8.6
Level 2 ASTAR II
Sub-Function 6.9
Level 3 ASTAR II
Sub-Function 6.9.1
Level 3 ASTAR II
Sub-Functions 6.9.2 and 6.9.3
Level 1 ASTAR II
Function 7.0
Level 1 ASTAR II
Function 8.0
Level 1 ASTAR II
Function 9.0
Level 1 ASTAR II
Function 10.0
4.3 **FLEXIBILITY**

Two areas within ASTAR II require flexibility in the program development. The first area is the file of ASTAR II questions. The three levels of ASTAR II questions should remain as independent text files. This permits terminology within questions to be modified for a specific operational environment. These changes should be made by appropriate DoD program personnel to ensure that all users within an operational environment are using an equivalent version of the program. The second area of potential modification is the ASTAR II computational formulas. If new information becomes available which indicates that the formulas could be improved, it should be possible to easily make the necessary changes. This requires the source code for ASTAR II to have adequate internal documentation and be structured so that the equations can be easily updated and verified. Changes to the computational formulas should only be made by personnel within the DoD organization charged with ASTAR II configuration control.

4.4 **SYSTEM DATA**

4.4.1 **Inputs**

The system data inputs are the same as described in Sections 3.1.1 and 3.4.

4.4.2 **Outputs**

The system data outputs are the same as described in Section 3.1.2. Appendix F provides examples of the different ASTAR II outputs indicating suggested format, headings, etc.

4.4.3 **Data Base**

The data base structure for ASTAR II shall be hierarchical and be comprised of separate smaller data bases for different data classes. An overall data base structure will be established for each system. Under this top level structure, separate smaller data bases will be established for each training device. This permits flexibility in selecting subsets of devices for analysis and editing. Below is a list of the basic data bases needed for ASTAR II.

1. **Title: System Data Base**

   Definition: Top level data base that defines the data base structure for a weapons system. It contains information on the number of training devices, the training device names, etc. It will also include the current computed ASTAR scores. The audit trail log may be part of the system data base or a separate data base.
2. Title: Audit Trail Log (may be implemented as part of the system data base)

Definition: A date and time tagged file of ASTAR II operations on a specific system data base. It contains information on the date of creation, source (new or merged), if merged it identifies the source files, operations conducted on each access of the ASTAR II data base, etc.

3. Title: Training Device Rating Data Base

Definition: A numeric and text data base which contains the ASTAR II ratings, for all three levels, for a particular device. This data base also contains the commonality and similarity analysis for the data base training device. These analyses are used to determine the active ratings for ASTAR II Level 2 and 3 analyses as appropriate.

4. Title: Task data base

Definition: A numeric and text file which contains the master list of tasks and subtasks and their associated number. (A master list is the total list of items across all devices prior to editing to create the tailored list applicable to a particular device.)

5. Title: Control data base

Definition: A numeric and text file which contains the master list of device controls and their associated number.

6. Title: Display data base

Definition: A numeric and text file which contains the master list of device displays and their associated number.

7. Title: Skill data base

Definition: A numeric and text file which contains the master list of skill items and their associated number.

8. Title: Knowledge data base

Definition: A numeric and text file which contains the master list of knowledge items and their associated number.

9. Title: Help

Definition: One or more text files to support the on-
line help facility. These files contain help messages, examples, prompts, etc.

10. Title: Error messages

Definition: Text file which contains a list of the ASTAR II error messages.

11. Title: ASTAR Level 1 questions

Definition: Text file which contains the questions for an ASTAR Level 1 analysis. Questions are provided in Appendix C.

12. Title: ASTAR Level 2 questions

Definition: Text file which contains the questions for an ASTAR Level 2 analysis. Questions are provided in Appendix C.

13. Title: ASTAR Level 3 questions

Definition: Text file which contains the questions for an ASTAR Level 3 analysis. Questions are provided in Appendix C.
SECTION 5. ENVIRONMENT

5.1 EQUIPMENT ENVIRONMENT

The current implementation of ASTAR is designed to run on an IBM PC, XT or 100% compatible, dual floppy disk drives or one floppy drive and one hard drive, monochrome monitor and 256k memory. This hardware environment is insufficient for useful implementation of ASTAR because it does not support more recent common microprocessors or printer outputs. The hardware environment for ASTAR II is outlined below. The hardware environment is compatible with the joint services ISD/LSAR DSS specification. Requirements are as follows:

a. Hardware - - IBM PC, XT, AT, PS/2 or 100% compatibles. A color monitor is recommended but not required; EGA or VGA preferred. A mouse is also recommended although not included in the ISD/LSAR DSS specification.

b. Main Memory - - Hardware should include 640k bytes of RAM.

c. Printer - - Any IBM character graphics set printer with 80 to 256 columns.

d. Storage Capacity - - Sufficient to support the import of data from other programs. Minimum storage recommended is 20 to 30m bytes. (ISD/LSAR DSS requires 65m bytes for a single weapon system.)

5.2 SUPPORT SOFTWARE ENVIRONMENT

The software support environment for ASTAR II is minimal. It is designed to run as a stand alone program operating in a MS-DOS environment with no external software requirements. It can be used in conjunction with other programs capable of producing ASCII data files, e.g., word processors, which are available in the user's work environment. The organization providing configuration control for ASTAR II should have available the C compiler selected for the program. The compiler would only be necessary for recompilation if changes are made to the program, such as modification of the computational formulas.

5.3 INTERFACES

The ASTAR II system should have the capability to interface with word processors, spreadsheets, data base programs or the data base of ISD/LSAR DSS to access task and control and display data. The data exchange format should be in ASCII format. Interface should be by disk or optionally by modem. Such an interface would save considerable duplication of effort and data entry time. The import routine within ASTAR II should provide a template which permits the imported data to be reformatted to meet ASTAR II data base structure and organization.
5.4 SUMMARY OF IMPACTS

5.4.1 ADP Organization Impacts

There are no ADP organizational impacts anticipated.

5.4.2 ADP Operational Impacts

There are no ADP operational impacts anticipated.

5.4.3 ADP Development Impacts

The personnel and processing commitment necessary to revise and test the ASTAR system will depend on the degree of acceptance of the recommended options and improvements.

5.5 FAILURE CONTINGENCIES

Backup disks of the ASTAR software and data bases should be kept available in the unlikely event of a software failure. A hardware failure can be overcome by using another IBM or IBM compatible PC. If both software and system hardware failures are encountered users would be instructed to return to manual methods.

5.6 SECURITY

ASTAR itself will require no special security provisions. However, in some instances, classified task, control and display information might be entered into the ASTAR data base. In such instances, normal national security regulations regarding "need to know" and levels of user clearance would prevail. The highest, most restrictive level of classification would be applied to the ASTAR disk holding the classified data base.

If data is exported to another program, such as ISD/LSAR DSS, special provisions should be observed. To maintain the integrity of the data base, it is important that importing of data be limited to those users of an appropriate level of responsibility.

5.7 ASSUMPTIONS AND CONSTRAINTS

It is assumed that ASTAR II will be compatible with the range of IBM compatible microcomputers in government and contractor inventory at the time of its development.
SECTION 6. COST FACTORS

This section addresses the cost factors which are associated with the actual development of ASTAR II. An attempt has been made to provide preliminary estimates of the manhours and other costs associated with the development of ASTAR II. It is estimated that this effort could be accomplished in a period of twelve months. The cost factors associated with the development of ASTAR II include:

- Technical Management
- Subject Matter Expertise
- Software Design
- Training Materials
- Software Development
- Documentation
- Reports
- Test and Evaluation
- Travel
- Miscellaneous
- Implementation

6.1 TECHNICAL MANAGEMENT

Technical management for a program such as this will require both a program manager and a technical manager/principal investigator. The program manager would be responsible for programmatic issues and non-technical issues. The technical manager/principal investigator would be responsible for the oversight of all technical matters. The program manager must have a medium level of understanding with ASTAR II concepts, while the technical manager must be intimately familiar with all aspects of ASTAR II. The level of effort for the program manager would be higher initially in the program and at the end of the program. By quarter, his level of effort should approximate 50%, 25%, 25%, 50%, respectively, for a total manhour level of effort of 780 hours. The technical manager would require approximately a 75% level of effort throughout the program for a manhour level of effort of 1560 hours.

6.2 SUBJECT MATTER EXPERTISE

Subject matter expertise will be needed throughout the design process, however, a greater level of effort will be necessary during the initial six months of the program. The subject matter expertise provides input on how analysts would use the program and how that should influence the design. This person would also assist in the development of the test and evaluation requirements. The anticipated level of effort would be approximately 20% over the first six months and 10% over the second six months. This equates to a manhour level of effort of approximately 312 hours.
6.3 SOFTWARE DESIGN

The software design activity is critical and will require a concentrated effort of a lead programmer working in conjunction with the technical manager. This would also require activities by other programmers involved in the program. This effort entails the refinement and completion of the design described in this document. The initial effort should require approximately 3 months with an estimated total manhours across all personnel of 800 hours.

6.4 TRAINING MATERIALS

The design and development of the users manual and on-line tutorial will require approximately 400 hours. Programming of the on-line tutorial (considered separate of 6.5 Software Development) will require approximately 200 hours.

6.5 SOFTWARE DEVELOPMENT

The software development will take approximately six months of time including refinements. A small effort would be required over an additional one month period to make final changes. It is assumed that the software development would make use of rapid prototyping techniques and permit several intermediate evaluations of the program to be conducted. By providing ongoing feedback, the development would be more efficient and eliminate the need for major reprogramming. It is also assumed that off-the-shelf routines would be used where possible. Total programming hours should not exceed 1800 hours. It is estimated that off-the-shelf routines would add approximately $1500 to the cost of this effort. Without the off-the-shelf routines add 500-1000 hours of software development.

6.6 SOFTWARE DOCUMENTATION

The costs associated with software development are influenced by the software development and documentation standards. This functional description recommended the use of on-line documentation where possible to minimize this cost. Estimated software documentation requirements to meet the DoD standards within the guidelines outlined in Section 1.0 will require approximately 1000 hours.

6.7 REPORTS

Reports of this effort should be minimal. The primary report would be monthly status reports. [It is recommended that bimonthly reports be used for this type of development effort with quarterly progress reviews.] A complete functional description detailing the final design should be required. In addition, it is expected that a final report will be required and that it would contain documentation of any test and evaluations conducted on the ASTAR II. Estimated manhours requirements for a functional description and final report is 340 hours. [Much of
the development of the Final Functional Description is contained in the manhour estimate for Section 6.3.]

6.8 TEST AND EVALUATION

A minimal level of test and evaluation should be conducted. Internal test of the software should be conducted during the developmental effort. At least one interim and one final test should be conducted with operational analysts to gather feedback on the design. These should be very informal test and evaluation efforts. It is suggested that the final test and evaluation be conducted with two of the three groups of subjects used in the operational tests conducted under Contract 61339-89-C-0029. This would provide feedback on how well the design addresses their initial comments which are the design drivers. Estimated level of effort for all test and evaluation activities is 400 hours.

6.9 TRAVEL

Travel will be required to conduct the test and evaluations on the design and gather initial inputs to the design, i.e., coordination with the ISD/LSAR DSS project. Total travel costs should not exceed $6,000.

6.10 MISCELLANEOUS

Miscellaneous cost include copying of documentation for delivery and other reproduction costs. Basic miscellaneous costs will be between $1500 - $2000.

6.11 IMPLEMENTATION

Implementation costs will include development of a formal implementation plan. Depending upon level of detail and whether a user survey will be required, between 100 and 200 manhours will be expended on the implementation plan. In addition, presentations and demonstrations to potential user groups, including at conventions, will require approximately 400 hours and an estimated $5,000 of travel. Another cost under implementation is the cost of initial distribution of the ASTAR II program. It is recommended that the entire program be distributed on disk, i.e., no separate hard copy documentation. This form of distribution minimizes cost of distribution. It is estimated that professional production cost of the disks (5 1/4 inch DS/DD) for distribution, with disk jacket printed instructions would be approximately $5.00 per disk. Costs for 3 1/2 disks or both disk formats would be slightly higher. Therefore, an initial distribution of 1000 copies of ASTAR II would be approximately $5000.

6.12 SUMMARY OF COSTS

This section summarizes the estimated development cost for ASTAR II. It includes time for familiarization with ASTAR, development time, documentation, test and evaluation, and initial
distribution. NOTE: These estimates assumes the use of off-the-shelf C language routines where appropriate. Without these off-the-shelf programs add 1000 hours.

<table>
<thead>
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<th>Technical and Program</th>
<th>Manhours</th>
<th>Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
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<td></td>
</tr>
<tr>
<td>Subject Matter Expertise</td>
<td>312</td>
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<td>Software Design</td>
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<td></td>
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<td>Training Materials</td>
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<td>1500</td>
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<tr>
<td>Documentation</td>
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</tr>
<tr>
<td>Reports</td>
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<tr>
<td>Test and Evaluation</td>
<td>400</td>
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<tr>
<td>Travel</td>
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<td>6000</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>Implementation</td>
<td>600</td>
<td>10000</td>
</tr>
<tr>
<td></td>
<td><strong>8152</strong></td>
<td><strong>$19500</strong></td>
</tr>
</tbody>
</table>

1 It is estimated, based on experience gained in the operational evaluation of ASTAR, that approximately 2000 of the specified manhours will be associated with all team members becoming sufficiently familiar with ASTAR to have the required depth of knowledge to develop ASTAR II.
SECTION 7. SYSTEM DEVELOPMENT PLAN

The system development plan is TBD. It will be developed by the developer and sponsor of the ASTAR II development effort when pursued.
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SECTION 8. APPENDICES

This section provides appendices of supporting data for the ASTAR II development effort. Appendix A presents a compilation of the comments, ratings and suggestions derived during the operational evaluation which drove the design of ASTAR II. Appendix B provides the source code for the current implementation of ASTAR. Appendix C provides a print out of the ASTAR questions. Appendix D provides detailed flow diagrams and other data for the current implementation of ASTAR. Appendices B, C and D are intended to provide background information on the operation of ASTAR. Appendix E provides hard copy examples of the preliminary screens associated with ASTAR II. Finally, Appendix F provides samples of ASTAR II output formats.
APPENDIX A

ASTAR COMMENTS/SUGGESTIONS
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COMPOSITE ASTAR NEGATIVE COMMENTS, 
BELOW AVERAGE RATINGS AND 
SUGGESTED CHANGES

1. Tediousness and length of time associated with the entry of almost identical lists of controls and displays for both the operational system and the trainer in both the workbook and the computer. M60A1

2. Inflexibility of the model once the data is entered SEAWOLF

3. Provide input/output capabilities from data base and spreadsheet programs DLI SEAWOLF

4. Allow revision of data base SEAWOLF

5. Allow input to be duplicated SEAWOLF

6. Upgrade to mouse input SEAWOLF

7. Allow side-by-side comparison of two systems rather than the current practice of producing output for one system followed by output for the next SEAWOLF DLI

8. Offer graphics capabilities SEAWOLF

9. The lack of definition of the data in final summary renders it meaningless. M60A1

10. Need documents or screen presentations to tell how to interpret the different scores. M60A1

11. Lack of organization of the menus which prohibited a free flow in and out of the process. In other words, there was no capability to escape from the program at any point and then return at a later time to the same point. This could be done, of course, but not quickly and conveniently. Instead, the user was forced to work his way through a time consuming, complex procedure to arrive at his point of interest. M60A1

12. ASTAR should be reprogrammed to make it more user friendly and to provide a more meaningful output. M60A1

A-3
13. Simplified utility menus to allow easy editing, addition, and deletion of controls and displays, and task and subtask data

14. A way to save data on both hard drive and floppy disks.

15. Some cost factors be included in ASTAR or costing recommendations made that could be used with the existing ASTAR results

16. Overall utility ASTAR rated 3 on scale of 1 to 3 compared to conventional methods and AIMS. (1=highest, 3=lowest)

17. Overall ease of use ASTAR rated 2.6 on scale of 1 to 3 compared to conventional methods and AIMS. (1=highest, 3=lowest)

18. Overall relevance of ASTAR rated 2.6 on scale of 1 to 3 compared to conventional methods and AIMS. (1=highest, 3=lowest)

19. Overall effectiveness ASTAR rated 2.3 on scale of 1 to 3 compared to conventional methods and AIMS. (1=highest, 3=lowest)

The following ratings were made on a seven point scale. (1 = low, 4 = average, 7 = high)

20. Not Useful/Useful rating of 2.3

21. Difficult/Easy rating of 2.1

22. Frustrating/Satisfying rating of 2.1

23. Rigid/Flexible rating of 2.3

24. Unproductive/Productive rating of 1.8

25. Illogical/Logical organization of menus of 3.6 (2 of 3 rated average or above)

26. Confusing/Very Clear Labels rating of 3.6 (2 of 3 rated above average)

27. Not Helpful/Helpful prompts rating of 3 (2 OF 3 average)

28. Never/Always kept informed rating of 2.6

29. Difficult/Easy learn to operate rating of 2.1
30. Difficult/Easy to explore features rating of 2.3

31. Not Helpful/Helpful instructional materials rating of 2.8

32. Incomplete/Thorough instructional materials rating of 3.3 (1 slightly below average and 1 above average)

33. Never/Always straightforward tasks rating of 3.1

34. Not Helpful/Helpful feedback rating of 3.0

35. High/Low memory requirement rating of 2.8

36. Not Helpful/Helpful error message rating of 1.6

37. Not Useful/Useful analysis results rating of 2.0

38. Difficult/Easy to understand results rating of 1.6

39. Confusing/Clear format of results rating of 2.3

40. Integrate with the Joint Services ILS/LSAR DSS
APPENDIX B

ASTAR SOURCE CODE

B-1
(This Page Intentionally Left Blank)
IDENTIFICATION DIVISION.
PROGRAM-ID. ASTARX.
* c 1984, American Institutes for Research
* This material may be reproduced by or for
* the U.S. Government pursuant to the
* copyright license under DAR clause 7-104.9(a)
* (1979 MAR)
*----------------------------------------------------------
* THIS PROGRAM IS THE ASTAR MENU PROGRAM.
*----------------------------------------------------------

AUTHOR. Timothy O'Connor.
INSTALLATION. American Institutes for Research.
DATE-WRITTEN. JULY 1984.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER.
OBJECT-COMPUTER.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
DATA DIVISION.
WORKING-STORAGE SECTION.
  01 NOTHING PIC X.
  01 CTL-STATUS-WORD PIC XX.
  01 DEVICE-STATUS-WORD PIC XX.
  01 TITLE-STATUS-WORD PIC XX.
  01 NEW-DESC PIC X(54).
  01 OPTION PIC X.
  01 LAST-KEY PIC XX.

PROCEDURE DIVISION.
BEGIN.
  DISPLAY (1, 1) ERASE.
  DISPLAY (1, 22)
    "ASTAR MAIN MENU".
  DISPLAY (2, 27)
    "ver 2.0".
  DISPLAY (5, 23)
    "(1) ASTAR 1".
  DISPLAY (7, 23)
    "(2) ASTAR 2".
  DISPLAY (9, 23)
    "(3) ASTAR 3".
  DISPLAY (11, 23)
    "(4) Display Ratings".
  DISPLAY (13, 23)
    "(5) Database Maintenance".
  DISPLAY (15, 23)
    "(6) EXIT PROGRAM".
  DISPLAY (17, 14)
    "Enter option ".
  ACCEPT (LIN, COL) OPTION WITH AUTO-SKIP.
  DISPLAY (1, 1) ERASE.
  IF OPTION = "1" CALL "ASTAR1".
  IF OPTION = "2" CALL "ASTAR2".
  IF OPTION = "3" CALL "ASTAR3".

IF OPTION = "4" CALL "LIST".
IF OPTION = "5" CALL "MAINT".
IF OPTION = "6" STOP RUN.
GO TO BEGIN.
IDENTIFICATION DIVISION.
PROGRAM-ID. ASTAR1.
*   c 1984, American Institutes for Research
*   This material may be reproduced by or for
*   the U.S. Government pursuant to the
*   copyright license under DAR clause 7-104.9(a)
*   (1979 MAR)
* THIS IS THE ASTAR 1 ANALYSIS PROGRAM.

AUTHOR. Timothy O'Connor.
INSTALLATION. American Institutes for Research.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER.
OBJECT-COMPUTER.
INPUT-OUTPUT SECTION.
FILE-CONTROL.

SELECT DEVICE-FILE ASSIGN TO DISK
ORGANIZATION IS INDEXED
ACCESS MODE IS DYNAMIC
RECORD KEY IS DEVICE-KEY
FILE STATUS IS DEVICE-STATUS-WORD.

SELECT TEXT-FILE ASSIGN TO DISK
ORGANIZATION IS LINE SEQUENTIAL.

DATA DIVISION.
FILE SECTION.
FD DEVICE-FILE
   LABEL RECORD IS STANDARD;
   VALUE OF FILE-ID IS "B:DEVICE".
   01 DEVICE-RECORD.
   03 DEVICE-KEY    PIC X(10).
   03 DEVICE-ANALYSIS OCCURS 20 TIMES PIC 999.
   03 DEVICE-TITLE  PIC X(60).

FD TEXT-FILE
   LABEL RECORD IS STANDARD;
   VALUE OF FILE-ID IS "ASTAR1.DOC".
   01 TEXT-RECORD.
   05 REC-INDICATOR  PIC XX.
   05 FILLER        PIC X.
   05 ANALYSIS-NUMBER PIC X.
   05 FILLER        PIC X(75).

WORKING-STORAGE SECTION.
   01 NOTHING PIC X.
   01 TASK-NO  PIC Z(4).9999 DISPLAY.
   01 RATING PIC 999.
   01 PREVIOUS-RATING PIC ZZ9.
   01 DEVICE-STATUS-WORD PIC XX.
PROCEDURE DIVISION.
BEGIN.
OPEN I-O DEVICE-FILE.
OPEN INPUT TEXT-FILE.
DISPLAY (1, 1) ERASE.
MOVE "0 0.0000" TO DEVICE-KEY.
MOVE TASK-NO TO REQ-TASK-NO.
READ DEVICE-FILE RECORD INVALID KEY GO TO BAD-KEY.
MOVE 0 TO OPTION.

MENU.
MOVE OPTION TO PREV-OPTION.
MOVE 0 TO OPTION.
MOVE 0 TO EOF-DEVICE
MOVE "00" TO LAST-KEY
DISPLAY (1, 1) ERASE.
DISPLAY (1, 25)
" "
DISPLAY (4, 25)
"(1) Performance Deficit",
DISPLAY (5, 25)
"(2) Learning Difficulty",
DISPLAY (6, 25)
"(3) Quality of Training-Acquisition".

B-6
DISPLAY (7, 25)
"(4) Residual Deficit"
DISPLAY (8, 25)
"(5) Residual Learning Difficulty"
DISPLAY (9, 25)
"(6) Physical Similarity"
DISPLAY (10, 25)
"(7) Functional Similarity"
DISPLAY (11, 25)
"(8) Quality of Training-Transfer"
DISPLAY (12, 25)
"(9) Evaluation Summary"
DISPLAY (15, 12) "Enter Option Number ".
ACCEPT (LIN, COL) OPTION WITH AUTO-SKIP.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "01" GO TO STOP-RUN.
DISPLAY (1, 1) ERASE.
IF OPTION = 01 GO TO PERFORMANCE-DEFICIT-ANALYSIS.
IF OPTION = 02 GO TO LEARNING-DIFFICULTY-ANALYSIS.
IF OPTION = 03 GO TO TRAINING-ACQUISITION-ANALYSIS.
IF OPTION = 04 GO TO RESIDUAL-DEFICIT-ANALYSIS.
IF OPTION = 05 GO TO RESIDUAL-DIFFICULTY-ANALYSIS.
IF OPTION = 06 GO TO PHYSICAL-SIMILARITY-ANALYSIS.
IF OPTION = 07 GO TO FUNCTIONAL-SIMILARITY-ANALYSIS.
IF OPTION = 08 GO TO TRAINING-TRANSFER-ANALYSIS.
IF OPTION = 09 GO TO EVALUATION-SUMMARY.
IF OPTION = 10 GO TO STOP-RUN.
GO TO MENU.

PERFORMANCE-DEFICIT-ANALYSIS.
MOVE 1 TO X.
MOVE 1 TO Z.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT.
GO TO MENU.

LEARNING-DIFFICULTY-ANALYSIS.
MOVE 2 TO X.
MOVE 2 TO Z.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT.
GO TO MENU.

TRAINING-ACQUISITION-ANALYSIS.
MOVE 3 TO X.
MOVE 3 TO Z.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT.
GO TO MENU.

RESIDUAL-DEFICIT-ANALYSIS.
MOVE 4 TO X.
MOVE 4 TO Z.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT.
GO TO MENU.
RESIDUAL-DIFFICULTY-ANALYSIS.
MOVE 5 TO X.
MOVE 5 TO Z.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT.
GO TO MENU.

PHYSICAL-SIMILARITY-ANALYSIS.
MOVE 6 TO X.
MOVE 6 TO Z.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT.
GO TO MENU.

FUNCTIONAL-SIMILARITY-ANALYSIS.
MOVE 7 TO X.
MOVE 7 TO Z.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT.
GO TO MENU.

TRAINING-TRANSFER-ANALYSIS.
MOVE 8 TO X.
MOVE 8 TO Z.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT.
GO TO MENU.

FIND-SCREEN.
IF ANALYSIS-NUMBER > OPTION OR OPTION = PREV-OPTION
CLOSE TEXT-FILE
OPEN INPUT TEXT-FILE
READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
DISPLAY (1, 1) ERASE.

READ-TEXT.
IF REC-INDICATOR = "ZZ" AND
ANALYSIS-NUMBER = OPTION GO TO DISPLAY-SCREEN.
IF REC-INDICATOR = "ZQ" AND ANALYSIS-NUMBER = OPTION
PERFORM DISPLAY-INTRO-SCREEN THRU
DISPLAY-INTRO-SCREEN-EXIT
PERFORM HIT-ANY-KEY
GO TO READ-TEXT.
READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
GO TO READ-TEXT.

DISPLAY-SCREEN.
IF LAST-KEY = "01" GO TO DISPLAY-SCREEN-EXIT.
READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
IF REC-INDICATOR = "ZZ" OR REC-INDICATOR = "ZQ"
GO TO DISPLAY-SCREEN-EXIT.
DISPLAY TEXT-RECORD.
GO TO DISPLAY-SCREEN.
DISPLAY-SCREEN-EXIT.
EXIT.
HIT-ANY-KEY.
DISPLAY (LIN, COL) "Hit any key to continue".
ACCEPT (LIN, COL) NOTHING WITH AUTO-Skip.
ACCEPT LAST-KEY FROM ESCAPE KEY.
DISPLAY (1, 1) ERASE.

RATE-TASKS.
DISPLAY (23, 1) ERASE.
DISPLAY (LIN, 1) DEVICE-TITLE.
DISPLAY " ".
MOVE DEVICE-ANALYSIS(X) TO RATING.
IF RATING NOT = 999
  MOVE RATING TO PREVIOUS-RATING
  DISPLAY (LIN, 1) "Previous Rating = ", PREVIOUS-RATING.
DISPLAY (LIN, COL) " Enter Rating = ".
ACCEPT (LIN, COL) RATING WITH AUTO-Skip UPDATE.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "01" GO TO RATE-TASKS-EXIT.
IF RATING = PREVIOUS-RATING GO TO RATE-TASKS-EXIT.
MOVE RATING TO DEVICE-ANALYSIS(X).
REWRITE DEVICE-RECORD INVALID KEY GO TO BAD-KEY.

RATE-TASKS-EXIT.
EXIT.

EVALUATION-SUMMARY.
DISPLAY (1, 1) ERASE.
DISPLAY (1, 31) "Evaluation Summary".
DISPLAY (3, 1)
  " Performance Deficit ".
MOVE DEVICE-ANALYSIS(1) TO PREVIOUS-RATING.
IF PREVIOUS-RATING NOT = 999
  DISPLAY (LIN, COL) PREVIOUS-RATING.
DISPLAY (4, 1)
  " Learning Difficulty ".
MOVE DEVICE-ANALYSIS(2) TO PREVIOUS-RATING.
IF PREVIOUS-RATING NOT = 999
  DISPLAY (LIN, COL) PREVIOUS-RATING.
DISPLAY (5, 1)
  " Training Problem ".
MOVE 999 TO TRAINING-PROBLEM.
IF DEVICE-ANALYSIS(1) NOT = 999 AND
  DEVICE-ANALYSIS(2) NOT = 999
  COMPUTE TRAINING-PROBLEM ROUNDED =
    (DEVICE-ANALYSIS(1) * DEVICE-ANALYSIS(2)) / 100
  MOVE TRAINING-PROBLEM TO DISPLAY-NUMBER.
  DISPLAY (LIN, COL) DISPLAY-NUMBER.
DISPLAY (6, 1)
  " Quality of Training-Acquisition ".
MOVE DEVICE-ANALYSIS(3) TO PREVIOUS-RATING.
IF PREVIOUS-RATING NOT = 999
  DISPLAY (LIN, COL) PREVIOUS-RATING.
DISPLAY (7, 1)
  " Acquisition-Efficiency ".
MOVE 999 TO ACQUISITION-EFFICIENCY.
IF DEVICE-ANALYSIS(3) NOT = 999
  COMPUTE ACQUISITION-EFFICIENCY ROUNDED =
    (DEVICE-ANALYSIS(3) / 100)
  MOVE ACQUISITION-EFFICIENCY TO SQR-ROOT
PERFORM SQUARE-ROOT
MOVE SQRT-ROOT TO ACQUISITION-EFFICIENCY
MOVE ACQUISITION-EFFICIENCY TO DISPLAY-NUMBER
DISPLAY(LIN, COL) DISPLAY-NUMBER.

DISPLAY (8, 10)
" Acquisition"
IF ACQUISITION-EFFICIENCY = 0
MOVE .01 TO ACQUISITION-EFFICIENCY.
MOVE 999 TO TRAINING-ACQUISITION.
IF TRAINING-PROBLEM NOT = 999 AND
ACQUISITION-EFFICIENCY NOT = 999
COMPUTE TRAINING-ACQUISITION ROUNDED =
TRAINING-PROBLEM / ACQUISITION-EFFICIENCY
MOVE TRAINING-ACQUISITION TO DISPLAY-NUMBER
DISPLAY(LIN, COL) DISPLAY-NUMBER.

DISPLAY (9, 1)
" Residual Deficit"
MOVE DEVICE-ANALYSIS(4) TO PREVIOUS-RATING.
IF PREVIOUS-RATING NOT = 999
DISPLAY (LIN, COL) PREVIOUS-RATING.
DISPLAY (10, 1)
" Residual Learning Difficulty"
MOVE DEVICE-ANALYSIS(5) TO PREVIOUS-RATING.
IF PREVIOUS-RATING NOT = 999
DISPLAY (LIN, COL) PREVIOUS-RATING.
DISPLAY (11, 1)
" Physical Similarity"
MOVE DEVICE-ANALYSIS(6) TO PREVIOUS-RATING.
IF PREVIOUS-RATING NOT = 999
DISPLAY (LIN, COL) PREVIOUS-RATING.
DISPLAY (12, 1)
" Functional Similarity"
MOVE DEVICE-ANALYSIS(7) TO PREVIOUS-RATING.
IF PREVIOUS-RATING NOT = 999
DISPLAY (LIN, COL) PREVIOUS-RATING.
DISPLAY (13, 1)
" Transfer Problem"
MOVE 999 TO TRANSFER-PROBLEM.
MOVE 0 TO ADDITIONAL-DEFICIT.
IF DEVICE-ANALYSIS(6) NOT = 999 AND
DEVICE-ANALYSIS(7) NOT = 999
COMPUTE ADDITIONAL-DEFICIT =
DEVICE-ANALYSIS(6) - DEVICE-ANALYSIS(7).
IF DEVICE-ANALYSIS(7) > DEVICE-ANALYSIS(6)
MOVE 0 TO ADDITIONAL-DEFICIT.
IF DEVICE-ANALYSIS(4) NOT = 999 AND
DEVICE-ANALYSIS(5) NOT = 999
COMPUTE TRANSFER-PROBLEM ROUNDED =
((DEVICE-ANALYSIS(4) * DEVICE-ANALYSIS(5)) / 100) +
ADDITIONAL-DEFICIT
MOVE TRANSFER-PROBLEM TO DISPLAY-NUMBER
DISPLAY (LIN, COL) DISPLAY-NUMBER.
DISPLAY (14, 1)
" Quality of Training-Transfer"
MOVE DEVICE-ANALYSIS(8) TO PREVIOUS-RATING.
IF PREVIOUS-RATING NOT = 999
DISPLAY (LIN, COL) PREVIOUS-RATING.
DISPLAY (15, 1)
" Transfer Efficiency ".
MOVE 999 TO TRANSFER-EFFICIENCY.
IF DEVICE-ANALYSIS(8) NOT = 999
  COMPUTE TRANSFER-EFFICIENCY ROUNDED =
      (DEVICE-ANALYSIS(8) / 100)
  MOVE TRANSFER-EFFICIENCY TO SQR-ROOT
  PERFORM SQUARE-ROOT
  MOVE SQR-ROOT TO TRANSFER-EFFICIENCY
  MOVE TRANSFER-EFFICIENCY TO DISPLAY-NUMBER
DISPLAY(LIN, COL) DISPLAY-NUMBER.
DISPLAY (16, 10)
" Transfer ".
IF TRANSFER-EFFICIENCY = 0
  MOVE .01 TO TRANSFER-EFFICIENCY.
MOVE 999 TO TRAINING-TRANSFER.
IF TRANSFER-PROBLEM NOT = 999 AND
  TRANSFER-EFFICIENCY NOT = 999
  COMPUTE TRAINING-TRANSFER ROUNDED =
      TRANSFER-PROBLEM / TRANSFER-EFFICIENCY
  MOVE TRAINING-TRANSFER TO DISPLAY-NUMBER
DISPLAY(LIN, COL) DISPLAY-NUMBER.
DISPLAY (18, 10)
" d ".
IF TRAINING-ACQUISITION NOT = 999 AND
  TRAINING-TRANSFER NOT = 999
  COMPUTE ASTAR = TRAINING-ACQUISITION +
      TRAINING-TRANSFER
  MOVE ASTAR TO DISPLAY-NUMBER
DISPLAY (LIN, COL) DISPLAY-NUMBER.
DISPLAY (20, 5) ERASE.
PERFORM HIT-ANY-KEY.
GO TO MENU.
STOP-RUN.
DISPLAY (1, 1) ERASE.
CLOSE DEVICE-FILE.
CLOSE TEXT-FILE.
EXIT PROGRAM.
STOPPER.
STOP RUN.
EOF-TEXT.
DISPLAY "_EOF ON TEXT FILE".
STOP RUN.
BAD-KEY.
DISPLAY "INVALID KEY ", DEVICE-KEY.
STOP RUN.
TIMER.
PERFORM NO-OP 2000 TIMES.
NO-OP.
EXIT.
DISPLAY-INTRO-SCREEN.
READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
IF REC-INDICATOR = "ZZ" OR REC-INDICATOR = "ZQ"
GO TO DISPLAY-INTRO-SCREEN-EXIT.
DISPLAY TEXT-RECORD.
GO TO DISPLAY-INTRO-SCREEN.
DISPLAY-INTRO-SCREEN-EXIT.
EXIT.
SQUARE-ROOT.
    COMPUTE SQR1 = SQR-ROOT * 10000.
    PERFORM SQR-PROC VARYING J FROM 1 BY 2 UNTIL SQR1 < 0.
    COMPUTE SQR-ROOT ROUNDED = (J - 3) / 200.
SQR-PROC.
    SUBTRACT J FROM SQR1.
IDENTIFICATION DIVISION.
PROGRAM-ID. ASTAR2.
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* (1979 MAR)
* THIS IS THE ASTAR II ANALYSIS PROGRAM
* ----------------------------------------
AUTHOR. Timothy O'Connor.
INSTALLATION. American Institutes for Research.
DATE-WRITTEN. AUG 1984.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER.
OBJECT-COMPUTER.
INPUT-OUTPUT SECTION.
FILE-CONTROL.

SELECT DEVICE-FILE ASSIGN TO DISK
ORGANIZATION IS INDEXED
ACCESS MODE IS DYNAMIC
RECORD KEY IS DEVICE-KEY
FILE STATUS IS DEVICE-STATUS-WORD.

SELECT TITLE-FILE ASSIGN TO DISK
ORGANIZATION IS INDEXED
ACCESS MODE IS DYNAMIC
RECORD KEY IS TITLE-KEY
FILE STATUS IS TITLE-STATUS-WORD.

SELECT TEXT-FILE ASSIGN TO DISK
ORGANIZATION IS LINE SEQUENTIAL.

DATA DIVISION.
FILE SECTION.
FD DEVICE-FILE
   LABEL RECORD IS STANDARD;
   VALUE OF FILE-ID IS "$B:DEVICE".
01 DEVICE-RECORD.
   05 DEVICE-KEY PIC X(10).
   05 DEVICE-ANALYSIS OCCURS 20 TIMES PIC 999.
   05 DEVICE-TITLE PIC X(60).

FD TEXT-FILE
   LABEL RECORD IS STANDARD;
   VALUE OF FILE-ID IS "$ASTAR2.DOC".
01 TEXT-RECORD.
   05 REC-INDICATOR PIC XX.
   05 FILLER PIC X.
   05 ANALYSIS-NUMBER PIC X.
   05 FILLER PIC X(75).

FD TITLE-FILE

B-13
LABEL RECORD IS STANDARD;
VALUE OF FILE-ID IS "B:TITLE".
01 TITLE-RECORD.
   05 TITLE-KEY.
      07 TITLE-TYPE PIC 9.
      07 TITLE-TASK PIC X(9).
      07 TITLE-PERIOD PIC X.
      07 TITLE-CONTROL PIC X(9).
   05 TITLE-DESC PIC X(60).

WORKING-STORAGE SECTION.
01 ANSWER PIC X.
01 NOTHING PIC X.
01 TITLE-FLAG PIC S9(4) COMP VALUE 0.
01 TASK-NO PIC Z(3)9.9999 DISPLAY.
01 RATING PIC 999.
01 PREVIOUS-RATING PIC ZZ9.
01 TITLE-STATUS-WORD PIC XX.
01 DEVICE-STATUS-WORD PIC XX.
01 EOF-DEVICE PIC 9 VALUE 0.
01 REQ-TASK-NO.
   05 REQ-TYPE PIC 9.
   05 REQ-TASK PIC Z(4).
   05 FILLER PIC X.
   05 REQ-SUBTASK PIC X(4).
01 READ-TASK-NO.
   05 READ-TYPE PIC 9.
   05 READ-TASK1 PIC Z(4).
   05 FILLER PIC X.
   05 READ-SUBTASK PIC X(4).
01 TASK-KEY.
   05 TYPE-PART PIC X.
   05 TASK-PART PIC X(9).
   C5 PERIOD-PART PIC X VALUE ",".
   C5 CONTROL-PART PIC X(9).
01 OPTION PIC 9.
01 FREV-OPTION PIC 9.
01 LAST-KEY PIC XX.
01 X PIC 9(4).
01 Ç PIC 9(4).
01 2 PIC 9(4).
01 K PIC 9(4).
01 I PIC 9(4).
01 DISPLAY-NUMBER PIC ZZ,ZZZ.99.
01 TRAINING-PROBLEM PIC 9(5)V99.
01 ACQUISITION-EFFICIENCY PIC 9(5)V99.
01 TRAINING-ACQUISITION PIC 9(5)V99.
01 TRANSFER-PROBLEM PIC 9(5)V99.
01 TRANSFER-EFFICIENCY PIC 9(5)V99.
01 ADDITIONAL-DEFICIT PIC 9999.
01 TRAINING-TRANSFER PIC 9(5)V99.
01 ASTAR PIC 9(5)V99.
01 N1 PIC 9(4).
01 N2 PIC 9(4).
01 N3 PIC 9(4).

B-14
PROCEDURE DIVISION.
BEGIN.
OPEN I-O DEVICE-FILE.
OPEN INPUT TEXT-FILE.
OPEN INPUT TITLE-FILE.
DISPLAY (1, 1) ERASE.
MOVE ZEROS TO TASK-NO.
MOVE TASK-NO TO REQ-TASK-NO.
MOVE 0 TO OPTION.
MENU.
MOVE OPTION TO PREV-OPTION.
MOVE 0 TO OPTION.
MOVE 0 TO EOF-DEVICE.
MOVE "00" TO LAST-KEY
DISPLAY (1, 1) ERASE.
DISPLAY (1, 25) "A STAR 2"
DISPLAY (4, 25) "(1) Performance Deficit"
DISPLAY (5, 25) "(2) Learning Difficulty"
DISPLAY (6, 25) "(3) Quality of Training-Acquisition"
DISPLAY (7, 25) "(4) Residual Deficit"
DISPLAY (8, 25) "(5) Residual Learning Difficulty"
DISPLAY (9, 25) "(6) Physical Similarity"
DISPLAY (10, 25) "(7) Functional Similarity"
DISPLAY (11, 25) "(8) Quality of Training-Transfer"
DISPLAY (12, 25) "(9) Evaluation Summary"
DISPLAY (15, 12) "Enter Option Number ".
ACCEPT (LINCOL) OPTION WITH AUTO-SKIP.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "01" GO TO STOP-RUN.
DISPLAY (1, 1) ERASE.
IF OPTION = 1 GO TO PERFORMANCE-DEFICIT-ANALYSIS.
IF OPTION = 2 GO TO LEARNING-DIFFICULTY-ANALYSIS.
IF OPTION = 3 GO TO TRAINING-ACQUISITION-ANALYSIS.
IF OPTION = 4 GO TO RESIDUAL-DEFICIT-ANALYSIS.
IF OPTION = 5 GO TO RESIDUAL-DIFFICULTY-ANALYSIS.
IF OPTION = 6 GO TO PHYSICAL-SIMILARITY-ANALYSIS.
IF OPTION = 7 GO TO FUNCTIONAL-SIMILARITY-ANALYSIS.
IF OPTION = 8 GO TO TRAINING-TRANSFER-ANALYSIS.
IF OPTION = 9 GO TO EVALUATION-SUMMARY.
GO TO MENU.

PERFORMANCE-DEFICIT-ANALYSIS.
MOVE 0 TO TYPE-PART.
MOVE 1 TO X.
MOVE 1 TO Z.
PERFORM FIND-STARTING-TASK.
IF LAST-KEY = "01" GO TO MENU.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
GO TO MENU.

LEARNING-DIFFICULTY-ANALYSIS.
MOVE 0 TO TYPE-PART.
MOVE 1 TO X.
MOVE 1 TO Z.
PERFORM FIND-STARTING-TASK.
IF LAST-KEY = "01" GO TO MENU.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
GO TO MENU.

TRAINING-ACQUISITION-ANALYSIS.
MOVE 0 TO TYPE-PART.
MOVE 9 TO X.
MOVE 12 TO Z.
MOVE "0 0.0000" TO DEVICE-KEY.
MOVE DEVICE-KEY TO REQ-TASK-NO.
MOVE DEVICE-KEY TO TASK-KEY.
START DEVICE-FILE KEY IS EQUAL TO DEVICE-KEY
INVALID KEY GO TO BAD-KEY.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT.
GO TO MENU.

RESIDUAL-DEFICIT-ANALYSIS.
MOVE 1 TO TYPE-PART.
MOVE 1 TO X.
MOVE 1 TO Z.
PERFORM FIND-STARTING-TASK.
IF LAST-KEY = "01" GO TO MENU.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
GO TO MENU.

RESIDUAL-DIFFICULTY-ANALYSIS.
MOVE 1 TO TYPE-PART.
MOVE 1 TO X.
MOVE 2 TO Z.
PERFORM FIND-STARTING-TASK.
IF LAST-KEY = "01" GO TO MENU.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I

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FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
GO TO MENU.

PHYSICAL-SIMILARITY-ANALYSIS.
   MOVE 1 TO TYPE-PART.
   MOVE 3 TO X.
   MOVE 3 TO Z
   PERFORM FIND-STARTING-TASK.
   IF LAST-KEY = "01" GO TO MENU.
   PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
   IF LAST-KEY = "01" GO TO MENU.
   PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
GO TO MENU.

FUNCTIONAL-SIMILARITY-ANALYSIS.
   MOVE 1 TO TYPE-PART.
   MOVE 4 TO X.
   MOVE 4 TO Z
   PERFORM FIND-STARTING-TASK.
   IF LAST-KEY = "01" GO TO MENU.
   PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
   IF LAST-KEY = "01" GO TO MENU.
   PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
GO TO MENU.

TRAINING-TRANSFER-ANALYSIS.
   MOVE 0 TO TYPE-PART.
   MOVE 13 TO X.
   MOVE 15 TO Z
   MOVE "0 0.0000 00 TO DEVICE-KEY.
   MOVE DEVICE-KEY TO REQ-TASK-NO.
   MOVE DEVICE-KEY TO TASK-KEY.
   START DEVICE-FILE KEY IS EQUAL TO DEVICE-KEY 
   INVALID KEY GO TO BAD-KEY.
   PERFORM RATE-TASKS THRU RATE-TASKS-EXIT.
GO TO MENU.

EVALUATION-SUMMARY.
   DISPLAY (1, 1)ERASE.
   DISPLAY (2, 5) "Evaluate by (T)ask or (S)ubtask ? ".
   MOVE SPACES TO ANSWER.
   MOVE "0000" TO REQ-SUBTASK.
   ACCEPT (LIN, COL) ANSWER WITH AUTO-SKIP.
   IF ANSWER = "S" OR ANSWER = "s" MOVE "9999" TO REQ-SUBTASK.
   MOVE 0 TO TRAINING-PROBLEM.
   MOVE 0 TO TRAINING-ACQUISITION.
   MOVE 0 TO TRANSFER-PROBLEM.
   MOVE 0 TO ADDITIONAL-DEFICIT.
   MOVE 0 TO TRAINING-TRANSFER.
   MOVE 0 TO ASTAR.
   MOVE 0 TO N1.
   MOVE 0 TO N2.
   MOVE 0 TO N3.
   MOVE 0 TO TP-PRODUCT.
   MOVE 0 TO RD-PRODUCT.
   MOVE 0 TO PS-FS.
   MOVE "0 0.0000" TO DEVICE-KEY.
READ DEVICE-FILE RECORD INVALID KEY GO TO BAD-KEY.
MOVE 999 TO ACQUISITION-EFFICIENCY.
IF DEVICE-ANALYSIS(9) NOT = 999 AND
   DEVICE-ANALYSIS(10) NOT = 999 AND
   DEVICE-ANALYSIS(11) NOT = 999 AND
   DEVICE-ANALYSIS(12) NOT = 999
   COMPUTE ACQUISITION-EFFICIENCY ROUNDED =
       ((DEVICE-ANALYSIS(9) + DEVICE-ANALYSIS(10) +
       DEVICE-ANALYSIS(11) + DEVICE-ANALYSIS(12)) / 400)
MOVE 999 TO TRANSFER-EFFICIENCY.
IF DEVICE-ANALYSIS(13) NOT = 999 AND
   DEVICE-ANALYSIS(14) NOT = 999 AND
   DEVICE-ANALYSIS(15) NOT = 999
   COMPUTE TRANSFER-EFFICIENCY ROUNDED =
       ((DEVICE-ANALYSIS(13) + DEVICE-ANALYSIS(14) +
       DEVICE-ANALYSIS(15)) / 300)
PERFORM SUM-TASK THRU SUM-TASK-EXIT VARYING I FROM 1 BY 1
   UNTIL EOF-DEVICE = 1.
DISPLAY (1, 1) ERASE.
DISPLAY (1, 31) "Evaluation Summary".
DISPLAY (3, 1) "Training Problem".
IF N1 NOT = 0
   COMPUTE TRAINING-PROBLEM ROUNDED = TP-PRODUCT / (N1 * 100)
   MOVE TRAINING-PROBLEM TO DISPLAY-NUMBER
   DISPLAY (LIN, COL) DISPLAY-NUMBER.
DISPLAY (5, 1) "Acquisition-Efficiency".
IF ACQUISITION-EFFICIENCY NOT = 999
   MOVE ACQUISITION-EFFICIENCY TO SQR-ROOT
   PERFORM SQUARE-ROOT
   MOVE SQR-ROOT TO ACQUISITION-EFFICIENCY
   MOVE ACQUISITION-EFFICIENCY TO DISPLAY-NUMBER
   DISPLAY (LIN, COL) DISPLAY-NUMBER.
DISPLAY (7, 10) "Acquisition".
IF ACQUISITION-EFFICIENCY = 0
   MOVE .01 TO ACQUISITION-EFFICIENCY.
IF ACQUISITION-EFFICIENCY NOT = 999
   COMPUTE TRAINING-ACQUISITION ROUNDED =
       TRAINING-PROBLEM / ACQUISITION-EFFICIENCY
   MOVE TRAINING-ACQUISITION TO DISPLAY-NUMBER
   DISPLAY (LIN, COL) DISPLAY-NUMBER.
DISPLAY (9, 1) "Transfer Problem".
IF N3 NOT = 0
   COMPUTE ADDITIONAL-DEFICIT ROUNDED =
       PS-FS / N3.
IF N2 NOT = 0
   COMPUTE TRANSFER-PROBLEM ROUNDED =
       (RD-PRODUCT / (N2 * 100)) + ADDITIONAL-DEFICIT
   MOVE TRANSFER-PROBLEM TO DISPLAY-NUMBER
   DISPLAY (LIN, COL) DISPLAY-NUMBER.
DISPLAY (11, 1) "Transfer Efficiency".
IF TRANSFER-EFFICIENCY NOT = 999
    MOVE TRANSFER-EFFICIENCY TO SQR-ROOT
    PERFORM SQUARE-ROOT
    MOVE SQR-ROOT TO TRANSFER-EFFICIENCY
    MOVE TRANSFER-EFFICIENCY TO DISPLAY-NUMBER
    DISPLAY(LIN, COL) DISPLAY-NUMBER.
DISPLAY (13, 10) "Transfer"
IF TRANSFER-EFFICIENCY = 0
    MOVE .01 TO TRANSFER-EFFICIENCY.
IF TRANSFER-EFFICIENCY NOT = 999
    COMPUTE TRAINING-TRANSFER ROUNDED = 
        TRANSFER-PROBLEM / TRANSFER-EFFICIENCY
    MOVE TRAINING-TRANSFER TO DISPLAY-NUMBER
    DISPLAY(LIN, COL) DISPLAY-NUMBER.
DISPLAY (16, 10) "d"
    COMPUTE ASTAR = TRAINING-ACQUISITION + 
        TRAINING-TRANSFER.
    MOVE ASTAR TO DISPLAY-NUMBER.
DISPLAY (LIN, COL) DISPLAY-NUMBER.
DISPLAY (20, 5) ERASE.
PERFORM HIT-ANY-KEY.
GO TO MENU.
EVALUATION-SUMMARY-EXIT.
EXIT.
FIND-SCREEN.
    IF ANALYSIS-NUMBER > OPTION OR OPTION = PREV-OPTION 
        CLOSE TEXT-FILE
        OPEN INPUT TEXT-FILE
        MOVE 0 TO PREV-OPTION
        READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
    DISPLAY (1, 1) ERASE.
READ-TEXT.
    IF REC-INDICATOR = "ZZ" AND 
        ANALYSIS-NUMBER = OPTION GO TO DISPLAY-SCREEN.
    IF REC-INDICATOR = "ZQ" AND ANALYSIS-NUMBER = OPTION 
        PERFORM DISPLAY-INTRO-SCREEN THRU 
        DISPLAY-INTRO-SCREEN-EXIT 
        PERFORM HIT-ANY-KEY 
        GO TO DISPLAY-SCREEN.
    READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
    GO TO READ-TEXT.
DISPLAY-SCREEN.
    IF LAST-KEY = "01" GO TO DISPLAY-SCREEN-EXIT.
    READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
    IF REC-INDICATOR = "ZZ" OR REC-INDICATOR = "ZQ" 
        GO TO DISPLAY-SCREEN-EXIT.
    DISPLAY TEXT-RECORD.
    GO TO DISPLAY-SCREEN.
DISPLAY-SCREEN-EXIT.
EXIT.
HIT-ANY-KEY.
    DISPLAY (LIN, COL) "Hit any key to continue ".
    ACCEPT (LIN, COL) NOTHING WITH AUTO-SKIP.

B-19
ACCEPT LAST-KEY FROM ESCAPE KEY.
DISPLAY(1, 1) ERASE.
FIND-STARTING-TASK.
DISPLAY (5, 1) ERASE.
MOVE ZEROS TO TASK-NO.
DISPLAY (22, 5)
"Hit 'F1' to List Training Device Tasks & Subtasks".
DISPLAY (23, 5)
"Hit 'F2' to List Operational Equipment Tasks & Subtasks".
DISPLAY (24, 5)
"Hit 'F3' to List Training Device Controls & Displays".
DISPLAY (25, 5)
"Hit 'F4' to List Operational Equipment Controls & Displays".
IF OPTION < 4
MOVE 0 TO TYPE-PART
DISPLAY (5, 1)
"Enter Starting Training Device Task.Subtask number "
ELSE IF OPTION < 9
MOVE 1 TO TYPE-PART
DISPLAY (5, 1)
"Enter Starting Operational Equipment Task.Subtask ",
"number ".
ACCEPT (LIN, COL) TASK-NO WITH AUTO-SKIP PROMPT.
ACCEPT LAST-KEY FROM ESCAPE KEY.
MOVE TASK-NO TO TASK-PART.
IF LAST-KEY = "02" OR LAST-KEY = "03" OR
LAST-KEY = "04" OR LAST-KEY = "05"
PERFORM DISPLAY-TASKS THRU DISPLAY-TASKS-END
GO TO FIND-STARTING-TASK.
IF LAST-KEY NOT = "01"
MOVE TASK-NO TO TASK-PART
MOVE TASK-KEY TO REQ-TASK-NO
MOVE TASK-KEY TO DEVICE-KEY
START DEVICE-FILE KEY IS EQUAL TO DEVICE-KEY
INVALID KEY
DISPLAY (LIN, 1) ERASE
DISPLAY (LIN, 1)
"TASK.SUBTASK NOT FOUND IN DATA BASE 
PERFORM TIMER
GO TO FIND-STARTING-TASK.
DISPLAY (1, 1) ERASE.
READ-TASK.
MOVE 0 TO EOF-DEVICE.
READ DEVICE-FILE NEXT RECORD AT END MOVE 1 TO EOF-DEVICE
GO TO READ-TASK-EXIT.
MOVE DEVICE-KEY TO READ-TASK-NO.
MOVE DEVICE-KEY TO TASK-KEY.
IF TASK-PART = " 0.0000" AND OPTION NOT = 3 AND
OPTION NOT = 8 GO TO READ-TASK.
IF REQ-SUBTASK = "0000" AND READ-SUBTASK NOT = "0000"
GO TO READ-TASK.
IF REQ-SUBTASK NOT = "0000" AND READ-SUBTASK = "0000"
GO TO READ-TASK.
IF REQ-TYPE NOT = READ-TYPE GO TO READ-TASK.
IF OPTION = 2 AND

DEVICE-ANALYSIS(1) = 0 GO TO READ-TASK.
IF (OPTION = 5 OR OPTION = 6 OR OPTION = 7) AND

DEVICE-ANALYSIS(1) = 0 GO TO READ-TASK.
READ-TASK-EXIT.
EXIT.
RATE-TASKS.
PERFORM READ-TASK THRU READ-TASK-EXIT.
IF EOF-DEVICE = 1 GO TO RATE-TASKS-EXIT.
PERFORM RATE-EACH-TASK THRU RATE-EACH-TASK-EXIT
VARYING K FROM X BY 1 UNTIL K > Z OR LAST-KEY = "01".
IF LAST-KEY = "01" GO TO RATE-TASKS-EXIT.
RATE-TASKS-EXIT.
EXIT.
RATE-EACH-TASK.
IF X NOT = Z

DISPLAY (1, 1) ERASE
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO RATE-EACH-TASK-EXIT.
DISPLAY (23, 1) ERASE.
DISPLAY (LIN, 1) "Task.Subtask = ", TASK-PART, ",
DEVICE-TITLE
MOVE DEVICE-ANALYSIS(K) TO RATING.
IF RATING NOT = 999

MOVE RATING TO PREVIOUS-RATING.
DISPLAY (LIN, 1) "Previous Rating = ", PREVIOUS-RATING.
DISPLAY (LIN, COL) " Enter Rating = ".
ACCEPT (LIN, COL) RATING WITH AUTO-SKIP UPDATE.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "01" GO TO RATE-EACH-TASK-EXIT.
IF RATING = PREVIOUS-RATING GO TO RATE-EACH-TASK-EXIT.
MOVE RATING TO DEVICE-ANALYSIS(K).
REWRITE DEVICE-RECORD INVALID KEY GO TO BAD-KEY.
RATE-EACH-TASK-EXIT.
EXIT.
SUM-TASK.
MOVE 0 TO EOF-DEVICE.
READ DEVICE-FILE NEXT RECORD AT END MOVE 1 TO EOF-DEVICE

GO TO SUM-TASK-EXIT.
MOVE DEVICE-KEY TO READ-TASK-NO.
MOVE DEVICE-KEY TO TASK-KEY.
IF REQ-SUBTASK = "0000" AND READ-SUBTASK NOT = "0000"

GO TO SUM-TASK.
IF REQ-SUBTASK NOT = "0000" AND READ-SUBTASK = "0000"
GO TO SUM-TASK.
IF TYPE-PART = 1 GO TO SUM-ACTUAL.
SUM-TRAINING-DEVICE.
IF DEVICE-ANALYSIS(1) = 0 ADD 1 TO N1

GO TO SUM-ACTUAL.
IF DEVICE-ANALYSIS(2) NOT = 999

ADD 1 TO N1
COMPUTE TP-PRODUCT ROUNDED = TP-PRODUCT +

(DEVICE-ANALYSIS(1) * DEVICE-ANALYSIS(2)).

GO TO SUM-TASK-EXIT.
SUM-ACTUAL.
IF DEVICE-ANALYSIS(1) = 0 ADD 1 TO N2
GO TO SUM-TASK-EXIT.
IF DEVICE-ANALYSIS(2) NOT = 999
ADD 1 TO N2
COMPUTE RD-PRODUCT ROUNDED = RD-PRODUCT +
(Device-ANALYSIS(1) * DEVICE-ANALYSIS(2))
IF DEVICE-ANALYSIS(3) NOT = 999 AND
DEVICE-ANALYSIS(4) NOT = 999
ADD 1 TO N3
IF DEVICE-ANALYSIS(3) > DEVICE-ANALYSIS(4)
COMPUTE PS-FS = PS-FS +
(Device-ANALYSIS(3) - DEVICE-ANALYSIS(4)).
SUM-TASK-EXIT.
EXIT.
STOP-RUN.
DISPLAY(1, 1)ERASE.
CLOSE DEVICE-FILE.
CLOSE TITLE-FILE.
CLOSE TEXT-FILE.
EXIT PROGRAM.
STOP RUN.
EOF-TEXT.
DISPLAY "EOF ON TEXT FILE".
STOP RUN.
BAD-KEY.
DISPLAY "INVALID KEY ", DEVICE-KEY.
STOP RUN.
TIMER.
PERFORM NO-OP 2000 TIMES.
NO-OP.
EXIT.
DISPLAY-INTRO-SCREEN.
READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
IF REC-INDICATOR = "ZZ" OR REC-INDICATOR = "ZQ"
GO TO DISPLAY-INTRO-SCREEN-EXIT.
DISPLAY TEXT-RECORD.
GO TO DISPLAY-INTRO-SCREEN.
DISPLAY-INTRO-SCREEN-EXIT.
EXIT.
DISPLAY-TASKS.
MOVE 0 TO TYPE-PART.
IF LAST-KEY = "03" OR LAST-KEY = "05"
MOVE 1 TO TYPE-PART.
IF LAST-KEY = "04" OR LAST-KEY = "05"
MOVE 1 TO TITLE-FLAG.
MOVE 0 TO Q.
MOVE TASK-KEY TO DEVICE-KEY.
MOVE DEVICE-KEY TO REQ-TASK-NO.
READ DEVICE-FILE RECORD INVALID KEY
GO TO DISPLAY-TASKS-END.
IF LAST-KEY = "01" GO TO DISPLAY-TASKS-END.
DISPLAY-TASKS-LOOP.
MOVE 0 TO I.
DISPLAY (5, 1)ERASE.
DISPLAY (LIN, COL)"
GO TO DISPLAY-20-DEVICES.

DISPLAY-20-DEVICES.
MOVE DEVICE-KEY TO READ-TASK-NO.
MOVE DEVICE-KEY TO TASK-KEY.
IF READ-TYPE NOT = REQ-TYPE MOVE 1 TO Q.
ADD 1 TO I.
IF I > 16 OR Q = 1
DISPLAY(25, 7)"Hit any key to continue"
ACCEPT(LIN, COL)NOTHING WITH AUTO-SKIP
ACCEPT LAST-KEY FROM ESCAPE KEY
DISPLAY(6, 1)ERASE
MOVE 1 TO I
IF Q = 1 GO TO DISPLAY-TASKS-END.
IF LAST-KEY = "01" GO TO DISPLAY-TASKS-END.
IF READ-SUBTASK NOT = "0000"
DISPLAY (LIN, COL) " ".
DISPLAY TASK-PART, " ", DEVICE-TITLE.
IF TITLE-FLAG = 1
PERFORM DISPLAY-CONTROLS THRU DISPLAY-CONTROLS-END.
READ DEVICE-FILE NEXT RECORD AT END MOVE 1 TO Q.
GO TO DISPLAY-20-DEVICES.
DISPLAY-TASKS-END.
MOVE 0 TO TITLE-FLAG.
DISPLAY(6, 1)ERASE.

DISPLAY-CONTROLS.
MOVE DEVICE-KEY TO TASK-KEY.
MOVE SPACES TO CONTROL-PART.
MOVE TASK-KEY TO TITLE-KEY.
START TITLE-FILE KEY IS NOT LESS THAN TITLE-KEY
INVALID KEY GO TO DISPLAY-CONTROLS-END.
READ TITLE-FILE NEXT RECORD AT END
GO TO DISPLAY-CONTROLS-END.
DISPLAY-20-CONTROLS.
IF TITLE-TASK NOT = TASK-PART OR TITLE-TYPE NOT = TYPE-PART
GO TO DISPLAY-CONTROLS-END.
ADD 1 TO I.
IF I > 16
DISPLAY(25, 7)"Hit any key to continue"
ACCEPT(LIN, COL)NOTHING WITH AUTO-SKIP
ACCEPT LAST-KEY FROM ESCAPE KEY
DISPLAY(6, 1)ERASE
DISPLAY TASK-PART, " ", DEVICE-TITLE
MOVE 1 TO I.
IF LAST-KEY = "01" GO TO DISPLAY-CONTROLS-END.
DISPLAY " " , TITLE-CONTROL,
" " , TITLE-DESC.
READ TITLE-FILE NEXT RECORD AT END
GO TO DISPLAY-CONTROLS-END.
GO TO DISPLAY-20-CONTROLS.
DISPLAY-CONTROLS-END.
EXIT.

SQUARE-ROOT.
COMPUTE SQR1 = SQR-ROOT * 10000.
PERFORM SQR-PROC VARYING J FROM 1 BY 2 UNTIL SQR1 < 0.
COMPUTE SQR-ROOT ROUNDED = (J - 3) / 200.
SQR-PROC.
SUBTRACT J FROM SQR1.
IDENTIFICATION DIVISION.
PROGRAM-ID. ASTAR3.
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* (1979 MAR)
*---------------------------------------------------------------
* THIS IS THE ASTAR III ANALYSIS PROGRAM.
*---------------------------------------------------------------
AUTHOR. Timothy O'Connor.
INSTALLATION. American Institutes for Research.
DATE-WRITTEN. AUG 1984.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER.
OBJECT-COMPUTER.
INPUT-OUTPUT SECTION.
FILE-CONTROL.

SELECT DEVICE-FILE ASSIGN TO DISK
   ORGANIZATION IS INDEXED
   ACCESS MODE IS DYNAMIC
   RECORD KEY IS DEVICE-KEY
   FILE STATUS IS DEVICE-STATUS-WORD.

SELECT TITLE-FILE ASSIGN TO DISK
   ORGANIZATION IS INDEXED
   ACCESS MODE IS DYNAMIC
   RECORD KEY IS TITLE-KEY
   FILE STATUS IS TITLE-STATUS-WORD.

SELECT CONTROL-FILE ASSIGN TO DISK
   ORGANIZATION IS INDEXED
   ACCESS MODE IS DYNAMIC
   RECORD KEY IS CONTROL-KEY
   FILE STATUS IS CTL-STATUS-WORD.

SELECT TEXT-FILE ASSIGN TO DISK
   ORGANIZATION IS LINE SEQUENTIAL.

DATA DIVISION.
FILE SECTION.
FD DEVICE-FILE
   LABEL RECORD IS STANDARD;
    VALUE OF FILE-ID IS "B:DEVICE".
01 DEVICE-RECORD.
   05 DEVICE-KEY PIC X(10).
   05 DEVICE-ANALYSIS OCCURS 20 TIMES PIC 999.
   05 DEVICE-TITLE PIC X(60).

FD TITLE-FILE
   LABEL RECORD IS STANDARD;
    VALUE OF FILE-ID IS "B:TITLE".

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01 TITLE-RECORD.
  05 TITLE-KEY.
    07 TITLE-TYPE PIC 9.
    07 TITLE-TASK PIC X(9).
    07 TITLE-PERIOD PIC X.
    07 TITLE-CONTROL PIC X(9).
  05 TITLE-DESC PIC X(60).
FD CONTROL-FILE
  LABEL RECORD IS STANDARD;
  VALUE OF FILE-ID IS "B:CONTROL".
01 CONTROL-RECORD.
  05 CONTROL-KEY.
    07 CTL-TYPE PIC 9.
    07 CTL-TASK PIC X(4).
    07 FILLER PIC X.
    07 CTL-SUBTASK PIC X(4).
    07 FILLER PIC X.
    07 CTL-NO PIC X(9).
  05 CONTROL-ANALYSIS OCCURS 2 TIMES PIC 999.
  05 CORR-CTL-KEY PIC X(20).
FD TEXT-FILE
  LABEL RECORD IS STANDARD;
  VALUE OF FILE-ID IS "ASTAR3.DOC".
01 TEXT-RECORD.
  05 REC-INDICATOR PIC XX.
  05 FILLER PIC X.
  05 ANALYSIS-NUMBER PIC X.
  05 FILLER PIC X(75).

WORKING-STOREAGE SECTION.
  77 NOTHING PIC X.
  77 TASK-NO PIC Z(3).99999 DISPLAY.
  77 RATING PIC 999.
  77 PREVIOUS-RATING PIC ZZ9.
  77 CTL-STATUS-WORD PIC XX.
  77 DEVICE-STATUS-WORD PIC XX.
  77 TITLE-STATUS-WORD PIC XX.
  77 EOF-CONTROL PIC 9 VALUE 0.
  77 EOF-DEVICE PIC 9 VALUE 0.
  77 PREV-OPTION PIC 9 COMP.
  77 CPTION PIC 9 COMP.
  77 LAST-KEY PIC XX.
  77 X PIC 9(4) COMP.
  77 C PIC 9(4) COMP.
  77 Z PIC 9(4) COMP.
  77 K PIC 9(4) COMP.
  77 I PIC 9(4) COMP.
  77 DISPLAY-NUMBER PIC ZZ,ZZZ.99.
  77 TRAINING-PROBLEM PIC 9(5)V99 COMP.
  77 ACQUISITION-EFFICIENCY PIC 9(5)V99 COMP.
  77 TRAINING-ACQUISITION PIC 9(5)V99 COMP.
  77 TRANSFER-PROBLEM PIC 9(5)V99 COMP.

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PROCEDURE DIVISION.
BEGIN.
 OPEN I-O DEVICE-FILE.
 OPEN I-O TITLE-FILE.
 OPEN I-O CONTROL-FILE.
 OPEN INPUT TEXT-FILE.
 DISPLAY (1,1) ERASE.
 MOVE ZEROS TO TASK-NO.
 MOVE TASK-NO TO REQ-TASK-NO.
 MOVE 0 TO OPTION.
MENU.
 MOVE OPTION TO PREV-OPTION.
MOVE 0 TO OPTION.
MOVE 0 TO EOF-DEVICE
MOVE "00" TO LAST-KEY
DISPLAY (1, 1)ERASE.
DISPLAY (1, 25)
" " ASTAR 3 ".
DISPLAY (4, 25)
"(1) Performance Deficit ".
DISPLAY (5, 25)
"(2) Learning Difficulty ".
DISPLAY (6, 25)
"(3) Quality of Training-Acquisition ".
DISPLAY (7, 25)
"(4) Residual Deficit ".
DISPLAY (8, 25)
"(5) Residual Learning Difficulty ".
DISPLAY (9, 25)
"(6) Physical Similarity ".
DISPLAY (10, 25)
"(7) Functional Similarity ".
DISPLAY (11, 25)
"(8) Quality of Training-Transfer ".
DISPLAY (12, 25)
"(9) Evaluation Summary ".
DISPLAY (16, 12)"Enter Option Number ".
ACCEPT (LIN, COL) OPTION WITH AUTO-SKIP.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF OPTION = "01" GO TO STOP-RUN.
DISPLAY (1, 1)ERASE.
IF OPTION = 1 GO TO PERFORMANCE-DEFICIT-ANALYSIS.
IF OPTION = 2 GO TO LEARNING-DIFFICULTY-ANALYSIS.
IF OPTION = 3 GO TO TRAINING-ACQUISITION-ANALYSIS.
IF OPTION = 4 GO TO RESIDUAL-DEFICIT-ANALYSIS.
IF OPTION = 5 GO TO RESIDUAL-DIFFICULTY-ANALYSIS.
IF OPTION = 6 GO TO PHYSICAL-SIMILARITY-ANALYSIS.
IF OPTION = 7 GO TO FUNCTIONAL-SIMILARITY-ANALYSIS.
IF OPTION = 8 GO TO TRAINING-TRANSFER-ANALYSIS.
IF OPTION = 9 GO TO EVALUATION-SUMMARY.
GO TO MENU.

PERFORMANCE-DEFICIT-ANALYSIS.
MOVE 0 TO TYPE-PART.
MOVE 3 TO X.
MOVE 3 TO Z.
PERFORM FIND-STARTING-TASK.
IF LAST-KEY = "01" GO TO MENU.
PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I
FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
GO TO MENU.

LEARNING-DIFFICULTY-ANALYSIS.
MOVE 0 TO TYPE-PART.
MOVE 4 TO X.
MOVE 9 TO Z
PERFORM FIND-STARTING-TASK.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I
    FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
GO TO MENU.

TRAINING-ACQUISITION-ANALYSIS.
    MOVE 0 TO TYPE-PART.
    MOVE 10 TO X.
    MOVE 20 TO Z
    PERFORM FIND-STARTING-TASK.
    IF LAST-KEY = "01" GO TO MENU.
    PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I
        FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
    GO TO MENU.

RESIDUAL-DEFICIT-ANALYSIS.
    MOVE 1 TO TYPE-PART.
    MOVE 6 TO X.
    MOVE 6 TO Z
    PERFORM FIND-STARTING-TASK.
    IF LAST-KEY = "01" GO TO MENU.
    PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
    IF LAST-KEY = "01" GO TO MENU.
    PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I
        FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
    GO TO MENU.

RESIDUAL-DIFFICULTY-ANALYSIS.
    MOVE 1 TO TYPE-PART.
    MOVE 7 TO X.
    MOVE 12 TO Z
    PERFORM FIND-STARTING-TASK.
    IF LAST-KEY = "01" GO TO MENU.
    PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I
        FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
    GO TO MENU.

PHYSICAL-SIMILARITY-ANALYSIS.
    MOVE 1 TO TYPE-PART.
    MOVE 1 TO X.
    MOVE 1 TO Z
    PERFORM FIND-STARTING-TASK.
    IF LAST-KEY = "01" GO TO MENU.
    PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
    IF LAST-KEY = "01" GO TO MENU.
    PERFORM RATE-CONTROLS THRU RATE-CONTROLS-EXIT VARYING I
        FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
    GO TO MENU.

FUNCTIONAL-SIMILARITY-ANALYSIS.
    MOVE 1 TO TYPE-PART.
    MOVE 2 TO X.
    MOVE 2 TO Z
    PERFORM FIND-STARTING-TASK.
    IF LAST-KEY = "01" GO TO MENU.
    PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
    IF LAST-KEY = "01" GO TO MENU.
    PERFORM RATE-CONTROLS THRU RATE-CONTROLS-EXIT VARYING I
        FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
    GO TO MENU.
TRAINING-TRANSFER-ANALYSIS.
MOVE 1 TO TYPE-PART.
MOVE 13 TO X.
MOVE 20 TO Z
PERFORM FIND-STARTING-TASK.
IF LAST-KEY = "01" GO TO MENU.
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
GO TO MENU.
EVALUATION-SUMMARY.
DISPLAY (1, 1) ERASE.
DISPLAY (2, 5) "Evaluate by (T)ask or (S)ubtask ? ".
MOVE SPACES TO ANSWER.
MOVE "0000" TO REQ-SUBTASK.
ACCEPT (LIN, COL) ANSWER WITH AUTO-SKIP.
IF ANSWER = "S" OR ANSWER = "s" MOVE "9999" TO REQ-SUBTASK.
MOVE 0 TO TRAINING-PROBLEM.
MOVE 0 TO TRAINING-ACQUISITION.
MOVE 0 TO TRANSFER-PROBLEM.
MOVE 0 TO ADDITIONAL-DEFICIT.
MOVE 0 TO TRAINING-TRANSFER.
MOVE 0 TO ASTAR.
MOVE 0 TO N1.
MOVE 0 TO N2.
MOVE 0 TO N3.
MOVE 0 TO N4.
MOVE 0 TO N5.
MOVE 0 TO TP-PRODUCT.
MOVE 0 TO AE-PRODUCT.
MOVE 0 TO RD-PRODUCT.
MOVE 0 TO TE-PRODUCT.
MOVE 0 TO PS-FS.
MOVE "0 0.0000" TO DEVICE-KEY.
READ DEVICE-FILE RECORD INVALID KEY GO TO BAD-KEY.
PERFORM SUM-TASK THRU SUM-TASK-EXIT VARYING I FROM 1 BY 1 UNTIL EOF-DEVICE = 1.
DISPLAY (1, 1) ERASE.
DISPLAY (1, 31) "Evaluation Summary".
DISPLAY (3, 1) "Training Problem ".
IF N1 NOT = 0
COMPUTE TRAINING-PROBLEM ROUNDED = TP-PRODUCT / N1
MOVE TRAINING-PROBLEM TO DISPLAY-NUMBER
DISPLAY (LIN, COL) DISPLAY-NUMBER.
DISPLAY (5, 1) " Acquisition-Efficiency ".
MOVE 999 TO ACQUISITION-EFFICIENCY.
IF N2 NOT = 0
COMPUTE ACQUISITION-EFFICIENCY ROUNDED = AE-PRODUCT / (N2 * 100)
MOVE ACQUISITION-EFFICIENCY TO SQR-ROOT
PERFORM SQUARE-ROOT
MOVE SQR-ROOT TO ACQUISITION-EFFICIENCY
MOVE ACQUISITION-EFFICIENCY TO DISPLAY-NUMBER
DISPLAY (LIN, COL) DISPLAY-NUMBER.
B-30
DISPLAY (7, 10)
   " Acquisition "
   IF ACQUISITION-EFFICIENCY = 0
      MOVE .01 TO ACQUISITION-EFFICIENCY.
   IF ACQUISITION-EFFICIENCY NOT = 999
      COMPUTE TRAINING-ACQUISITION ROUNDED =
         TRAINING-PROBLEM / ACQUISITION-EFFICIENCY
      MOVE TRAINING-ACQUISITION TO DISPLAY-NUMBER
      DISPLAY(LIN, COL) DISPLAY-NUMBER.
   DISPLAY (9, 1)
   " Transfer Problem "
   IF N5 NOT = 0 AND PS-FS NOT = 0
      COMPUTE ADDITIONAL-DEFICIT ROUNDED = PS-FS / N5.
   IF N3 NOT = 0
      COMPUTE TRANSFER-PROBLEM ROUNDED =
         (RD-PRODUCT / N3) + ADDITIONAL-DEFICIT
      MOVE TRANSFER-PROBLEM TO DISPLAY-NUMBER
      DISPLAY (LIN, COL) DISPLAY-NUMBER.
   DISPLAY (11, 1)
   " Transfer Efficiency "
   MOVE 999 TO TRANSFER-EFFICIENCY.
   IF N4 NOT = 0
      COMPUTE TRANSFER-EFFICIENCY ROUNDED =
         TE-PRODUCT / (N4 * 100)
      MOVE TRANSFER-EFFICIENCY TO SQR-ROOT
      PERFORM SQUARE-ROOT
      MOVE SQR-ROOT TO TRANSFER-EFFICIENCY
      MOVE TRANSFER-EFFICIENCY TO DISPLAY-NUMBER
      DISPLAY(LIN, COL) DISPLAY-NUMBER.
   DISPLAY (13, 10)
   " Transfer "
   IF TRANSFER-EFFICIENCY = 0
      MOVE .01 TO TRANSFER-EFFICIENCY.
   IF TRANSFER-EFFICIENCY NOT = 999
      COMPUTE TRAINING-TRANSFER ROUNDED =
         TRAINING-PROBLEM / TRANSFER-EFFICIENCY
      MOVE TRAINING-TRANSFER TO DISPLAY-NUMBER
      DISPLAY(LIN, COL) DISPLAY-NUMBER.
   DISPLAY (16, 10)
   " d "
   COMPUTE ASTAR = TRAINING-ACQUISITION +
      TRAINING-TRANSFER.
   MOVE ASTAR TO DISPLAY-NUMBER.
   DISPLAY (LIN, COL) DISPLAY-NUMBER.
   DISPLAY (20, 5)ERASE.
   PERFORM HIT-ANY-KEY.
   GO TO MENU.
EVALUATION-SUMMARY-EXIT.
EXIT.
FIND-SCREEN.
   IF ANALYSIS-NUMBER > OPTION OR OPTION = PREV-OPTION
      CLOSE TEXT-FILE
      OPEN INPUT TEXT-FILE
      MOVE 0 TO PREV-OPTION
      READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
DISPLAY (1, 1) ERASE.
READ-TEXT.
  IF REC-INDICATOR = "ZZ" AND
  ANALYSIS-NUMBER = OPTION GO TO DISPLAY-SCREEN.
  IF REC-INDICATOR = "ZQ" AND ANALYSIS-NUMBER = OPTION
  PERFORM DISPLAY-INTRO-SCREEN THRU
  DISPLAY-INTRO-SCREEN-EXIT
  PERFORM HIT-ANY-KEY
  GO TO DISPLAY-SCREEN.
READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
GO TO READ-TEXT.
DISPLAY-SCREEN.
  IF LAST-KEY = "01" GO TO DISPLAY-SCREEN-EXIT.
  READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
  IF REC-INDICATOR = "ZZ" OR REC-INDICATOR = "ZQ"
  GO TO DISPLAY-SCREEN-EXIT.
  DISPLAY TEXT-RECORD.
  GO TO DISPLAY-SCREEN.
DISPLAY-SCREEN-EXIT.
EXIT.
HIT-ANY-KEY.
  DISPLAY (LIN, COL) "Hit any key to continue ".
  ACCEPT (LIN, COL) NOTHING WITH AUTO-SKIP.
  ACCEPT LAST-KEY FROM ESCAPE KEY.
  DISPLAY(1, 1)ERASE.
FIND-STARTING-TASK.
  DISPLAY (5, 1)ERASE.
  MOVE ZEROS TO TASK-NO.
  DISPLAY (22, 5)
  "Hit 'F1' to List Training Device Tasks & Subtasks".
  DISPLAY (23, 5)
  "Hit 'F2' to List Operational Equipment Tasks & Subtasks".
  DISPLAY (24, 5)
  "Hit 'F3' to List Training Device Controls & Displays".
  DISPLAY (25, 5)
  "Hit 'F4' to List Operational Equipment ",
  "Controls & Displays".
  IF OPTION < 4
  MOVE 0 TO TYPE-PART
  DISPLAY (5, 1)
  "Enter Starting Training Device Task.Subtask number "
  ELSE IF OPTION < 9
  MOVE 1 TO TYPE-PART
  DISPLAY (5, 1)
  "Enter Starting Operational Equipment Task.Subtask ",
  "number ".
  ACCEPT (LIN, COL) TASK-NO WITH AUTO-SKIP PROMPT.
  ACCEPT LAST-KEY FROM ESCAPE KEY.
  MOVE TASK-NO TO TASK-PART.
  MOVE TASK-KEY TO REQ-TASK-NO.
  IF LAST-KEY = "02" OR LAST-KEY = "03" OR
  LAST-KEY = "04" OR LAST-KEY = "05"
  PERFORM DISPLAY-TASKS THRU DISPLAY-TASKS-END
  GO TO FIND-STARTING-TASK.
  IF LAST-KEY = "00"
MOVE TASK-KEY TO REQ-TASK-NO
MOVE REQ-TASK-NO TO DEVICE-KEY
START DEVICE-FILE KEY IS EQUAL TO DEVICE-KEY
INVALID KEY
  DISPLAY (LIN, 1) ERASE
  DISPLAY (LIN, 1) "TASK.SUBTASK NOT FOUND IN DATA BASE"
  PERFORM TIMER
  GO TO FIND-STARTING-TASK.

READ-TASK.
  MOVE 0 TO EOF-DEVICE.
  READ DEVICE-FILE NEXT RECORD AT END MOVE 1 TO EOF-DEVICE
  GO TO READ-TASK-EXIT.
  MOVE DEVICE-KEY TO READ-TASK-NO.
  MOVE DEVICE-KEY TO TASK-KEY.
  IF TASK-PART = " 0.0000" GO TO READ-TASK.
  IF REQ-TYPE NOT = READ-TYPE GO TO READ-TASK.
  IF REQ-SUBTASK = "0000" AND READ-SUBTASK NOT = "0000"
    GO TO READ-TASK.
  IF REQ-SUBTASK NOT = "0000" AND READ-SUBTASK = "0000"
    GO TO READ-TASK.
  IF (OPTION = 2 OR OPTION = 3) AND
    DEVICE-ANALYSIS(3) > 3
    GO TO READ-TASK.
  IF OPTION > 4 AND DEVICE-ANALYSIS(6) > 3
    GO TO READ-TASK.
  IF (OPTION = 6 OR OPTION = 7) AND
    DEVICE-ANALYSIS(5) NOT = 1
    GO TO READ-TASK.

READ-TASK-EXIT.
EXIT.
RATE-TASKS.
  PERFORM READ-TASK THRU READ-TASK-EXIT.
  IF EOF-DEVICE = 1 GO TO RATE-TASKS-EXIT.
  PERFORM RATE-EACH-TASK THRU RATE-EACH-TASK-EXIT
    VARYING K FROM X BY 1 UNTIL K > Z OR LAST-KEY = "01".
    IF LAST-KEY = "01" GO TO RATE-TASKS-EXIT.

RATE-TASKS-EXIT.
EXIT.
RATE-EACH-TASK.
  IF X NOT = Z
    DISPLAY (1, 1) ERASE
    PERFORM FIND-SCREEN THRU DISPLAY-SCREEN-EXIT.
    IF LAST-KEY = "01" GO TO RATE-EACH-TASK-EXIT.
    DISPLAY (23, 1)ERASE.
    DISPLAY (LIN, 1) "Task.Subtask = ", TASK-PART, " ",
    DEVICE-TITLE
    MOVE DEVICE-ANALYSIS(K) TO RATING.
    IF RATING NOT = 999
      MOVE RATING TO PREVIOUS-RATING
      DISPLAY (LIN, 1) "Previous Rating = ", PREVIOUS-RATING.
      DISPLAY (LIN, COL) " Enter Rating = 
      ACCEPT (LIN, COL) RATING WITH AUTO-SKIP UPDATE.
      ACCEPT LAST-KEY FROM ESCAPE KEY.
      IF LAST-KEY = "01" GO TO RATE-EACH-TASK-EXIT.
I' RATING = PREVIOUS-RATING GO TO RATE-EACH-TASK-EXIT.
MOVE RATING TO DEVICE-ANALYSIS(K)
WRITE DEVICE-RECORD INVALID KEY GO TO BAD-KEY.
RATE-EACH-TASK-EXIT.
EXIT.
RATE-CONTROLS.
PERFORM READ-TASK THRU READ-TASK-EXIT.
I' EOF-DEVICE = 1 GO TO RATE-CONTROLS-EXIT.
MOVE DEVICE-KEY TO REQ-CTL-KEY.
MOVE DEVICE-KEY TO TASK-KEY.
MOVE REQ-CTL-TYPE TO CONTROL-KEY.
MOVE REQ-CTL-TASK TO CTL-TASK.
MOVE 0 TO EOF-CONTROL.
MOVE 0 TO EOF-DEVICE.
START CONTROL-FILE KEY IS NOT LESS THAN CONTROL-KEY
INVALID KEY GO TO RATE-CONTROLS-EXIT.
DISPLAY (21, 1) ERASE.
DISPLAY "Task = ", TASK-PART, ", DEVICE-TITLE.
PERFORM RATE-EACH-CONTROL THRU RATE-EACH-CONTROL-EXIT
VARYING K FROM 1 BY 1 UNTIL EOF-CONTROL = 1 OR
EOF-DEVICE = 1 OR LAST-KEY = "01".
I' LAST-KEY = "01" GO TO RATE-CONTROLS-EXIT.
RATE-CONTROLS-EXIT.
EXIT.
RATE-EACH-CONTROL.
MOVE 0 TO EOF-CONTROL.
READ CONTROL-FILE NEXT RECORD AT END
MOVE 1 TO EOF-CONTROL
GO TO RATE-EACH-CONTROL-EXIT.
I' REQ-CTL-TYPE NOT = CTL-TYPE OR
REQ-CTL-TASK NOT = CTL-TASK
GO TO RATE-EACH-CONTROL-EXIT.
I' REQ-CTL-SUBTASK NOT = "0000" AND
REQ-CTL-SUBTASK NOT = CTL-SUBTASK
GO TO RATE-EACH-CONTROL-EXIT.
MOVE CONTROL-KEY TO TITLE-KEY.
READ TITLE-FILE RECORD INVALID KEY PERFORM BAD-KEY.
DISPLAY (22, 1) ERASE.
DISPLAY (22, 1) " ", TITLE-CONTROL, ", TITLE-DESC.
MOVE CORR-CTL-KEY TO DEVICE-KEY.
READ DEVICE-FILE RECORD INVALID KEY PERFORM BAD-KEY.
MOVE DEVICE-KEY TO TASK-KEY.
DISPLAY (23, 1) "Task = ", TASK-PART, ", DEVICE-TITLE.
MOVE CORR-CTL-KEY TO TITLE-KEY.
READ TITLE-FILE RECORD INVALID KEY PERFORM BAD-KEY.
DISPLAY (24, 1) " ", TITLE-CONTROL, ", TITLE-DESC.
MOVE CONTROL-ANALYSIS(X) TO RATING.
DISPLAY (25, 5) ERASE.
I' RATING NOT = 999
MOVE RATING TO PREVIOUS-RATING
DISPLAY (25, 5) "Previous Rating = ", PREVIOUS-RATING.
DISPLAY (LIN, COL) " Enter Rating = "
ACCEPT (LIN, COL) RATING WITH AUTO-SKIP UPDATE.
ACCEPT LAST-KEY FROM ESCAPE KEY.

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IF LAST-KEY = "01" GO TO RATE-EACH-CONTROL-EXIT.
IF RATING = PREVIOUS-RATING GO TO RATE-EACH-CONTROL-EXIT.
MOVE RATING TO CONTROL-ANALYSIS(X)
REWRI TE CONTROL-RECORD INVALID KEY GO TO BAD-KEY.
RATE-EACH-CONTROL-EXIT.
MOVE READ-TASK-NO TO DEVICE-KEY.
READ DEVICE-FILE RECORD
    INVALID KEY MOVE 1 TO EOF-DEVICE.
STOP-RUN.
    DISPLAY(1, 1)ERASE.
    CLOSE DEVICE-FILE.
    CLOSE TITLE-FILE.
    CLOSE CONTROL-FILE.
    CLOSE TEXT-FILE.
    EXIT PROGRAM.
STOPPED.
    STOP RUN.
EOF-TEXT.
    DISPLAY "EOF ON TEXT FILE".
    STOP RUN.
BAD-KEY.
    DISPLAY "INVALID KEY ", DEVICE-KEY, TITLE-KEY.
    STOP RUN.
TIMER.
    PERFORM NO-OP 2000 TIMES.
NO-OP.
    EXIT.
DISPLAY-INTRO-SCREEN.
    READ TEXT-FILE RECORD AT END GO TO EOF-TEXT.
    IF REC-INDICATOR = "ZZ" OR REC-INDICATOR = "ZQ"
        GO TO DISPLAY-INTRO-SCREEN-EXIT.
    DISPLAY TEXT-RECORD.
    GO TO DISPLAY-INTRO-SCREEN.
DISPLAY-INTRO-SCREEN-EXIT.
    EXIT.
SUM-TASK.
    MOVE 0 TO EOF-DEVICE.
    READ DEVICE-FILE NEXT RECORD AT END MOVE 1 TO EOF-DEVICE
        GO TO SUM-TASK-EXIT.
    MOVE DEVICE-KEY TO READ-TASK-NO.
    IF REQ-SUBTASK = "0000" AND READ-SUBTASK NOT = "0000"
        GO TO SUM-TASK.
    IF REQ-SUBTASK NOT = "0000" AND READ-SUBTASK = "0000"
        GO TO SUM-TASK.
    IF READ-TYPE = 1 GO TO SUM-ACTUALS.
    IF DEVICE-ANALYSIS(3) > 3 ADD 1 TO N1
        GO TO SUM-TASK-EXIT.
    IF DEVICE-ANALYSIS(3) NOT = 999
        MOVE 999 TO DIFFICULTY
    IF DEVICE-ANALYSIS(3) < 4 AND
        DEVICE-ANALYSIS(4) NOT = 999 AND
        DEVICE-ANALYSIS(5) NOT = 999 AND
        DEVICE-ANALYSIS(6) NOT = 999 AND
        DEVICE-ANALYSIS(7) NOT = 999 AND
        DEVICE-ANALYSIS(8) NOT = 999 AND
DEVICE-ANALYSIS(9) NOT = 999
ADD 1 TO N1
COMPUTE DIFFICULTY ROUNDED =
DEVICE-ANALYSIS(4) +
DEVICE-ANALYSIS(5) +
DEVICE-ANALYSIS(6) +
DEVICE-ANALYSIS(7) +
DEVICE-ANALYSIS(8) +
DEVICE-ANALYSIS(9).
IF DEVICE-ANALYSIS(3) = 0 AND DIFFICULTY NOT = 999
COMPUTE TP-PRODUCT ROUNDED = TP-PRODUCT +
(10 * DIFFICULTY).
IF DEVICE-ANALYSIS(3) = 1 AND DIFFICULTY NOT = 999
COMPUTE TP-PRODUCT ROUNDED = TP-PRODUCT +
(9 * DIFFICULTY).
IF DEVICE-ANALYSIS(3) = 2 AND DIFFICULTY NOT = 999
COMPUTE TP-PRODUCT ROUNDED = TP-PRODUCT +
(7 * DIFFICULTY).
IF DEVICE-ANALYSIS(3) = 3 AND DIFFICULTY NOT = 999
COMPUTE TP-PRODUCT ROUNDED = TP-PRODUCT +
(4 * DIFFICULTY).

IF DEVICE-ANALYSIS(3) < 4 AND
DEVICE-ANALYSIS(10) NOT = 999 AND
DEVICE-ANALYSIS(11) NOT = 999 AND
DEVICE-ANALYSIS(12) NOT = 999 AND
DEVICE-ANALYSIS(13) NOT = 999 AND
DEVICE-ANALYSIS(14) NOT = 999 AND
DEVICE-ANALYSIS(15) NOT = 999 AND
DEVICE-ANALYSIS(16) NOT = 999 AND
DEVICE-ANALYSIS(17) NOT = 999 AND
DEVICE-ANALYSIS(18) NOT = 999 AND
DEVICE-ANALYSIS(19) NOT = 999 AND
DEVICE-ANALYSIS(20) NOT = 999
ADD 1 TO N2
COMPUTE AE-PRODUCT ROUNDED =
AE-PRODUCT +
((DEVICE-ANALYSIS(10) +
DEVICE-ANALYSIS(11) +
DEVICE-ANALYSIS(12) +
DEVICE-ANALYSIS(13) +
DEVICE-ANALYSIS(14) +
DEVICE-ANALYSIS(15) +
DEVICE-ANALYSIS(16) +
DEVICE-ANALYSIS(17) +
DEVICE-ANALYSIS(18) +
DEVICE-ANALYSIS(19) +
DEVICE-ANALYSIS(20)) / 11).
GO TO SUM-TASK-EXIT.
SUM-ACTUALS.
IF READ-TYPE = 0 GO TO SUM-TASK-EXIT.
IF DEVICE-ANALYSIS(6) > 3 ADD 1 TO N3
GO TO SUM-TASK-EXIT.

IF DEVICE-ANALYSIS(6) NOT = 999
MOVE 999 TO DIFFICULTY

IF DEVICE-ANALYSIS(6) < 4 AND
DEVICE-ANALYSIS(7) NOT = 999 AND
DEVICE-ANALYSIS(8) NOT = 999 AND
DEVICE-ANALYSIS(9) NOT = 999 AND
DEVICE-ANALYSIS(10) NOT = 999 AND
DEVICE-ANALYSIS(11) NOT = 999 AND
DEVICE-ANALYSIS(12) NOT = 999
ADD 1 TO N3

COMPUTE DIFFICULTY ROUNDED =
DEVICE-ANALYSIS (7) +
DEVICE-ANALYSIS (8) +
DEVICE-ANALYSIS (9) +
DEVICE-ANALYSIS (10) +
DEVICE-ANALYSIS (11) +
DEVICE-ANALYSIS (12).

IF DEVICE-ANALYSIS(6) = 0 AND DIFFICULTY NOT = 999
COMPUTE RD-PRODUCT ROUNDED = RD-PRODUCT +
(10 * DIFFICULTY).

IF DEVICE-ANALYSIS(6) = 1 AND DIFFICULTY NOT = 999
COMPUTE RD-PRODUCT ROUNDED = RD-PRODUCT +
(9 * DIFFICULTY).

IF DEVICE-ANALYSIS(6) = 2 AND DIFFICULTY NOT = 999
COMPUTE RD-PRODUCT ROUNDED = RD-PRODUCT +
(7 * DIFFICULTY).

IF DEVICE-ANALYSIS(6) = 3 AND DIFFICULTY NOT = 999
COMPUTE RD-PRODUCT ROUNDED = RD-PRODUCT +
(4 * DIFFICULTY).

IF DEVICE-ANALYSIS(5) = 1
PERFORM SUM-CONTROLS THRU SUM-CONTROLS-EXIT.

IF DEVICE-ANALYSIS(6) < 4 AND
DEVICE-ANALYSIS(13) NOT = 999 AND
DEVICE-ANALYSIS(14) NOT = 999 AND
DEVICE-ANALYSIS(15) NOT = 999 AND
DEVICE-ANALYSIS(16) NOT = 999 AND
DEVICE-ANALYSIS(17) NOT = 999 AND
DEVICE-ANALYSIS(18) NOT = 999 AND
DEVICE-ANALYSIS(19) NOT = 999 AND
DEVICE-ANALYSIS(20) NOT = 999
ADD 1 TO N4

COMPUTE TE-PRODUCT ROUNDED =
TE-PRODUCT +
(((DEVICE-ANALYSIS(13) +
DEVICE-ANALYSIS(14) +
DEVICE-ANALYSIS(15) +
DEVICE-ANALYSIS(16) +
DEVICE-ANALYSIS(17) +
DEVICE-ANALYSIS(18) +
DEVICE-ANALYSIS(19) +
DEVICE-ANALYSIS(20)) / 8).

SUM-TASK-EXIT.
EXIT.
SUM-CONTROLS.
MOVE READ-TASK-NO TO REQ-CTL-KEY.
MOVE REQ-CTL-KEY TO CONTROL-KEY.
START CONTROL-FILE KEY IS NOT LESS THAN CONTROL-KEY
   INVALID KEY GO TO SUM-CONTROLS-EXIT.

SUM-EACH-CONTROL.
   READ CONTROL-FILE NEXT RECORD AT END
   GO TO SUM-CONTROLS-EXIT.
   IF REQ-CTL-TASK NOT = CTL-TASK GO TO SUM-CONTROLS-EXIT.
   IF REQ-CTL-SUBTASK NOT = "0000" AND
      REQ-CTL-SUBTASK NOT = CTL-SUBTASK
   GO TO SUM-CONTROLS-EXIT.
   IF CONTROL-ANALYSIS(1) = 999 OR CONTROL-ANALYSIS(2) = 999
   GO TO SUM-CONTROLS-EXIT.
   ADD 1 TO NS.
   IF CONTROL-ANALYSIS(1) > CONTROL-ANALYSIS(2)
      COMPES PS-FS = PS-FS +
      (CONTROL-ANALYSIS(1) - CONTROL-ANALYSIS(2)).
   GO TO SUM-EACH-CONTROL.

SUM-CONTROLS-EXIT.
   EXIT.

DISPLAY-TASKS.
   IF LAST-KEY = "04" OR LAST-KEY = "05"
      MOVE 1 TO TITLE-FLAG.
   IF LAST-KEY = "03" OR LAST-KEY = "05"
      MOVE 1 TO TYPE-PART.
   MOVE 0 TO Q.
   MOVE TASK-KEY TO DEVICE-KEY.
   MOVE DEVICE-KEY TO REQ-TASK-NO.
   READ DEVICE-FILE RECORD INVALID KEY
   GO TO DISPLAY-TASKS-END.
   IF LAST-KEY = "01" GO TO DISPLAY-TASKS-END.

DISPLAY-TASKS-LOOP.
   MOVE 0 TO I.
   DISPLAY (5, 1)ERASE.
   DISPLAY (LIN, COL) " ".
   GO TO DISPLAY-20-DEVICES.

DISPLAY-20-DEVICES.
   MOVE DEVICE-KEY TO READ-TASK-NO.
   MOVE DEVICE-KEY TO TASK-KEY.
   IF READ-TYPE NOT = REQ-TYPE MOVE 1 TO Q.
   ADD 1 TO I.
   IF I > 16 OR Q = 1
      DISPLAY(25, 7) "Hit any key to continue"
      ACCEPT(LIN, COL)NOTHING WITH AUTO-SKIP
      ACCEPT LAST-KEY FROM ESCAPE KEY
      DISPLAY(5, 1)ERASE
      MOVE 1 TO I
      IF Q = 1 GO TO DISPLAY-TASKS-END.
      IF LAST-KEY = "01" GO TO DISPLAY-TASKS-END.
      IF READ-SUBTASK NOT = "0000"
      DISPLAY (LIN, COL) " ".
      DISPLAY TASK-PART, " ", DEVICE-TITLE.
      IF TITLE-FLAG = 1
         PERFORM DISPLAY-CONTROLS THRU DISPLAY-CONTROLS-END.
      READ DEVICE-FILE NEXT RECORD AT END MOVE 1 TO Q.
      GO TO DISPLAY-20-DEVICES.

DISPLAY-TASKS-END.

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MOVE 0 TO TITLE-FLAG.
DISPLAY(6, 1) ERASE.
DISPLAY-CONTROLS.
MOVE DEVICE-KEY TO TASK-KEY.
MOVE SPACES TO CONTROL-PART.
MOVE TASK-KEY TO TITLE-KEY.
START TITLE-FILE KEY IS NOT LESS THAN TITLE-KEY
INVALID KEY GO TO DISPLAY-CONTROLS-END.
READ TITLE-FILE NEXT RECORD AT END
GO TO DISPLAY-CONTROLS-END.
DISPLAY-20-CONTROLS.
IF TITLE-TASK NOT = TASK-PART OR TITLE-TYPE NOT = TYPE-PART
GO TO DISPLAY-CONTROLS-END.
ADD 1 TO I.
IF I > 16
DISPLAY(25, 7) "Hit any key to continue"
ACCEPT(LIN, COL) NOTHING WITH AUTO-SKIP
ACCEPT LAST-KEY FROM ESCAPE KEY
DISPLAY(6, 1) ERASE
DISPLAY TASK-PART, " ", DEVICE-TITLE
MOVE 1 TO I.
IF LAST-KEY = "01" GO TO DISPLAY-CONTROLS-END.
DISPLAY " ", TITLE-CONTROL,
" ", TITLE-DESC.
READ TITLE-FILE NEXT RECORD AT END
GO TO DISPLAY-CONTROLS-END.
GO TO DISPLAY-20-CONTROLS.
DISPLAY-CONTROLS-END.
EXIT.
SQUARE-ROOT.
COMPUTE SQR1 = SQR-ROOT * 10000.
PERFORM SQR-PROC VARYING J FROM 1 BY 2 UNTIL SQR1 < 0.
COMPUTE SQR-ROOT ROUNDED = (J - 3) / 200.
SQR-PROC.
SUBTRACT J FROM SQR1.
IDENTIFICATION DIVISION.
PROGRAM-ID. BUILD.
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  * (1979 MAR)

* THIS IS THE ASTAR DATABASE BUILD PROGRAM.

AUTHOR. Timothy O'Connor.
INSTALLATION. American Institutes for Research.
DATE-WRITTEN. APR 1987.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER.
OBJECT-COMPUTER.
INPUT-OUTPUT SECTION.
FILE-CONTROL.

SELECT DEVICE-FILE ASSIGN TO DISK
  ORGANIZATION IS INDEXED
  ACCESS MODE IS DYNAMIC
  RECORD KEY IS DEVICE-KEY
  FILE STATUS IS DEVICE-STATUS-WORD.

SELECT TITLE-FILE ASSIGN TO DISK
  ORGANIZATION IS INDEXED
  ACCESS MODE IS DYNAMIC
  RECORD KEY IS TITLE-KEY
  FILE STATUS IS TITLE-STATUS-WORD.

SELECT CONTROL-FILE ASSIGN TO DISK
  ORGANIZATION IS INDEXED
  ACCESS MODE IS DYNAMIC
  RECORD KEY IS CONTROL-KEY
  FILE STATUS IS CTL-STATUS-WORD.

DATA DIVISION.
FILE SECTION.
FD DEVICE-FILE
  LABEL RECORD IS STANDARD;
  VALUE OF FILE-ID IS "B:DEVICE".
01 DEVICE-RECORD.
   05 DEVICE-KEY PIC X(10).
   05 DEVICE-ANALYSIS OCCURS 20 TIMES PIC 999.
   05 DEVICE-TITLE PIC X(60).

FD TITLE-FILE
  LABEL RECORD IS STANDARD;
  VALUE OF FILE-ID IS "B:TITLE".
01 TITLE-RECORD.
   05 TITLE-KEY.
PROCEDURE DIVISION.
BEGIN.
    MOVE 0 TO OPTION.
    MOVE "00" TO LAST-KEY
    DISPLAY (1, 1) ERASE.
    DISPLAY (8, 10)
        "Building Task, Subtask, Device & Control Database".
    DISPLAY (11, 25)
        "Hit any key to continue          Esc to ABORT".
    ACCEPT (LIN, COL) ANSWER WITH AUTO-Skip.
    ACCEPT LAST-KEY FROM ESCAPE KEY.
    IF LAST-KEY = "01" GO TO STOP-RUN.
    OPEN OUTPUT DEVICE-FILE.
    OPEN OUTPUT TITLE-FILE.
    OPEN OUTPUT CONTROL-FILE.
    CLOSE DEVICE-FILE.
    CLOSE TITLE-FILE.
    CLOSE CONTROL-FILE.
    DISPLAY (1, 1) ERASE.
    DISPLAY (8, 10)
        "Database build completed!".
    DISPLAY (11, 25)
        "Hit any key to continue".
    ACCEPT (LIN, COL) ANSWER WITH AUTO-Skip.
STOP-RUN.
STOP RUN.
IDENTIFICATION DIVISION.
PROGRAM-ID. LIST.
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* (1979 MAR)
*---------------------------------------------------------------
*THIS IS THE ASTAR DATA FILE LISTING PROGRAM
*---------------------------------------------------------------
AUTHOR. Timothy O'Connor.
INSTALLATION. American Institutes for Research.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER.
OBJECT-COMPUTER.
INPUT-OUTPUT SECTION.
FILE-CONTROL.

SELECT DEVICE-FILE ASSIGN TO DISK
ORGANIZATION IS INDEXED
ACCESS MODE IS DYNAMIC
RECORD KEY IS DEVICE-KEY
FILE STATUS IS DEVICE-STATUS-WORD.

SELECT TITLE-FILE ASSIGN TO DISK
ORGANIZATION IS INDEXED
ACCESS MODE IS DYNAMIC
RECORD KEY IS TITLE-KEY
FILE STATUS IS TITLE-STATUS-WORD.

SELECT CONTROL-FILE ASSIGN TO DISK
ORGANIZATION IS INDEXED
ACCESS MODE IS DYNAMIC
RECORD KEY IS CONTROL-KEY
FILE STATUS IS CTL-STATUS-WORD.

DATA DIVISION.
FILE SECTION.
FD DEVICE-FILE
LABEL RECORD IS STANDARD;
VALUE OF FILE-ID IS "B:DEVICE".
01 DEVICE-RECORD.
   05 DEVICE-KEY PIC X(10).
   05 DEVICE-ANALYSIS OCCURS 20 TIMES PIC 999.
   05 DEVICE-TITLE PIC X(60).

FD TITLE-FILE
LABEL RECORD IS STANDARD;
VALUE OF FILE-ID IS "B:TITLE".
01 TITLE-RECORD.
   05 TITLE-KEY.
   07 TITLE-TYPE PIC 9.
FD CONTROL-FILE
   LABEL RECORD IS STANDARD;
   VALUE OF FILE-ID IS "B:CONTROL".
01 CONTROL-RECORD.
   05 CONTROL-KEY PIC X(20).
   05 CONTROL-ANALYSIS OCCURS 2 TIMES PIC 999.
   05 CORR-CTL-KEY PIC X(20).

WORKING-STORAGE SECTION.
01 ANSWER PIC X.
01 NOTHING PIC X.
01 TITLE-FLAG PIC S9(4) COMP VALUE 0.
01 TASK-NO PIC Z(3)9.9999 DISPLAY.
01 CTL-STATUS-WORD PIC XX.
01 RATING PIC 999.
01 PREVIOUS-RATING PIC Z29.
01 TITLE-STATUS-WORD PIC XX.
01 DEVICE-STATUS-WORD PIC XX.
01 EOF-DEVICE PIC 9 VALUE 0.
01 REQ-TASK-NO.
   05 REQ-TYPE PIC 9.
   05 REQ-TASK PIC Z(4).
   05 FILLER PIC X.
   05 REQ-SUBTASK PIC X(4).
01 READ-TASK-NO.
   05 READ-TYPE PIC 9.
   05 READ-TASK PIC Z(4).
   05 FILLER PIC X.
   05 READ-SUBTASK PIC X(4).
01 TASK-KEY.
   05 TYPE-PART PIC X.
   05 TASK-PART PIC X(9).
   05 PERIOD-PART PIC X VALUE ".".
   05 CONTROL-PART PIC X(9).
01 OPTION PIC 9.
01 PREV-OPTION PIC 9.
01 LAST-KEY PIC XX.
01 X PIC 9(4).
01 Q PIC 9(4).
01 Z PIC 9(4).
01 K PIC 9(4).
01 I PIC 9(4).

PROCEDURE DIVISION.
BEGIN.
   OPEN I-O DEVICE-FILE.
   OPEN INPUT CONTROL-FILE.
   OPEN INPUT TITLE-FILE.
   DISPLAY (1, 1) ERASE.
   MOVE ZEROS TO TASK-NO.
   MOVE TASK-NO TO REQ-TASK-NO.
MOVE 0 TO OPTION.

MENU.
MOVE OPTION TO PREV-OPTION.
MOVE 0 TO OPTION.
MOVE 0 TO EOF-DEVICE.
MOVE "00" TO LAST-KEY
DISPLAY (1, 1) ERASE.
DISPLAY (1, 25)
"LIST RATINGS ".
DISPLAY (4, 25)
"(1) List Training Device Ratings ".
DISPLAY (6, 25)
"(2) List Operational Equipment Ratings ".
DISPLAY (8, 25)
"(3) List Common Controls & Displays ".
DISPLAY (10, 25)
"(4) EXIT PROGRAM ".
DISPLAY (13, 12) "Enter Option Number ".
ACCEPT (LIN, COL) OPTION WITH AUTO-SKIP.
ACCEPT LAST-KEY FROM ESCAPE KEY.
DISPLAY (1, 1) ERASE.
IF OPTION = 1 GO TO TASK-LIST-LOOP.
IF OPTION = 2 GO TO TASK-LIST-LOOP.
IF OPTION = 3 GO TO CONTROL-LIST-LOOP.
IF OPTION = 4 GO TO STOP-RUN.
GO TO MENU.

TASK-LIST-LOOP.
PERFORM FIND-STARTING-TASK.
IF LAST-KEY = "01" GO TO MENU.
PERFORM READ-TASK THRU READ-TASK-EXIT.
GO TO MENU.

CONTROL-LIST-LOOP.
PERFORM FIND-STARTING-TASK.
IF LAST-KEY = "01" GO TO MENU.
MOVE TASK-KEY TO CONTROL-KEY.
START CONTROL-FILE KEY IS NOT LESS THAN CONTROL-KEY
INVALID KEY
DISPLAY (LIN, 1) ERASE
DISPLAY (LIN, 1)
"TASK.SUBTASK NOT FOUND IN DATA BASE 
PERFORM TIMER
GO TO CONTROL-LIST-LOOP.
DISPLAY (1, 1) ERASE.
PERFORM READ-CONTROL THRU READ-CONTROL-EXIT.
GO TO MENU.

HIT-ANY-KEY.
DISPLAY (25, 50) "Hit any key to continue ".
ACCEPT (LIN, COL) NOTHING WITH AUTO-SKIP.
ACCEPT LAST-KEY FROM ESCAPE KEY.
DISPLAY (1, 1) ERASE.

FIND-STARTING-TASK.
DISPLAY (5, 1) ERASE.
MOVE ZEROS TO TASK-NO.
DISPLAY (22, 5)
"Hit 'F1' to List Training Device Tasks & Subtasks".
DISPLAY (23, 5)
"Hit 'F2' to List Operational Equipment Tasks & Subtasks".
DISPLAY (24, 5)
"Hit 'F3' to List Training Device Controls & Displays".
DISPLAY (25, 5)
"Hit 'F4' to List Operational Equipment 
"Controls & Displays".

IF OPTION = 1
MOVE 0 TO TYPE-PART
DISPLAY (5, 1)
"Enter Starting Training Device Task.Subtask number "
ELSE
MOVE 1 TO TYPE-PART
DISPLAY (5, 1)
"Enter Starting Operational Equipment Task.Subtask 
"number ".
ACCEPT (LIN, COL) TASK-NO WITH AUTO-SKIP PROMPT.
ACCEPT LAST-KEY FROM ESCAPE KEY.
MOVE TASK-NO TO TASK-PART.
IF LAST-KEY = "02" OR LAST-KEY = "03" OR
   LAST-KEY = "04" OR LAST-KEY = "05"
   PERFORM DISPLAY-TASKS THRU DISPLAY-TASKS-END
   GO TO FIND-STARTING-TASK.
IF LAST-KEY NOT = "01"
MOVE TASK-NO TO TASK-PART
MOVE TASK-KEY TO REQ-TASK-NO
MOVE TASK-KEY TO DEVICE-KEY
START DEVICE-FILE KEY IS EQUAL TO DEVICE-KEY

INVALID KEY
   DISPLAY (LIN, 1) ERASE
   DISPLAY (LIN, 1) 
   "TASK.SUBTASK NOT FOUND IN DATA BASE 
   "PERFORM TIMER
   GO TO FIND-STARTING-TASK.

DISPLAY (1, 1)ERASE.
READ-TASK.
MOVE 0 TO EOF-DEVICE.
READ DEVICE-FILE NEXT RECORD AT END MOVE 1 TO EOF-DEVICE
   GO TO READ-TASK-EXIT.
MOVE DEVICE-KEY TO READ-TASK-NO.
MOVE DEVICE-KEY TO TASK-KEY.
IF DEVICE-KEY = "1 0.0000" GO TO READ-TASK.
DISPLAY (1, 1)ERASE.
IF TYPE-PART = "0" DISPLAY (1, 32)
   "Training Device ".
IF TYPE-PART = "1" DISPLAY (1, 32)
   "Operational Equipment".
DISPLAY (3, 1)ERASE.
DISPLAY " ", TASK-PART, " ", DEVICE-TITLE.
DISPLAY " ".
DISPLAY-ASTAR1.
IF DEVICE-KEY NOT = "0 0.0000" GO TO DISPLAY-ASTAR-TD.
DISPLAY " ".
DISPLAY " ".
DISPLAY " ",

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"ASTAR 1 - Device Level Ratings".
DISPLAY " PERFORM LEARNING TRAINING RESIDUAL ",
" RESIDUAL PHYSICAL FUNCTION TRAINING".
DISPLAY " DEFICIT DIFF ACQ DEFICIT ",
"LEARN DIFF SIMILAR SIMILAR TRANSFER".
DISPLAY " , DEVICE-ANALYSIS(1), " ",
" , DEVICE-ANALYSIS(2), " ",
" , DEVICE-ANALYSIS(3), " ",
" , DEVICE-ANALYSIS(4), " ",
" , DEVICE-ANALYSIS(5), " ",
" , DEVICE-ANALYSIS(6), " ",
" , DEVICE-ANALYSIS(7), " ",
" , DEVICE-ANALYSIS(8).
DISPLAY ".
DISPLAY ".
DISPLAY " -------------------------------------".
DISPLAY ".
DISPLAY " ASTAR 2 - Device Level Ratings".
DISPLAY " ".
DISPLAY " TRAINING ACQUISITION ",
" TRAINING TRANSFER ".
DISPLAY " (1) (2) (3) (4) ".
" (1) (2) (3) ".
DISPLAY " , DEVICE-ANALYSIS(9),
" , DEVICE-ANALYSIS(10),
" , DEVICE-ANALYSIS(11),
" , DEVICE-ANALYSIS(12), " ",
" , DEVICE-ANALYSIS(13),
" , DEVICE-ANALYSIS(14),
" , DEVICE-ANALYSIS(15).
PERFORM HIT-ANY-KEY.
IF LAST-KEY = "01" GO TO READ-TASK-EXIT.
GO TO READ-TASK.
DISPLAY-ASTAR-TD.
IF TYPE-PART = "1" GO TO DISPLAY-ASTAR-OE.
DISPLAY " ",
"ASTAR 2 - Training Device Task(Subtask) Ratings".
DISPLAY " ".
DISPLAY " PERFORMANCE DEFICIT ",
" LEARNING DIFFICULTY ".
DISPLAY " , DEVICE-ANALYSIS(1),
" , DEVICE-ANALYSIS(2),
" , DEVICE-ANALYSIS(3),
DISPLAY ".
DISPLAY " -------------------------------------".
DISPLAY ".
DISPLAY " ASTAR 3 - Training Device Task(Subtask) Ratings".
DISPLAY " ".
DISPLAY " PERFORMANCE DEFICIT ",
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DISPLAY "LEARNING DIFFICULTY ",
DISPLAY "(1) (2) (3) (4) (5) (6)",
DISPLAY " , DEVICE-ANALYSIS(3),
DISPLAY " , DEVICE-ANALYSIS(4),
DISPLAY " , DEVICE-ANALYSIS(5),
DISPLAY " , DEVICE-ANALYSIS(6),
DISPLAY " , DEVICE-ANALYSIS(7),
DISPLAY " , DEVICE-ANALYSIS(8),
DISPLAY " , DEVICE-ANALYSIS(9).
DISPLAY ".
DISPLAY "TRAINING ",
"ACQUISITION ",
DISPLAY " (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)",
DISPLAY " , DEVICE-ANALYSIS(10),
DISPLAY " , DEVICE-ANALYSIS(11),
DISPLAY " , DEVICE-ANALYSIS(12),
DISPLAY " , DEVICE-ANALYSIS(13),
DISPLAY " , DEVICE-ANALYSIS(14),
DISPLAY " , DEVICE-ANALYSIS(15),
DISPLAY " , DEVICE-ANALYSIS(16),
DISPLAY " , DEVICE-ANALYSIS(17),
DISPLAY " , DEVICE-ANALYSIS(18),
DISPLAY " , DEVICE-ANALYSIS(19),
DISPLAY " , DEVICE-ANALYSIS(20).

PERFORM HIT-ANY-KEY.
IF LAST-KEY = "01" GO TO READ-TASK-EXIT.
GO TO READ-TASK.
DISPLAY-ASTAR-OE.
DISPLAY " ",
"ASTAR 2 - Operational Equipment Task(Subtask) Ratings".
DISPLAY " ",
DISPLAY "RESIDUAL DEFICIT , RESIDUAL LEARNING DIFFICULTY ",
DISPLAY " , DEVICE-ANALYSIS(1),
DISPLAY " , DEVICE-ANALYSIS(2).
DISPLAY " ",
DISPLAY "PHYSICAL SIMILARITY , FUNCTIONAL SIMILARITY ",
DISPLAY " , DEVICE-ANALYSIS(3),
DISPLAY " , DEVICE-ANALYSIS(4).
DISPLAY " ",
DISPLAY "-------------------------------------", 
"ASTAR 3 - Operational Equipment Task(Subtask) Ratings ",
DISPLAY " ",
DISPLAY "COMMONALITY , RESIDUAL DEFICIT ",
DISPLAY " , DEVICE-ANALYSIS(5),
DEVICE-ANALYSIS(6).

DISPLAY "RESIDUAL LEARNING DIFFICULTY TRAINING TRANSFER ",

DISPLAY "(1) (2) (3) (4) (5) (6) ",

DISPLAY ", DEVICE-ANALYSIS(7),

DISPLAY ", DEVICE-ANALYSIS(8),

DISPLAY ", DEVICE-ANALYSIS(9),

DISPLAY ", DEVICE-ANALYSIS(10),

DISPLAY ", DEVICE-ANALYSIS(11),

DISPLAY ", DEVICE-ANALYSIS(12),

DISPLAY ", DEVICE-ANALYSIS(13),

DISPLAY ", DEVICE-ANALYSIS(14),

DISPLAY ", DEVICE-ANALYSIS(15),

DISPLAY ", DEVICE-ANALYSIS(16),

DISPLAY ", DEVICE-ANALYSIS(17),

DISPLAY ", DEVICE-ANALYSIS(18),

DISPLAY ", DEVICE-ANALYSIS(19),

DISPLAY ", DEVICE-ANALYSIS(20).

PERFORM HIT-ANY-KEY.
IF LAST-KEY = "01" GO TO READ-TASK-EXIT.
GO TO READ-TASK.
READ-TASK-EXIT.
EXIT.
READ-CONTROL.
READ CONTROL-FILE NEXT RECORD AT END
GO TO READ-CONTROL-EXIT.
MOVE CONTROL-KEY TO TITLE-KEY.
MOVE CONTROL-KEY TO DEVICE-KEY.
READ DEVICE-FILE RECORD INVALID KEY GO TO READ-CONTROL.
READ TITLE-FILE RECORD INVALID KEY GO TO READ-CONTROL.
MOVE DEVICE-KEY TO TASK-KEY.
IF DEVICE-ANALYSIS(5) NOT = 1 GO TO READ-CONTROL.
DISPLAY (1, 1)ERASE.
IF TYPE-PART = "1" DISPLAY (1, 32)
"Operational Equipment".
DISPLAY (3, 1)ERASE.
DISPLAY "", TASK-PART, "", DEVICE-TITLE.
DISPLAY "".
DISPLAY "", TITLE-CONTROL, "", TITLE-DESC.
MOVE CORR-CTL-KEY TO DEVICE-KEY.
MOVE CORR-CTL-KEY TO TITLE-KEY.
READ DEVICE-FILE RECORD INVALID KEY GO TO READ-CONTROL.
READ TITLE-FILE RECORD INVALID KEY GO TO READ-CONTROL.
MOVE DEVICE-KEY TO TASK-KEY.
IF TYPE-PART = "0" DISPLAY (7, 32)
"Training Device".
DISPLAY (9, 1)ERASE.
DISPLAY "", TASK-PART, "", DEVICE-TITLE.
DISPLAY "".
DISPLAY "", TITLE-CONTROL, "", TITLE-DESC.
DISPLAY "".
DISPLAY "".-----------------------------". 

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DISPLAY " ".
DISPLAY "   PHYSICAL SIMILARITY   ",
"   FUNCTIONAL SIMILARITY   ".
DISPLAY "  , CONTROL-ANALYSIS(1),
"  , CONTROL-ANALYSIS(2).

DISPLAY " ".
PERFORM HIT-ANY-KEY.
IF LAST-KEY = "01" GO TO READ-CONTROL-EXIT.
GO TO READ-CONTROL.

READ-CONTROL-EXIT.
EXIT.
STOP-RUN.
   DISPLAY(1, 1)ERASE.
   CLOSE DEVICE-FILE.
   CLOSE CONTROL-FILE.
   CLOSE TITLE-FILE.
   EXIT PROGRAM.
STOPPED.
STOP RUN.
TIMER.
   PERFORM NO-OP 2000 TIMES.
NO-OP.
EXIT.
DISPLAY-TASKS.
   MOVE 0 TO TYPE-PART.
   IF LAST-KEY = "03" OR LAST-KEY = "05"
      MOVE 1 TO TYPE-PART.
   IF LAST-KEY = "04" OR LAST-KEY = "05"
      MOVE 1 TO TITLE-FLAG.
   MOVE 0 TO Q.
   MOVE TASK-KEY TO DEVICE-KEY.
   MOVE DEVICE-KEY TO REQ-TASK-NO.
   READ DEVICE-FILE RECORD INVALID KEY
      GO TO DISPLAY-TASKS-END.
   IF LAST-KEY = "01" GO TO DISPLAY-TASKS-END.
DISPLAY-TASKS-LOOP.
   MOVE 0 TO I.
   DISPLAY (5, 1)ERASE.
   DISPLAY (LIN, COL)"    ".
   GO TO DISPLAY-20-DEVICES.
DISPLAY-20-DEVICES.
   MOVE DEVICE-KEY TO READ-TASK-NO.
   MOVE DEVICE-KEY TO TASK-KEY.
   IF READ-TYPE NOT = REQ-TYPE MOVE 1 TO Q.
   ADD 1 TO I.
   IF I > 16 OR Q = 1
      DISPLAY(25, 7)"Hit any key to continue"
      ACCEPT(LIN, COL)NOTHING WITH AUTO-SKIP
      ACCEPT LAST-KEY FROM ESCAPE KEY
      DISPLAY(6, 1)ERASE
      MOVE 1 TO I
   IF Q = 1 GO TO DISPLAY-TASKS-END.
   IF LAST-KEY = "01" GO TO DISPLAY-TASKS-END.
   IF READ-SUBTASK NOT = "0000"

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DISPLAY (LIN, COL) " ".
DISPLAY TASK-PART, " ", DEVICE-TITLE.
IF TITLE-FLAG = 1
PERFORM DISPLAY-CONTROLS THRU DISPLAY-CONTROLS-END.
READ DEVICE-FILE NEXT RECORD AT END MOVE 1 TO Q.
GO TO DISPLAY-20-DEVICES.
DISPLAY-TASKS-END.
MOVE 0 TO TITLE-FLAG.
DISPLAY(6, 1)ERASE.
DISPLAY-CONTROLS.
MOVE DEVICE-KEY TO TASK-KEY.
MOVE SPACES TO CONTROL-PART.
MOVE TASK-KEY TO TITLE-KEY.
START TITLE-FILE KEY IS NOT LESS THAN TITLE-KEY
INVALID KEY GO TO DISPLAY-CONTROLS-END.
READ TITLE-FILE NEXT RECORD AT END
GO TO DISPLAY-CONTROLS-END.
DISPLAY-CONTROLS-END.
IF TITLE-TASK NOT = TASK-PART OR TITLE-TYPE NOT = TYPE-PART
GO TO DISPLAY-CONTROLS-END.
ADD 1 TO I.
IF I > 16
DISPLAY(25, 7) "Hit any key to continue"
ACCEPT(LIN, COL) NOTHING WITH AUTO-SKIP
ACCEPT LAST-KEY FROM ESCAPE KEY
DISPLAY(6, 1)ERASE
DISPLAY TASK-PART, " ", DEVICE-TITLE
MOVE 1 TO I.
IF LAST-KEY = "01" GO TO DISPLAY-CONTROLS-END.
DISPLAY " ", TITLE-CONTROL,
" ", TITLE-DESC.
READ TITLE-FILE NEXT RECORD AT END
GO TO DISPLAY-CONTROLS-END.
GO TO DISPLAY-20-CONTROLS.
DISPLAY-CONTROLS-END.
EXIT.
IDENTIFICATION DIVISION.
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* THIS IS THE ASTAR DATA FILE MAINTENANCE PROGRAM

*-----------------------------------------------

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DATE-WRITTEN. AUG 1984.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER.
OBJECT-COMPUTER.
INPUT-OUTPUT SECTION.
FILE-CONTROL.

SELECT DEVICE-FILE ASSIGN TO DISK
  ORGANIZATION IS INDEXED
  ACCESS MODE IS DYNAMIC
  RECORD KEY IS DEVICE-KEY
  FILE STATUS IS DEVICE-STATUS-WORD.

SELECT CONTROL-FILE ASSIGN TO DISK
  ORGANIZATION IS INDEXED
  ACCESS MODE IS DYNAMIC
  RECORD KEY IS CONTROL-KEY
  FILE STATUS IS CTL-STATUS-WORD.

SELECT TITLE-FILE ASSIGN TO DISK
  ORGANIZATION IS INDEXED
  ACCESS MODE IS DYNAMIC
  RECORD KEY IS TITLE-KEY
  FILE STATUS IS TITLE-STATUS-WORD.

DATA DIVISION.
FILE SECTION.
FD DEVICE-FILE
  LABEL RECORD IS STANDARD;
  VALUE OF FILE-ID IS "B:DEVICE".
  01 DEVICE-RECORD.
     05 DEVICE-KEY PIC X(10).
     05 DEVICE-ANALYSIS OCCURS 20 TIMES PIC 999.
     05 DEVICE-TITLE PIC X(50).

FD TITLE-FILE
  LABEL RECORD IS STANDARD;
  VALUE OF FILE-ID IS "B:TITLE".
  01 TITLE-RECORD.
     05 TITLE-KEY.
        07 TITLE-TYPE PIC 9.
        07 TITLE-TASK PIC X(9).
07 TITLE-PERIOD PIC X.
07 TITLE-CONTROL PIC X(9).
05 TITLE-DESC PIC X(60).

FD CONTROL-FILE
   LABEL RECORD IS STANDARD;
   VALUE OF FILE-ID IS "B:CONTROL".
01 CONTROL-RECORD.
   05 CONTROL-KEY PIC X(20).
   05 CONTROL-ANALYSIS OCCURS 2 TIMES PIC 999.
   05 CORR-CTL-KEY PIC X(20).

WORKING-STORAGE SECTION.
77 RATING PIC 999.
77 PREVIOUS-RATING PIC ZZ9.
77 EOF-DEVICE PIC 9 VALUE 0.
77 TITLE-FLAG PIC 9(4) COMP VALUE 0.
77 I PIC 9(4) COMP.
01 REQ-TASK-NO.
   05 REQ-TYPE PIC 9.
   05 REQ-TASK PIC Z(4).
   05 FILLER PIC X.
   05 REQ-SUBTASK PIC X(4).
01 TASK-KEY.
   05 TYPE-PART PIC X.
   05 TASK-PART PIC X(9).
   05 PERIOD-PART PIC X VALUE ".".
   05 CONTROL-PART PIC X(9).
01 C-D-KEY PIC X(10).
01 TASK-NO PIC Z(3)9.9999 DISPLAY.
01 NOTHING PIC X.
01 CTL-STATUS-WORD PIC XX.
01 READ-TASK-NO.
   05 READ-TYPE PIC 9.
   05 READ-TASK1 PIC Z(4).
   05 FILLER PIC X.
   05 READ-SUBTASK PIC X(4).
01 DEVICE-STATUS-WORD PIC XX.
01 TITLE-STATUS-WORD PIC XX.
01 NEW-DESC PIC X(54).
01 OPTION PIC X.
01 LAST-KEY PIC XX.
01 Z PIC 99.

PROCEDURE DIVISION.
BEGIN.
   OPEN I-O DEVICE-FILE.
   OPEN I-O CONTROL-FILE.
   OPEN I-O TITLE-FILE.
   DISPLAY (1, 1) ERASE.
   MOVE 0 TO TASK-NO.
   MOVE SPACES TO DEVICE-KEY.
DISPLAY-MENU.
   DISPLAY (1, 1) ERASE.
   DISPLAY (1, 12)
"Data Base Maintenance".

DISPLAY (3, 12)
"(1) Training Device - Task and Subtask Maintenance".
DISPLAY (5, 12)
"(2) Training Device - Control and Display Maintenance".
DISPLAY (7, 12)
"(3) Operational Equipment - Task and Subtask Maintenance".
DISPLAY (9, 12)
"(4) Operational Equipment - Control and Display ",
"Maintenance".
DISPLAY (11, 12)
"(5) Commonality Analysis"
DISPLAY (13, 12)
"(6) Similarity Matching"
DISPLAY (15, 12)
"(7) EXIT PROGRAM"
DISPLAY (17, 30)
"Enter Option ".
ACCEPT (LIN, COL) OPTION WITH AUTO-SKIP.
DISPLAY (1, 1) ERASE.
IF OPTION = "1" PERFORM DISPLAY-FUNCTION-KEYS
GO TO DEVICE-TITLES.
IF OPTION = "2" PERFORM DISPLAY-FUNCTION-KEYS
GO TO CONTROL-TITLES.
IF OPTION = "3" PERFORM DISPLAY-FUNCTION-KEYS
GO TO DEVICE-TITLES.
IF OPTION = "4" PERFORM DISPLAY-FUNCTION-KEYS
GO TO CONTROL-TITLES.
IF OPTION = "5" GO TO COMMONALITY-ANALYSIS.
IF OPTION = "6" GO TO SIMILARITY-ANALYSIS.
IF OPTION = "7" GO TO STOP-RUN.
GO TO DISPLAY-MENU.

DEVICE-TITLES.
IF OPTION = 1 MOVE 0 TO TYPE-PART.
IF OPTION = 3 MOVE 1 TO TYPE-PART.
MOVE " 0.0000" TO TASK-PART
IF TYPE-PART = 0
DISPLAY (3, 15)
"(1) Training Device - Task and Subtask Definition " .
IF TYPE-PART = 1
DISPLAY (3, 15)
"(3) Operational Equipment - Task and Subtask Definition".
MOVE TASK-KEY TO DEVICE-KEY.
READ DEVICE-FILE RECORD INVALID KEY GO TO ADD-DEVICE.
IF TYPE-PART = 0
DISPLAY (6, 5)
"Enter Training Device Task.Subtask number ".
IF TYPE-PART = 1
DISPLAY (6, 5)
"Enter Operational Equipment Task.Subtask number ".
MOVE ZEROS TO TASK-NO.
ACCEPT (LIN, COL) TASK-NO WITH AUTO-SKIP PROMPT.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "01" GO TO DISPLAY-MENU.
IF LAST-KEY = "02" OR LAST-KEY = "03" OR
LAST-KEY = "04" OR LAST-KEY = "05"
PERFORM DISPLAY-TASKS THRU DISPLAY-TASKS-END
GO TO DEVICE-TITLES.
MOVE TASK-NO TO TASK-PART.
MOVE TASK-KEY TO DEVICE-KEY.
DISPLAY (4, 1) ERASE.
DISPLAY (6, 5) "Task.Subtask = ", TASK-PART.
DISPLAY (7, 5) " Title = ".
READ DEVICE-FILE RECORD
INVALID KEY GO TO ADD-DEVICE.
ACCEPT (LIN, COL) DEVICE-TITLE WITH UPDATE.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "01" GO TO DISPLAY-MENU.
IF DEVICE-TITLE = "DELETE" OR DEVICE-TITLE = "delete"
GO TO DELETE-DEVICE.
Rewrite DEVICE-RECORD INVALID KEY PERFORM BAD-KEY.
DISPLAY (4, 1) ERASE.
PERFORM DISPLAY-FUNCTION-KEYS.
GO TO DEVICE-TITLES.
ADD-DEVICE.
MOVE SPACES TO DEVICE-TITLE.
IF DEVICE-KEY = "0 0.0000"
DISPLAY (6, 5) "Enter Title of Training Device"
ELSE
IF DEVICE-KEY = "1 0.0000"
DISPLAY (6, 5) "Enter Title of Operational Equipment ".
DISPLAY (7, 5) " Title = ".
ACCEPT (LIN, COL) DEVICE-TITLE WITH UPDATE.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "01" GO TO DISPLAY-MENU.
IF DEVICE-TITLE = "DELETE" OR DEVICE-TITLE = "delete"
GO TO DISPLAY-MENU.
PERFORM MOVE-NINES VARYING I FROM 1 BY 1 UNTIL I > 20.
WRITE DEVICE-RECORD INVALID PERFORM BAD-KEY.
DISPLAY (4, 1) ERASE.
PERFORM DISPLAY-FUNCTION-KEYS.
GO TO DEVICE-TITLES.
CONTROL-TITLES.
IF OPTION = 2
MOVE 0 TO TYPE-PART
DISPLAY (3, 12)
"(2) Training Device - Control and Display Mainten", 
"ance ".
IF OPTION = 4
MOVE 1 TO TYPE-PART
DISPLAY (3, 12)
"(4) Operational Equipment - Control and Display ", 
"Maintenance".
IF TYPE-PART = 0
DISPLAY (6, 5)
"Enter Training Device Task.Subtask number ".
IF TYPE-PART = 1
DISPLAY (6, 5)
"Enter Operational Equipment Task.Subtask number ".
MOVE 0 TO TASK-NO.
ACCEPT (LIN, COL) TASK-NO WITH AUTO-SKIP PROMPT.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "01" GO TO DISPLAY-MENU.
IF LAST-KEY = "02" OR LAST-KEY = "03" OR
   LAST-KEY = "04" OR LAST-KEY = "05"
   PERFORM DISPLAY-TASKS THRU DISPLAY-TASKS-END
   GO TO CONTROL-TITLES.
MOVE TASK-NO TO TASK-PART.
MOVE TASK-KEY TO DEVICE-KEY.
READ DEVICE-FILE RECORD INVALID KEY
   PERFORM BAD-KEY
   GO TO CONTROL-TITLES.
DISPLAY (4, 1) ERASE.
DISPLAY (6, 5) "Task.Subtask = ", TASK-PART.
DISPLAY (7, 5) " Title = ", DEVICE-TITLE.
GET-CONTROL-TITLE.
DISPLAY (9, 1) ERASE.
DISPLAY (9, 10)
   "Enter Control or Display number ".
MOVE "." TO PERIOD-PART.
MOVE " " TO CONTROL-PART.
ACCEPT (LIN, COL) CONTROL-PART WITH UPDATE.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY NOT = "00"
   DISPLAY (4, 1) ERASE
   GO TO CONTROL-TITLES.
MOVE SPACES TO TITLE-DESC.
MOVE TASK-KEY TO TITLE-KEY.
DISPLAY (8, 1) ERASE.
DISPLAY (9, 5) "Control/Display = ", TASK-PART, ".", CONTROL-PART.
DISPLAY (10, 5) " Title = ".
READ TITLE-FILE RECORD
   INVALID KEY GO TO ADD-CONTROL.
ACCEPT (LIN, COL) TITLE-DESC WITH UPDATE.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "01" GO TO DISPLAY-MENU.
IF LAST-KEY NOT = "00"
   DISPLAY (4, 1) ERASE
   GO TO CONTROL-TITLES.
IF TITLE-DESC = "DELETE" OR TITLE-DESC = "delete"
   GO TO DELETE-CONTROL.
REWRITE TITLE-RECORD INVALID KEY PERFORM BAD-KEY.
DISPLAY (4, 1) ERASE.
PERFORM DISPLAY-FUNCTION-KEYS.
GO TO GET-CONTROL-TITLE.
ADD-CONTROL.
MOVE SPACES TO TITLE-DESC.
ACCEPT (LIN, COL) TITLE-DESC WITH UPDATE.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY NOT = "00" GO TO DISPLAY-MENU.
IF TITLE-DESC = "DELETE" OR TITLE-KEY = "delete"
   GO TO DISPLAY-MENU.
WRITE TITLE-RECORD INVALID KEY PERFORM BAD-KEY.
GO TO GET-CONTROL-TITLE.

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DELET-DEVICE.
   DELETE DEVICE-FILE RECORD INVALID KEY PERFORM BAD-KEY.
   DISPLAY (4, 1)ERASE.
   PERFORM DISPLAY-FUNCTION-KEYS.
   GO TO DEVICE-TITLES.
DELET-CONTROL.
   MOVE TITLE-KEY TO CONTROL-KEY.
   DELETE TITLE-FILE RECORD INVALID KEY PERFORM BAD-KEY.
   DELETE CONTROL-FILE RECORD INVALID KEY GO TO CONTROL-TITLES.
   DISPLAY (4, 1)ERASE.
   PERFORM DISPLAY-FUNCTION-KEYS.
   GO TO CONTROL-TITLES.
BAD-KEY.
   DISPLAY (4, 1)ERASE.
   DISPLAY (9, 8)"Task.Subtask = ", TASK-PART, ", " ,
   "NOT FOUND IN DATABASE".
   PERFORM TIMER.
   DISPLAY (4, 1)ERASE.
   PERFORM DISPLAY-FUNCTION-KEYS.
STOP-RUN.
   DISPLAY (1, 1)ERASE.
   CLOSE CONTROL-FILE, DEVICE-FILE, TITLE-FILE.
   EXIT PROGRAM.
STOPPED.
   STOP RUN.
DISPLAY-TASKS.
   MOVE 0 TO TYPE-PART.
   IF LAST-KEY = "03" OR LAST-KEY = "05"
      MOVE 1 TO TYPE-PART.
   IF LAST-KEY = "04" OR LAST-KEY = "05"
      MOVE 1 TO TITLE-FLAG.
   MOVE TASK-NO TO TASK-PART.
   MOVE 0 TO Z.
   MOVE TASK-KEY TO DEVICE-KEY.
   MOVE DEVICE-KEY TO REQ-TASK-NO.
   READ DEVICE-FILE RECORD INVALID KEY
   GO TO DISPLAY-TASKS-END.
   IF LAST-KEY = "01" GO TO DISPLAY-TASKS-END.
DISPLAY-TASKS-LOOP.
   MOVE 0 TO I.
   DISPLAY (8, 1)ERASE.
   DISPLAY (LIN, COL)"" .
   GO TO DISPLAY-20-DEVICES.
DISPLAY-20-DEVICES.
   MOVE DEVICE-KEY TO READ-TASK-NO.
   MOVE DEVICE-KEY TO TASK-KEY.
   IF READ-TYPE NOT = REQ-TYPE GO TO DISPLAY-TASKS-END.
   ADD 1 TO I.
   IF I > 16
      DISPLAY(25, 50)"Hit any key to continue"
      ACCEPT(LIN, COL)NOTHING WITH AUTO-SKIP
      ACCEPT LAST-KEY FROM ESCAPE KEY
      MOVE 1 TO I
   IF LAST-KEY NOT = "01" DISPLAY(8, 1)ERASE.
   IF LAST-KEY = "01" GO TO DISPLAY-TASKS-END.
IF READ-SUBTASK NOT = "0000"
DISPLAY (LIN, COL) " ".
DISPLAY TASK-PART, " ", DEVICE-TITLE.
IF TITLE-FLAG = 1
PERFORM DISPLAY-CONTROLS THRU DISPLAY-CONTROLS-END.
READ DEVICE-FILE NEXT RECORD
AT END GO TO DISPLAY-TASKS-END.
GO TO DISPLAY-20-DEVICES.
DISPLAY-TASKS-END.
MOVE 0 TO TITLE-FLAG.
DISPLAY-CONTROLS.
MOVE DEVICE-KEY TO TASK-KEY.
MOVE SPACES TO CONTROL-PART.
MOVE TASK-KEY TO TITLE-KEY.
START TITLE-FILE KEY IS NOT LESS THAN TITLE-KEY
INVALID KEY GO TO DISPLAY-CONTROLS-END.
READ TITLE-FILE NEXT RECORD AT END
GO TO DISPLAY-CONTROLS-END.
DISPLAY-20-CONTROLS.
IF TITLE-TASK NOT = TASK-PART OR TITLE-TYPE NOT = TYPE-PART
GO TO DISPLAY-CONTROLS-END.
ADD 1 TO I.
IF I > 16
DISPLAY(25, 50) "Hit any key to continue"
ACCEPT(LIN, COL) NOTHING WITH AUTO-SKIP
ACCEPT LAST-KEY FROM ESCAPE KEY
MOVE 1 TO I
IF LAST-KEY NOT = "01" DISPLAY(8, 1) ERASE
DISPLAY TASK-PART, " ", DEVICE-TITLE.
IF LAST-KEY = "01" GO TO DISPLAY-CONTROLS-END.
DISPLAY " ", TITLE-CONTROL,
" ", TITLE-DESC.
READ TITLE-FILE NEXT RECORD AT END
GO TO DISPLAY-CONTROLS-END.
GO TO DISPLAY-20-CONTROLS.
DISPLAY-CONTROLS-END.
EXIT.
TIMER.
PERFORM NO-OP 5000 TIMES.
NO-OP.
EXIT.
FIND-STARTING-TASK.
MOVE 0 TO EOF-DEVICE.
MOVE 1 TO TYPE-PART.
MOVE ZEROS TO TASK-NO.
DISPLAY (5, 1)
"Enter Starting Operational Equipment Task.Subtask ",
"number ".
ACCEPT (LIN, COL) TASK-NO WITH AUTO-SKIP PROMPT.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "02" OR LAST-KEY = "03" OR
LAST-KEY = "04" OR LAST-KEY = "05"
PERFORM DISPLAY-TASKS THRU DISPLAY-TASKS-END
GO TO FIND-STARTING-TASK.
MOVE TASK-NO TO TASK-PART.
MOVE TASK-KEY TO REQ-TASK-NO.
MOVE TASK-KEY TO DEVICE-KEY.
START DEVICE-FILE KEY IS EQUAL TO DEVICE-KEY
INVALID KEY
  DISPLAY (LIN, 1) ERASE
  DISPLAY (LIN, 1)
  "TASK.SUBTASK NOT FOUND IN DATA BASE"
  PERFORM TIMER
  GO TO FIND-STARTING-TASK.

READ-TASK.
  MOVE 0 TO EOF-DEVICE.
  READ DEVICE-FILE NEXT RECORD AT END MOVE 1 TO EOF-DEVICE
  GO TO READ-TASK-EXIT.
  MOVE DEVICE-KEY TO READ-TASK-NO.
  MOVE DEVICE-KEY TO TASK-KEY.
  IF TASK-PART = "0.0000" GO TO READ-TASK.
  IF REQ-SUBTASK = "0000" AND READ-SUBTASK NOT = "0000"
    GO TO READ-TASK.
  IF REQ-SUBTASK NOT = "0000" AND READ-SUBTASK = "0000"
    GO TO READ-TASK.
  IF REQ-TYPE NOT = "READ-TYPE" GO TO READ-TASK.
READ-TASK-EXIT.
  EXIT.

RATE-TASKS.
  PERFORM READ-TASK THRU READ-TASK-EXIT.
  IF EOF-DEVICE = 1 GO TO RATE-TASKS-EXIT.
  PERFORM RATE-EACH-TASK THRU RATE-EACH-TASK-EXIT
  IF LAST-KEY = "01" GO TO RATE-TASKS-EXIT.
RATE-TASKS-EXIT.
  EXIT.

RATE-EACH-TASK.
  DISPLAY (23, 1) ERASE.
  DISPLAY (LIN, 1) "Task.Subtask = ", TASK-PART, " ",
    DEVICE-TITLE
  MOVE DEVICE-ANALYSIS(5) TO RATING.
  IF RATING NOT = 999
    MOVE RATING TO PREVIOUS-RATING
    DISPLAY (LIN, 1) "Previous Rating = ", PREVIOUS-RATING.
    DISPLAY (LIN, COL) " Enter Rating = "
    ACCEPT (LIN, COL) RATING WITH AUTO-SKIP UPDATE.
    ACCEPT LAST-KEY FROM ESCAPE KEY.
    IF LAST-KEY = "01" GO TO RATE-EACH-TASK-EXIT.
    IF RATING = PREVIOUS-RATING GO TO RATE-EACH-TASK-EXIT.
    MOVE RATING TO DEVICE-ANALYSIS(5)
    REWRITE DEVICE-RECORD INVALID KEY PERFORM BAD-KEY.
RATE-EACH-TASK-EXIT.
  EXIT.

COMMONALITY-ANALYSIS.
  DISPLAY (1, 1) ERASE.
  DISPLAY (3, 30)
    "(5) Commonality Analysis".
  PERFORM DISPLAY-FUNCTION-KEYS.
  PERFORM FIND-STARTING-TASK.
  IF LAST-KEY = "01" GO TO DISPLAY-MENU.
  DISPLAY (4, 1) ERASE.

B-58
DISPLAY " ".
DISPLAY " ",
"Consider descriptions of the subtasks (tasks) that ",
"comprise the".
DISPLAY " ",
"training objective(s), the subtasks (tasks) that ",
"comprise the".
DISPLAY " ",
"operational performance objective(s), as well as ",
"descriptions of the".
DISPLAY " ",
"training device and operational equipment, including ",
"their displays".
DISPLAY " and controls.".
DISPLAY " ",
DISPLAY " ",
"For each subtask (task) in the operational performance ",
"objective(s)".
DISPLAY " ",
"enter a '1' if it is represented (simulated) in the ",
"training".
DISPLAY " ",
"objective(s); enter a '0' if it is not represented ",
"(simulated) in the ".
DISPLAY " ",
"training objective(s)."
PERFORM RATE-TASKS THRU RATE-TASKS-EXIT VARYING I
FROM 1 BY 1 UNTIL EOF-DEVICE = 1 OR LAST-KEY = "01".
GO TO DISPLAY-MENU.
SIMILARITY-ANALYSIS.
DISPLAY (1, 1)ERASE.
DISPLAY (3, 15)
"(6) Similarity Matching".
PERFORM DISPLAY-FUNCTION-KEYS.
GET-OE-TASK-NO.
MOVE 1 TO TYPE-PART.
DISPLAY (6, 5)
"Enter Operational Equipment Task. Subtask number ".
MOVE 0 TO TASK-NO.
ACCEPT (LIN, COL) TASK-NO WITH AUTO-Skip PROMPT.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY = "01" GO TO DISPLAY-MENU.
IF LAST-KEY = "02" OR LAST-KEY = "03" OR
LAST-KEY = "04" OR LAST-KEY = "05"
PERFORM DISPLAY-TASKS THRU DISPLAY-TASKS-END
GO TO GET-OE-TASK-NO.
MOVE 1 TO TYPE-PART.
MOVE TASK-NO TO TASK-PART.
MOVE TASK-KEY TO DEVICE-KEY.
READ DEVICE-FILE RECORD INVALID KEY
PERFORM BAD-KEY
GO TO SIMILARITY-ANALYSIS.
DISPLAY (4, 1) ERASE.
DISPLAY (5, 1)"Operational Equipment".

B-59
DISPLAY (6, 5) "Task.Subtask = ", TASK-PART.
DISPLAY (7, 5) " Title = ", DEVICE-TITLE.
IF DEVICE-ANALYSIS(5) NOT = 1
   DISPLAY (9, 1) "IS NOT COMMON IN TRAINING DEVICE"
   PERFORM TIMER
   GO TO SIMILARITY-ANALYSIS.
GET-SIM-CONTROL-TITLE.
   MOVE 1 TO TYPE-PART.
   MOVE REQ-TASK-NO TO TASK-KEY.
   DISPLAY (8, 1) ERASE.
   DISPLAY (9, 10)
       "Enter Control or Display number ".
   MOVE 
       " TO PERIOD-PART.
   MOVE 
       " TO CONTROL-PART.
   ACCEPT (LIN, COL) CONTROL-PART WITH UPDATE.
   ACCEPT LAST-KEY FROM ESCAPE KEY.
   IF LAST-KEY NOT = "00"
      GO TO SIMILARITY-ANALYSIS.
   MOVE TASK-KEY TO TITLE-KEY.
   READ TITLE-FIILE RECORD INVALID KEY
      DISPLAY(8, 1) ERASE
      DISPLAY (8, 1) TASK-PART, ".", CONTROL-PART,
           "NOT FOUND IN DATABASE"
      PERFORM TIMER
      GO TO GET-SIM-CONTROL-TITLE.
   DISPLAY (8, 1) ERASE.
   DISPLAY (9, 5) "Control/Display =", TASK-PART, ".", CONTROL-PART.
   DISPLAY (10, 5) " Title = ", TITLE-DESC.
   MOVE TITLE-KEY TO CONTROL-KEY.
GET-CORR-TASK-NO.
   DISPLAY (14, 5) ERASE.
   DISPLAY (16, 5)
       "Enter Training Device Task.Subtask number ".
   MOVE 0 TO TASK-NO.
   ACCEPT (LIN, COL) TASK-NO WITH AUTO-SKIP PROMPT.
   ACCEPT LAST-KEY FROM ESCAPE KEY.
   IF LAST-KEY NOT = "00" GO TO GET-SIM-CONTROL-TITLE.
   MOVE 0 TO TYPE-PART.
   MOVE TASK-NO TO TASK-PART.
   MOVE TASK-KEY TO DEVICE-KEY.
   READ DEVICE-FIILE RECORD INVALID KEY
      DISPLAY(14, 1) ERASE
      DISPLAY (14, 1) TASK-PART, " ",
          "NOT FOUND IN DATABASE"
      PERFORM TIMER
      GO TO GET-CORR-TASK-NO.
   DISPLAY (14, 1) ERASE.
   DISPLAY (15, 1) "Training Device".
   DISPLAY (16, 5) " Task.Subtask = ", TASK-PART.
   DISPLAY (17, 5) " Title = ", DEVICE-TITLE.
GET-CORR-CONTROL-TITLE.
   DISPLAY (18, 1) ERASE.
   DISPLAY (19, 10)
       "Enter Control or Display number ".

B-60
MOVE "." TO PERIOD-PART.
MOVE " " TO CONTROL-PART.
ACCEPT (LIN, COL) CONTROL-PART WITH UPDATE.
ACCEPT LAST-KEY FROM ESCAPE KEY.
IF LAST-KEY NOT = "00"
  GO TO GET-CORR-TASK-NO.
MOVE TASK-KEY TO TITLE-KEY.
READ TITLE-FILE RECORD INVALID KEY
  
  DISPLAY (18, 1) ERASE
  DISPLAY (18, 1) TASK-PART, "." CONTROL-PART,
  "NOT FOUND IN DATABASE"
  PERFORM TIMER
  GO TO GET-SIM-CONTROL-TITLE.
  
  DISPLAY (18, 1) ERASE.
  DISPLAY (19, 5) "Control/Display =", TASK-PART, ".", CONTROL-PART.
  DISPLAY (20, 5) "Title =", TITLE-DESC.
  MOVE TITLE-KEY TO CORR-CTL-KEY.
  DISPLAY (25, 50) "Hit any key to continue"
  ACCEPT (LIN, COL) NOTHING WITH AUTO-SKIP
  ACCEPT LAST-KEY FROM ESCAPE KEY
  IF LAST-KEY NOT = "00" GO TO SIMILARITY-ANALYSIS.
  MOVE 999 TO CONTROL-ANALYSIS(1).
  MOVE 999 TO CONTROL-ANALYSIS(2).
  WRITE CONTROL-RECORD INVALID KEY GO TO REWRITE-CONTROL-REC.
  GO TO GET-CORR-TASK-NO.
  
  REWRITE-CONTROL-REC.
  REWRITE CONTROL-RECORD INVALID KEY
  DISPLAY (1, 1) ERASE
  DISPLAY "INVALID KEY ON CONTROL REWRITE ", CONTROL-KEY.
  GO TO GET-CORR-TASK-NO.
  
  MOVE-NINES.
  MOVE 999 TO DEVICE-ANALYSIS(1).
  
  DISPLAY-FUNCTION-KEYS.
  DISPLAY (21, 1) ERASE.
  DISPLAY (22, 5)
  "Hit 'F1' to List Training Device Tasks & Subtasks".
  DISPLAY (23, 5)
  "Hit 'F2' to List Operational Equipment Tasks & Subtasks".
  DISPLAY (24, 5)
  "Hit 'F3' to List Training Device Controls & Displays".
  DISPLAY (25, 5)
  "Hit 'F4' to List Operational Equipment ",
  "Controls & Displays".
PERFORMANCE DEFICIT

Examine the training objectives and consider what you know about the typical trainee's background, work experience, and prior training.

What proportion of the skills and knowledge required by the training objectives will the typical trainee have to learn in order to reach criterion performance on the training device?

Enter this proportion using the following scale:

```
0 10 20 30 40 50 60 70 80 90 100
```

0 = None - the trainee does not have to learn anything.

100 = All - the trainee has to learn all of the skills and knowledge needed to meet the training objectives.
LEARNING DIFFICULTY

Consider the skills and knowledge needed to meet the training objectives that the trainee must learn (the Performance Deficit that you identified).

Rate the difficulty the typical trainee will have learning these skills and knowledge using the following scale:

\[ \begin{array}{ccccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array} \]

0 = Very easy - it will take practically no training or practice on the device to learn the skills and knowledge needed to meet the training objectives.

100 = Very difficult - it will take a lot of training or practice on the device to learn the skills and knowledge needed to meet the training objectives.

QUALITY OF TRAINING - ACQUISITION

Consider what you know about the training device, a typical instructor (if there is one), the skills and knowledge that the typical trainee must learn, and how the device will be used.

To provide good instruction, a training system (the device and the instructor) should:

- tell the trainees what they must learn to do,

- tell the trainees how they are doing in a way that they will understand,

- provide enough practice, and

- provide a record of trainee performance.

Enter one of the following ratings:

0 = the training system does NONE of these things.
25 = the training system does ONE of these things.
50 = the training system does TWO of these things.
75 = the training system does THREE of these things.
100 = the training system does ALL of these things.
RESIDUAL DEFICIT

Assume that the trainees have completed training and are proficient on the training device.

Examine the operational performance objectives. What proportion of the operational skills and knowledge will typical trainees STILL have to learn in order to meet the performance objectives?

Enter this proportion using the following scale:

/o-----------------------------------------------------------/
\ 0  10  20  30  40  50  60  70  80  90  100

0  =  None  -  the trainees do not have to learn anything else.
100  =  All  -  the trainees have to learn all of the skills and knowledge needed to meet the operational performance objectives.

RESIDUAL LEARNING DIFFICULTY

Consider the skills and knowledge that a graduate of the training device STILL must learn in order to meet the operational performance objectives (the Residual Deficit that you identified).

Rate the difficulty the typical trainee will have learning these skills and knowledge using the following scale:

/o-----------------------------------------------------------/
\ 0  10  20  30  40  50  60  70  80  90  100

0  =  Very easy  -  it will take practically no training or practice on the operational equipment to learn the skills and knowledge.
100  =  Very difficult  -  it will take a lot of training or practice on the operational equipment to learn the skills and knowledge.

PHYSICAL SIMILARITY

Physical similarity is based on a comparison of the physical characteristics of the training system and the operational system.

Compare the location, appearance, and feel of controls and displays in the training system with the controls and displays in the operational system. Compare the environmental conditions (lighting, temperature, noise levels, etc.) in the training system with the conditions in the operational system.
Rate the physical similarity between the training device and the operational equipment using the following scale:

\[ \begin{array}{cccccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array} \]

0 = Different - the trainee will notice a large difference between the training device and the operational equipment.

100 = Identical - the trainee will not notice any difference between the training device and the operational equipment.

Rate the functional similarity between the training device and the operational equipment using the following scale:

\[ \begin{array}{cccccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array} \]

0 = Different - all the controls and displays work differently in the training device and in the operational equipment.

100 = Identical - all the controls and displays work the same way in the training device and in the operational equipment.

Consider what you know about the training device and operational situation, a typical instructor (if there is one), and how the device will be used.
To provide good transfer, a device should:

- train tasks that are similar to the operational tasks,
- provide training conditions that are similar to the operational conditions, and
- provide extensive practice for difficult tasks.

Enter one of the following ratings:

0 = the training system does NONE of these things.
33 = the training system does ONE of these things.
67 = the training system does TWO of these things.
100 = the training system does ALL of these things.
(1) Performance Deficit  
(2) Learning Difficulty  
(3) Quality of Training - Acquisition  
(4) Residual Deficit  
(5) Residual Learning Difficulty  
(6) Physical Similarity  
(7) Functional Similarity  
(8) Quality of Training - Transfer  
(9) Evaluation Summary  
(10) MAIN MENU

PERFORMANCE DEFICIT

Examine the training objectives and the description of this task. Consider what you know about the typical trainee's background, work experience, and prior training.

What proportion of the skills and knowledge required to perform this task to criterion in the training device will the typical trainee have to learn?

Enter this proportion using the following scale:

\[ \begin{array}{cccccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array} \]

0 = None - the trainee does not have to learn anything.  
100 = All - the trainee has to learn all of the skills and knowledge needed to meet the training objectives for this task.
LEARNING DIFFICULTY

Consider the skills and knowledge needed to meet the training objectives for this task that the trainee must learn (the Performance Deficit that you identified).

Rate the difficulty the typical trainee will have in learning to perform this task using the following scale:

\[
\begin{array}{ccccccccccc}
\text{0} & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array}
\]

0 = Very easy - it will take practically no training or practice on the device to learn the skills and knowledge needed to meet the training objectives for this task.

100 = Very difficult - it will take a lot of training or practice on the device to learn the skills and knowledge needed to meet the training objectives for this task.

QUALITY OF TRAINING - ACQUISITION

Consider what you know about the training device, a typical instructor (if there is one), the skills and knowledge that the typical trainee must learn, and how the device will be used.

Rate the training system using the following four scales.

1. For what percentage of the tasks does the training system tell the trainees exactly what they must learn to do?

\[
\begin{array}{ccccccccccc}
\text{0} & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array}
\]

0 = None - trainees are not told what they must learn to do for any of the tasks.

100 = All - trainees are told what they must learn to do for all of the tasks.
2. For what percentage of the tasks does the training system provide enough practice?

0 = None - practice is not provided on any of the tasks that must be learned.

100 = All - enough practice is provided on all of the tasks that must be learned.

3. For what percentage of the tasks does the training system tell the trainees how they are doing (provide feedback) in a way that they will understand?

0 = None - feedback about performance is not provided on any of the tasks that must be learned.

100 = All - feedback about performance is provided on all of the tasks that must be learned.

4. For what percentage of the tasks does the training system provide a record of trainee performance?

0 = None - records of trainee performance are not provided for any of the tasks that must be learned.

100 = All - records of performance are provided for all of the tasks that must be learned.
RESIDUAL DEFICIT

Assume that the trainees have completed training and are proficient on this task in the training device.

Examine the operational performance objectives for this task. What proportion of the skills and knowledge required to perform this operational task will the trainees STILL have to learn?

Enter this proportion using the following scale:

\[
\begin{array}{cccccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100
\end{array}
\]

0 = None - the trainees do not have to learn anything else to perform this task.

100 = All - the trainees have to learn all of the skills and knowledge needed to meet the operational performance objectives for this task.

RESIDUAL LEARNING DIFFICULTY

Consider the skills and knowledge that a graduate of the training device STILL must learn in order to meet the operational performance objectives for this task (the Residual Deficit that you identified).

Rate the difficulty the typical trainee will have learning these skills and knowledge using the following scale:

\[
\begin{array}{cccccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100
\end{array}
\]

0 = Very easy - it will take practically no training or practice on the operational equipment to learn the skills and knowledge.

100 = Very difficult - it will take a lot of training or practice on the operational equipment to learn the skills and knowledge.

PHYSICAL SIMILARITY

Physical similarity is based on a comparison of the physical characteristics of the training system and the operational system.

Compare the location, appearance, and feel of controls and displays in the training system with the controls and displays in the operational system. Compare the environmental conditions (lighting, temperature, noise levels, etc.) in the training system with the conditions in the operational system.
PHYSICAL SIMILARITY

For this task, rate the physical similarity between the training device and the operational equipment using the following scale:

0 = Different - the trainee will notice a large difference between the training and operational equipment for this task.

100 = Identical - the trainee will not notice any difference between the training device and the operational equipment for this task.

FUNCTIONAL SIMILARITY

Functional similarity is based on how the controls and displays work in the training device and in the operational equipment.

Do the corresponding controls work the same way in the training device and in the operational equipment? Do the corresponding displays show the same information in the training device and in the operational equipment?

QUALITY OF TRAINING - TRANSFER

Consider what you know about the training device and operational situation, a typical instructor (if there is one), and how the device will be used.

Considering the training system as a whole, answer the following three questions.
1. What percentage of the tasks that must be learned in the training device are similar to the tasks that are performed in the operational situation?

\[
\begin{array}{cccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
0 = & None & - & none & of & the & training & tasks & are & similar & to & the & operational & tasks. \\
100 = & All & - & all & of & the & training & tasks & are & identical & to & the & operational & tasks. \\
\end{array}
\]

2. For what percentage of the tasks that must be learned in the training device are the conditions of performance similar to the operational situation?

\[
\begin{array}{cccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
0 = & None & - & conditions & in & training & are & not & similar & to & the & operational & situation & for & any & of & the & tasks. \\
100 = & All & - & conditions & in & training & are & similar & to & the & operational & situation & for & all & of & the & tasks. \\
\end{array}
\]

3. For what percentage of the tasks that must be learned in the training device is an extensive amount of practice given?

\[
\begin{array}{cccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
0 = & None & - & not & even & a & single & task & is & practiced & extensively. \\
100 = & All & - & every & task & that & trainees & must & learn & in & the & device & is & practiced & extensively. \\
\end{array}
\]
Examine the training objectives and the description of each training subtask. Consider what you know about the typical trainee's background, work experience, and prior training.

Rate how well the typical trainee will be able to perform each subtask in the training device. Enter your ratings using the following definitions.

Rating  Definition
0 = Cannot perform this subtask. Has had no previous training.
1 = Cannot perform this subtask. Has had orientation training only.
2 = Can perform this subtask only if assisted in every step. Has had familiarization training only.
3 = Can perform this subtask but needs more training. Has had procedural training.
4 = Can perform this subtask completely and accurately. Has received skill training.
Consider the skills and knowledge needed to meet the training objectives for this subtask that the trainee must learn (the Performance Deficit that you identified). Answer the following six questions.

1. Will the trainee use job aids or memory aids to perform this subtask in the training device?

*Definition* - Job and memory aids assist in doing a subtask correctly. Some examples are:

- Documents (Tech Manuals, etc.),
- Instructions printed on the equipment, and
- Memory joggers (S-A-L-U-T-E).

Enter one of these ratings:

0 = Job or memory aids ARE used
1 = Job or memory aids ARE NOT used.

2. How many steps are required to do this subtask?

*Definition* - A step is a separate physical activity with well defined, observable beginning and end points. A subtask may have one step (identify enemy vehicles) or many steps (those involved in disassembling a rifle).

Enter one of these ratings:

0 = The subtask contains LESS than 10 steps.
1 = The subtask contains MORE than 10 steps.

3. Must the trainee perform the steps in this subtask in sequence?

Enter one of these ratings:

0 = The subtask steps DO NOT have to be performed in order.
1 = The subtask steps MUST BE performed in a specific order.
4. Does the subtask have a built-in logic so that the trainees know when they are doing it correctly?

Definition - Some subtasks consist of steps that form a logical or natural sequence, like fixing a tire or changing a light bulb. Other subtasks have steps that seem arbitrary, like many trouble-shooting subtasks. Some subtasks contain a mixture of "natural" and "unnatural" steps. For example, safety steps often break the natural flow and logic of a subtask.

Enter one of these ratings:

0 = The subtask HAS a built-in logic.
1 = The subtask DOES NOT HAVE a built-in logic.

5. What are the mental requirements of the subtask?

Definition - Repetitive, physical subtasks require almost no mental work. Many subtasks that look easy require a lot of mental work, such as planning an attack or trouble-shooting a complex piece of equipment. Consider the number of decisions or calculations that must be made in choosing your answer. Also consider the impact of any job aid.

Enter one of these ratings:

0 = The subtask IS NOT mentally demanding.
3 = The subtask IS mentally demanding.

6. What are the motor control demands of the subtask?

Definition - Motor control refers to precise finger, hand, or arm movements, not to large body movement. Sheer physical strength does not require much motor control. Tracking a target and repairing a gauge require a lot of motor control.

Enter one of these ratings:

0 = The motor control demands are SMALL.
3 = The motor control demands are LARGE.
Consider what you know about the training device, a typical instructor (if there is one), the skills and knowledge that the typical trainee must learn, and how device will be used.

For this subtask, answer the following 11 questions.

1. To what extent will the training system tell trainees, at key stages of training, the training objective of this subtask and their current standing relative to the objective?

   /-----------------------------------------------------------\
   0 10 20 30 40 50 60 70 80 90 100

   0 = Not at all - trainees are never told the training objective nor are they told their standing relative to the objective.

   100 = Completely - trainees are told the training objective and their standing relative to the objective throughout training.

2. To what extent will the trainee begin with easy examples of this subtask and progress to more difficult examples?

   /-----------------------------------------------------------\
   0 10 20 30 40 50 60 70 80 90 100

   0 = Not at all - the material to be learned is not sequenced in terms of difficulty.

   100 = Completely - the material to be learned is sequenced in terms of difficulty from easy to hard.
3. To what extent will the training system tell the trainees what they did and how well they did it?

0 = Not at all - the training system provides trainees with no information about their performance.

100 = Completely - the training system provides trainees with explicit information about what they did and how well they did it.

4. To what extent will the training system provide enough practice of this subtask?

0 = Minimum practice - there is no practice, rehearsal, or repetition of this subtask.

100 = Maximum practice - there is extensive practice, rehearsal, or repetition of this subtask.

5. To what extent will the training system provide help (such as prompts and cues) to trainees early in training and gradually fade this help out as training progresses?

0 = Not at all - training help is not provided.

100 = Completely - the training system provides help early in training and gradually fades it out late in training.
6. To what extent will the training system organize the material to be learned into small blocks or steps?

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</tbody>
</table>

0 = Not at all - the material to be learned is not well organized.
100 = Completely - the material to be learned is well organized.

7. To what extent does the training system use memory aids to help train?

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
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<th>90</th>
<th>100</th>
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<tbody>
<tr>
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<td></td>
</tr>
</tbody>
</table>

0 = Not at all - although memory aids could be used, the training system does not use them.
100 = Completely - the training system uses memory aids to help learning when they are appropriate.

8. To what extent does the training system start with a wide tolerance for errors, narrowing the tolerance as training progresses?

<table>
<thead>
<tr>
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</tr>
</tbody>
</table>

0 = Not at all - error tolerances are not varied as training progresses.
100 = Completely - error boundaries are broad at the start of training and become narrow late in training.
9. To what extent does the training device provide a variety of examples of this subtask?

\[
\begin{array}{cccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array}
\]

0 = Not at all - the device presents only one version of this subtask.
100 = Completely - the device presents a wide variety of examples of this subtask.

10. To what extent does the training system present difficult examples of this subtask?

\[
\begin{array}{cccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array}
\]

0 = Not at all - the device presents only easy examples of this subtask.
100 = Completely - the device presents the most difficult examples of this subtask.

11. To what extent can the training system present different examples of this subtask as a function of the trainee’s performance?

\[
\begin{array}{cccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array}
\]

0 = Not at all - the device provides lock-step instruction; training is not interactive.
100 = Completely - the program of instruction is varied as a function of trainee performance; the device provides for interactive training.
Assume that the trainees have completed training and are proficient on all subtasks in the training device. Examine the performance objectives and the description of each operational subtask.

Rate how well the typical trainee will be able to perform each subtask in the operational situation. Enter your rating using the following definitions.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Cannot perform this subtask. Has had no previous training.</td>
</tr>
<tr>
<td>1</td>
<td>Cannot perform this subtask. Has had orientation training only.</td>
</tr>
<tr>
<td>2</td>
<td>Can perform this subtask only if assisted in every step. Has had familiarization training only.</td>
</tr>
<tr>
<td>3</td>
<td>Can perform this subtask but needs more training. Has had procedural training.</td>
</tr>
<tr>
<td>4</td>
<td>Can perform this subtask completely and accurately. Has received skill training.</td>
</tr>
</tbody>
</table>

Consider the skills and knowledge that a graduate of the training device STILL must learn in order to meet the operational performance objectives for this subtask (the Residual Deficit that you identified).

Answer the following six questions.
1. Will the trainee use job aids or memory aids to perform this subtask in the operational setting?

Definition - Job and memory aids assist in doing a subtask correctly. Some examples are:
- Documents (SM, Tech Manuals, etc.),
- Instructions printed on the equipment,
- Memory joggers (S-A-L-U-T-E).

Enter one of these ratings:

0 = Job or memory aids ARE used
1 = Job or memory aids ARE NOT used.

2. How many steps are required to do this subtask?

Definition - A step is a separate physical activity with well-defined, observable beginning and end points. A subtask may have one step (identify enemy vehicles) or many steps (those involved in disassembling a rifle).

Enter one of these ratings:

0 = The subtask contains LESS than 10 steps.
1 = The subtask contains MORE than 10 steps.

3. Must the trainee perform the steps in this subtask in sequence?

Enter one of these ratings:

0 = The subtask steps DO NOT have to be performed in order.
1 = The subtask steps MUST BE performed in a specific order.
4. Does the subtask have a built-in logic so that the trainees know when they are doing it correctly?

Definition - Some subtasks consist of steps that form a logical or natural sequence, like fixing a tire or changing a light bulb. Other subtasks have steps that seem arbitrary, like many trouble-shooting subtasks. Some subtasks contain a mixture of "natural" and "unnatural" steps. For example, safety steps often break the natural flow and logic of a subtask.

Enter one of these ratings:

0 = The subtask HAS a built-in logic.
1 = The subtask DOES NOT HAVE a built-in logic.

5. What are the mental requirements of the subtask?

Definition - Repetitive, physical subtasks require almost no mental work. Many subtasks that look easy require a lot of mental work, such as planning an attack or trouble-shooting a complex piece of equipment. Consider the number of decisions or calculations that must be made in choosing your answer. Also consider the impact of any job aid.

Enter one of these ratings:

0 = The subtask IS NOT mentally demanding.
3 = The subtask IS mentally demanding.

6. What are the motor control demands of the subtask?

Definition - Motor control refers to precise finger, hand, or arm movements, not to large body movement. Sheer physical strength does not require much motor control. Tracking a target and repairing a gauge require a lot of motor control.

Enter one of these ratings:

0 = The motor control demands are SMALL.
3 = The motor control demands are LARGE.
Physical similarity is based on a comparison of the physical characteristics of the training system and the operational system.

Compare the location, appearance, and feel of the controls and displays in the training system with the controls and displays in the operational system. Compare the environmental conditions (lighting, temperature, noise levels, etc.) in the training system with the conditions in the operational system.

For this subtask, rate the physical similarity between this operational control or display and its corresponding control or display in the training system. Use the following scale:

```
0 10 20 30 40 50 60 70 80 90 100
```

0 = Different - the trainee will notice a large difference between this control/display in the training device and in the operational equipment.

100 = Identical - the trainee will not notice any difference between this control/display in the training device and in the operational equipment.

Functional similarity is based on how the controls and displays work in the training device and in the operational equipment.

Do the corresponding controls work the same way in the training device and in the operational equipment? Do the corresponding displays show the same information in the training device and in the operational equipment?
FUNCTIONAL SIMILARITY

For this sub-task, rate the functional similarity between this operational control or display and its corresponding control or display in the training device. Use the following scale:

\[
0 \quad 10 \quad 20 \quad 30 \quad 40 \quad 50 \quad 60 \quad 70 \quad 80 \quad 90 \quad 100
\]

\(0\) = Different - this control/display works differently in the training device and in the operational equipment.

\(100\) = Identical - this control/display works the same way in the training device and in the operational equipment.

QUALITY OF TRAINING - TRANSFER

Consider what you know about the training device and operational situation, a typical instructor (if there is one), and how the device will be used.

For this sub-task, answer the following eight questions.

1. To what extent is the sub-task that must be learned in the training device similar to the sub-task that is performed in the operational situation?

\[
0 \quad 10 \quad 20 \quad 30 \quad 40 \quad 50 \quad 60 \quad 70 \quad 80 \quad 90 \quad 100
\]

\(0\) = Not at all - the device sub-task is not similar to the operational sub-task.

\(100\) = Completely - the device sub-task is identical to the operational sub-task.
2. To what extent are features of the operational setting presented in the training device?

\[
\begin{array}{cccccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array}
\]

0 = Not at all - the device does not present any features of the operational setting for this subtask.

100 = Completely - the device presents all the features of the operational setting for this subtask.

3. To what extent will the training system make clear to the trainee the relationship between the training objective and the operational objective for this subtask?

\[
\begin{array}{cccccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array}
\]

0 = Not at all - the relationship of training objective to the operational objective is not made clear to the trainee.

100 = Completely - the relationship of the training objective to the operational objective is made clear to the trainee.

4. To what extent later in training does the training system gradually reduce training help for this subtask?

\[
\begin{array}{cccccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array}
\]

0 = Not at all - training help is not reduced toward the end of training.

100 = Completely - training help is gradually faded out.
5. By the end of training on the device, to what extent do the trainees see and do the same things that they will see and do in the operational situation?

0 = Not at all - trainees see and do different things in the training device than they see and do in the operational situation at the end of training.

100 = Completely - trainees see and do the same things in the training device that they see and do in the operational situation at the end of training.

6. To what extent will the training system permit trainees to practice in the device until they can demonstrate a job entry level of skill on this subtask?

0 = Not at all - the amount of practice trainees receive will not enable them to perform at a job entry skill level.

100 = Completely - the amount of practice trainees receive will enable them to perform at a job entry skill level.

7. To what extent will the training system provide overlearning to enable trainees to cope with stressful real-world situations when performing this subtask?

0 = Not at all - the training system does not provide overlearning of this subtask.

100 = Completely - the training system will permit trainees to overlearn this subtask.
8. To what extent will the training system provide for practice that spans the range of operational situations for this subtask? (For example, easy to difficult problems, various signal sources and patterns, etc.)

\[\begin{array}{cccccccccccc}
0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\end{array}\]

0 = Not at all - the conditions under which practice occurs are constant and represent a small portion of the operational situation.

100 = Completely - practice occurs under a broad range of conditions that span the operational situation.
APPENDIX D

ORIGINAL ASTAR FLOW DIAGRAMS
AND SUPPORTING DATA
ASTAR 2.0
ASTAR MAIN MENU

ASTAR MAIN MENU
ver 2.0

(1) ASTAR 1
(2) ASTAR 2
(3) ASTAR 3
(4) Display Ratings
(5) Database Maintenance
(6) EXIT PROGRAM

Enter option
### DEVICE-RECORD ("B.DEVICE")

<table>
<thead>
<tr>
<th>DEVICE-KEY</th>
<th>DEVICE-ANALYSIS OCCURS 20 TIMES</th>
<th>DEVICE-TITLE</th>
</tr>
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<tbody>
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<td>0</td>
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### TEXT-RECORD ("ASTAR1.DOC")

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1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
ASTAR1 MENU

ASTAR 1

(1) Performance Deficit
(2) Learning Difficulty
(3) Quality of Training-Acquisition
(4) Residual Deficit
(5) Residual Learning Difficulty
(6) Physical Similarity
(7) Functional Similarity
(8) Quality of Training-Transfer
(9) Evaluation Summary

Enter Option Number

EVALUATION SUMMARY SCREEN

Evaluation Summary

<table>
<thead>
<tr>
<th></th>
<th>ZZ9</th>
<th>ZZ.ZZZ.99</th>
<th>ZZ.ZZZ.99</th>
</tr>
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<tr>
<td>Performance Deficit</td>
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<td></td>
</tr>
<tr>
<td>Learning Difficulty</td>
<td>ZZ9</td>
<td>ZZ.ZZZ.99</td>
<td></td>
</tr>
<tr>
<td>Training Problem</td>
<td>ZZ9</td>
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<tr>
<td>Quality of Training-Acquisition</td>
<td>ZZ9</td>
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</tr>
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<td>Acquisition-Efficiency</td>
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<td>Transfer Problem</td>
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<td></td>
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<td>Quality of Training-Transfer</td>
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<tr>
<td>Transfer Efficiency</td>
<td>ZZ.ZZZ.99</td>
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<td>Transfer d</td>
<td>ZZ.ZZZ.99</td>
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<td>ZZ.ZZZ.99</td>
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</tr>
</tbody>
</table>

D-7
Start Run

OPEN I-O DEVICE-FILE, INPUT TEXT-FILE

INITIALIZE DEVICE-FILE.DEVICE-KEY

READ DEVICE-FILE

INVALID KEY?

Yes

DISPLAY "INVALID KEY", DEVICE-FILE.DEVICE-KEY

No

MOVE C TO OPTION

PERFORM STOP-RUN

MENU
MOVE OPTION TO PREV-OPTION
MOVE 0 TO OPTION
MOVE 0 TO EOF-DEVICE
MOVE "00" TO LAST-KEY

CLEAR SCREEN, DISPLAY ASTAR1 MENU

ACCEPT OPTION

ESCAPE KEY PRESSED?
Yes
PERFORM STOP-RUN
No
OPTION = ?

01 thru 08
PERFORM OPTION-ANALYSIS

09
PERFORM EVALUATION-SUMMARY

10
PERFORM STOP-RUN
OPTION-ANALYSIS

MOVE OPTION TO X
MOVE OPTION TO Z

PERFORM
FIND-SCREEN,
READ-TEXT,
DISPLAY-SCREEN

ESCAPE KEY
PRESSED?

Yes
RETURN

No

PERFORM
RATE-TASKS

RETURN
DISPLAY EVALUATION SUMMARY SCREEN

SET LOOP-VAR = 1

PERFORM PRINT-ANALYSIS(LOOP-VAR)

ADD 1 TO LOOP-VAR

LOOP-VAR >= 8?

Yes

DEVICE-ANALYSIS(1)
NCT = 999 AND
DEVICE-ANALYSIS(2)
NCT = 999?

No

Yes

COMPUTE TRAINING-PROBLEM =
(Device-ANALYSIS(1) * Device-ANALYSIS(2))
/ 100

DISPLAY TRAINING-PROBLEM
Generalized Flow Chart
Documentation for
Program: ASTAR1
Page: 5 of 13

A
Yes

DEVICE-ANALYSIS(3) NOT = 999
Yes

 COMPUTE
 ACQUISITION-EFFICIENCY = 
 (DEVICE-ANALYSIS(3) / 100)

 COMPUTE
 ACQUISITION-EFFICIENCY = 
 SQUARE-ROOT (ACQUISITION-EFFICIENCY)

 DISPLAY
 ACQUISITION-EFFICIENCY

ACQUISITION-EFFICIENCY = 0?
Yes

 MOVE .01 TO
 ACQUISITION-EFFICIENCY

B
No

D-12
C

DEVICE-ANALYSIS(4) NOT = 999 AND DEVICE-ANALYSIS(8) NOT = 999?

YES

COMPUTE TRANSFER-PROBLEM = (DEVICE-ANALYSIS(4) * DEVICE-ANALYSIS(5)) / 100; 

DISPLAY TRANSFER-PROBLEM

DEVI CE-ANALYSIS(8) NOT = 999?

YES

COMPUTE TRANSFER-EFFICIENCY = (DEVICE-ANALYSIS(8) / 100; 

COMPUTE TRANSFER-EFFICIENCY = SQUARE ROOT (TRANSFER-EFFICIENCY) 

DISPLAY TRANSFER-EFFICIENCY

D
PRINT-ANALYSIS

DEVICE-ANALYSIS (LOOP-VAR)
NOT = 999?

YES
DISPLAY
DEVICE-ANALYSIS (LOOP-VAR)

RETURN

NO
FIND-SCREEN

ANALYSIS-NUMBER
> OPTION OR
OPTION = PREV-OPTION?

YES
READ FIRST
TEXT-FILE
RECORD

YES
ECF
TEXT-FILE?

PERFORM
STOP-RUN

RETURN

RETURN
DISPLAY-SCREEN

DISPLAY
TEXT-RECORD

RETURN
RATE-TASKS

DISPLAY DEVICE-TITLE

MOVE DEVICE-ANALYSIS(x) TO RATING

RATING NOT = 9999?

NO

YES

MOVE RATING TO PREVIOUS-RATING

DISPLAY "Previous Rating =" PREVIOUS-RATING

ACCEPT RATING "Enter Rating"

ESCAPE KEY PRESSED OR NONENTRY?

YES

PERFORM STOP-RUN

NO

MOVE RATING TO DEVICE-ANALYSIS(x)

REWRITE DEVICE-RECORD

RETURN
### DEVICE-RECORD ("B:DEVICE")

<table>
<thead>
<tr>
<th>DEVICE-KEY</th>
<th>DEVICE-ANALYSIS</th>
<th>OCCURS 20 TIMES</th>
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### TEXT-RECORD ("ASTAR2.DOC")

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### TITLE-RECORD ("B:TITLE")

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</table>
### ASTAR2 MENU

**ASTAR 2**

1. Performance Deficit
2. Learning Difficulty
3. Quality of Training-Acquisition
4. Residual Deficit
5. Residual Learning Difficulty
6. Physical Similarity
7. Functional Similarity
8. Quality of Training-Transfer
9. Evaluation Summary

Enter Option Number

### EVALUATION SUMMARY SCREEN

**Evaluation Summary**

<table>
<thead>
<tr>
<th>Training Problem</th>
<th>ZZ.ZZZ.99</th>
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</thead>
<tbody>
<tr>
<td>Acquisition-Efficiency</td>
<td>ZZ.ZZZ.99</td>
</tr>
<tr>
<td>Acquisition</td>
<td>ZZ.ZZZ.99</td>
</tr>
<tr>
<td>Transfer Problem</td>
<td>ZZ.ZZZ.99</td>
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<td>Transfer Efficiency</td>
<td>ZZ.ZZZ.99</td>
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<td>Transfer</td>
<td>ZZ.ZZZ.99</td>
</tr>
<tr>
<td>d</td>
<td>ZZ.ZZZ.99</td>
</tr>
</tbody>
</table>
STARTING TASK SCREEN

Enter Starting Training Device Task.Subtask number

or

Enter Starting Operational Equipment Task.Subtask number

Hit 'F1' to List Training Device Tasks & Subtasks
Hit 'F2' to List Operational Equipment Tasks & Subtasks
Hit 'F3' to List Training Device Controls & Displays
Hit 'F4' to List Operational Equipment Controls and Displays
Start Run

OPEN I-O DEVICE-FILE,
INPUT TEXT-FILE
INPUT TITLE-FILE

MOVE 0 TO
TASK-NO,
REQ-TASK-NO,
OPTION

MENU

CLEAR SCREEN,
DISPLAY ASTAR2
MENU

ACCEPT OPTION

ESCAPE
KEY
PRESSED?

Yes

PERFORM
STOP-RUN

OPTION
- 1,2,4,5,6,7

PERFORM
OPTION-ANALYSIS

PERFORM
TRAINING-
ACQUISITION-
ANALYSIS

PERFORM
TRAINING-
TRANSFER-
ANALYSIS

PERFORM
EVALUATION-
SUMMARY

else

D-24
OPTION-ANALYSIS

PERFORM OPTION-ANALYSIS-ASSIGNS(OPTION)

PERFORM FIND-STARTING-TASK

ESCAPE KEY PRESSED?

Yes

RETURN

No

PERFORM FIND-SCREEN

PERFORM READ-TEXT

PERFORM DISPLAY-SCREEN

ESCAPE KEY PRESSED?

Yes

RETURN

No

A
A

SET I TO 1

PERFORM RATE-TASKS (I)

EOF DEVICE = 1 OR ESCAPE KEY FRESSED?

Yes → RETURN

No → PERFORM RATE-TASKS (I)
OPTION-ANALYSIS-ASSIGNS

OPTION - 1?
Yes
MOVE 0 TO TYPE-PART
MOVE 1 TO X
MOVE 1 TO Z
(PERFORMANCE-DEFICIT-ANALYSIS)

No

OPTION - 2?
Yes
MOVE 0 TO TYPE-PART
MOVE 2 TO X
MOVE 2 TO Z
(LEARNING-DIFFICULTY-ANALYSIS)

No

OPTION - 4?
Yes
MOVE 1 TO TYPE-PART
MOVE 1 TO X
MOVE 1 TO Z
(RESIDUAL-DEFICIT-ANALYSIS)

No

OPTION - 5?
Yes
MOVE 1 TO TYPE-PART
MOVE 2 TO X
MOVE 2 TO Z
(RESIDUAL-DIFFICULTY-ANALYSIS)

No

OPTION - 6?
Yes
MOVE 1 TO TYPE-PART
MOVE 3 TO X
MOVE 3 TO Z
(PHYSICAL-SIMILARITY-ANALYSIS)

No

OPTION - 7?
Yes
MOVE 1 TO TYPE-PART
MOVE 4 TO X
MOVE 4 TO Z
(FUNCTIONAL-SIMILARITY-ANALYSIS)

No

RETURN
TRAINING-ACQUISITION ANALYSIS

MOVE 0 TO TYPE-PART

MOVE 9 TO X
MOVE 12 TO Z

MOVE "0 0.0000" TO DEVICE-KEY

MOVE DEVICE-KEY TO REQ-TASK-NO. TASK-KEY

IND FIRST RECORD IN DEVICE-FILE WITH KEY = DEVICE-KEY

PERFORM RATE-TASKS

RETURN
TRAINING-TRANSFER-ANALYSIS

MOVE 0 TO TYPE-PART

MOVE 13 TO X
MOVE 15 TO Z

MOVE "0 0.0000" TO DEVICE-KEY

MOVE DEVICE-KEY TO REO-TASK-NO, TASK-KEY

FIND FIRST RECORD IN DEVICE-FI LE WITH KEY = DEVICE-KEY

PERFORM RATE-TASKS

RETURN
Generalized Flow Chart
Documentation for
Program: ASTAR2
Page: 7 of 32

EVALUATION-SUMMARY

ACCEPT ANSWER
"Evaluate by (T)ask or (S)ubtask"

ANSWER = "S"?
Yes
MOVE "9999" TO REG-SUBTASK

No
MOVE "0000" TO REG-SUBTASK

INITIALIZE REPORTING VARIABLES

READ DEVICE-FILE RECORD

DEVICE-ANALYSIS(9) NOT = 999?
Yes

No
DEVICE-ANALYSIS(10) NOT = 999?
Yes

No
DEVICE-ANALYSIS(11) NOT = 999?
Yes

No
DEVICE-ANALYSIS(12) NOT = 999?
Yes

No

D
C
D-30
COMPUTE ACQUISITION-EFFICIENCY = 
((DEVICE-ANALYSIS(9) * DEVICE-ANALYSIS(10) * 
DEVICE-ANALYSIS(11) * DEVICE-ANALYSIS(12)) / 400)

Yes

DEVICE-ANALYSIS(13)

NOT = 999?

No

Yes

DEVICE-ANALYSIS(14)

NOT = 999?

No

Yes

DEVICE-ANALYSIS(15)

NOT = 999?

No

COMPUTE TRANSFER-EFFICIENCY = 
((DEVICE-ANALYSIS(13) * DEVICE-ANALYSIS(14) * 
DEVICE-ANALYSIS(15)) / 100)

SET / TC 1

C

D
PERFORM SUM-TASK

PERFORM SUM-TRAINING-DEVICE

PERFORM SUM-ACTUAL

EOF-DEVICE = 1?

DISPLAY EVALUATION-SUMMARY-SCREEN

N1, TP-PRODUCT
Computed in SUM-TRAINING-DEVICE

N1 NOT = 0?

COMPUTE TRAINING-PROBLEM =
TP-PRODUCT / (N1 * 100)

DISPLAY TRAINING-PROBLEM

E
ACQUISITION-EFFICIENCY COMPUTED?

Yes

COMPUTE ACQUISITION-EFFICIENCY = SQUARE ROOT (ACQUISITION-EFFICIENCY)

DISPLAY ACQUISITION-EFFICIENCY

No

ACQUISITION-EFFICIENCY COMPUTED?

Yes

COMPUTE TRAINING-ACQUISITION = TRAINING-PROBLEM / ACQUISITION-EFFICIENCY

DISPLAY TRAINING-ACQUISITION

No

N3 NOT = 0?

Yes

COMPUTE ADDITIONAL-DEFICIT = PF-FS / N3

No

N3, PS-FS, Computed In SUM-ACTUAL

E

F
The flowchart represents a program's logic for computing and displaying transfer efficiency. Here are the steps:

1. **N2, RD-PRODUCT COMPUTED IN SUM-M actual**
2. **Compute**
   
   \[ \text{TRANSFER-PROBLEM} = \frac{\text{RD-PRODUCT}}{(N2 + 100)} \times \text{ADDITIONAL-DEFICIT} \]
3. **Display**
   
   TRANSFER-PROBLEM
4. **Transfer-Efficiency Computed?**
   - **Yes**
     
     \[ \text{TRANSFER-EFFICIENCY} = \sqrt{\text{TRANSFER-EFFICIENCY}} \]
     
     **Display**
     
     TRANSFER-PROBLEM
   - **No**
     
     **Transfer-Efficiency = 0**
     
     **Move 01 to Transfer-Efficiency**
G

TRANSFER-EFFICIENCY COMPUTED?

Yes

COMPUTE TRAINING-TRANSFER
TRANSFER-PROBLEM
TRANSFER-EFFICIENCY

DISPLAY TRAINING-TRANSFER

COMPLETE ASTAR
TRAINING-ACQUISITION
TRAINING-TRANSFER

DISPLAY ASTAR

RETURN
FIND-SCREEN

TEXT-RECORD ANALYSIS-NUMBER > OPTION OR OPTION = PREV-OPTION?

Yes

RESET TEXT-FILE

MOVE 0 TO PREV-OPTION

READ TEXT-FILE RECORD

CLEAR SCREEN

RETURN

No
READ-TEXT

TEXT-RECORD ANALYSING-NUMBER = OPTION AND TEXT-RECORD.REC-INDICATOR = "ZZ"?

Yes
RETURN

No

TEXT-RECORD ANALYSING-NUMBER = OPTION AND TEXT-RECORD.REC-INDICATOR = "ZO"?

Yes
PERFORM DISPLAY-INTRO-SCREEN

No

READ TEXT-FILE RECORD

RETURN
DISPLAY-SCREEN

ESCAPE KEY PRESSED?
  Yes → RETURN
  No → READ TEXT-FILE RECORD

TEXT-RECORD.REC-INDICATOR = "ZZ" OR "ZC"?
  Yes → RETURN
  No → DISPLAY TEXT-RECORD
FIND-STARTING-TASK

DISPLAY STARTING TASK SCREEN

OPTION < 4?

Yes

MOVE 0 TO TYPE-PART

DISPLAY "Enter Starting Operational Equipment."

ACCEPT TASK-NO

MOVE TASK-NO TO TASK-PART

F2 OR F3 OR F4 OR F5 PRESSED?

Yes

PERFORM DISPLAY-TASKS LOOP

PERFORM DISPLAY-TASKS DEVICES

No

H

DISPLAY-TASKS

PERFORM DISPLAY-TASKS LOOP

PERFORM DISPLAY-20 DEVICES

F-S-T
H

ESC E A C K  N E SS E D?  N o

M O V E T A S K - N O T O T A S K - P A R T

M O V E T A S K - K E Y T O R E Q - T A S K - N O


F I N D F I R S T R E C O R D I N D E V I C E - F I L E W I T H K E Y = D E V I C E - K E Y

I N V A L I D K E Y ?  Y e s  F - S - T

R E T U R N
READ-TASK

PERFORM READ-TASK

ECF (DEVICE-FILE)

Yes

RETURN

No

SET K TO X

PERFORM RATE-EACH-TASK

K > Z OR LAST-KEY(DEVICE-FILE)

No

RETURN

Yes
RATE-EACH-TASK

\[ X \neq Z \] No

Yes

PERFORM FIND-SCREEN

PERFORM READ-TEXT

PERFORM DISPLAY-SCREEN

ESCAPE KEY PRESSED?

Yes

RETURN

No

DISPLAY "Task.Subtask" ASK-PART, DEVICE-TITLE

MOVE DEVICE-ANALYSIS(K) TO RATING

RATING COMPUTED?

Yes

MOVE RATING TO PREVIOUS-RATING

DISPLAY "Previous Rating = " PREVIOUS-RATING

No

J

D-43
J

ACCEPT RATING
"Enter Rating"

ESCAPE KEY PRESSED?
Yes → RETURN
No

RATING = PREVIOUS-RATING
Yes → RETURN
No

MOVE RATING TO DEVICE-ANALYSIS(K)

REWRITE DEVICE-RECORD

RETURN
SUM-TRAINING-DEVICE

DEVICE-ANALYSIS(1) = 0

Yes

ADD 1 TO N1

No

RETURN

DEVICE-ANALYSIS(2) COMPUTED?

No

RETURN

Yes

ADD 1 TO N1

COMPLETE TP-PRODUCT =

TP-PRODUCT •

(DEVICE-ANALYSIS(1) • DEVICE-ANALYSIS(2))
DISPLAY-INTRO-SCREEN

READ TEXT-FILE RECORD

REC-INDICATOR = "22" OR "20"

Yes

RETURN

No

DISPLAY TEXT-RECORD
DISPLAY-TASKS

MOVE 0 TO TYPE-PART

LAST-KEY = "03" OR "05"

Yes

MOVE 1 TO TYPE-PART

LAST-KEY = "04" OR "05"

Yes

MOVE 1 TO TITLE-FLAG

NO

MOVE 0 TO 0

MOVE TASK-KEY TO DEVICE-KEY, REQ-TASK-NO

READ DEVICE-FILE RECORD

INVALID KEY OR ESCAPE KEY PRESSED?

No

DISPLAY-TASKS-END

Yes

RETURN
DISPLAY-TASKS-LOOP

MOVE C TO I

CLEAR SCREEN

RETURN
K

DISPLAY TASK-PART, DEVICE-TITLE

TITLE-FLAG = 1

Yes

PERFORM DISPLAY-CONTROLS

PERFORM DISPLAY-20-CONTROLS

READ DEVICE-FILE
NEXT RECORD

EOF (DEVICE-FILE)

Yes

MOVE 1 TO 0

No

D-2 D
K

ESCAPE KEY PRESSED
Yes ➔ RETURN
No

DISPLAY TITLE-CONTROL, TITLE-DESC

READ TITLE-FILE NEXT RECORD

EOF (TITLE-FILE)
Yes ➔ DISPLAY-20-CONTROLS
No ➔ RETURN

RETURN
ASTAR3 file descriptions:

1. **B:DEVICE (DEVICE-FILE)**
   
   DEVICE-KEY  alphanumeric 10
   DEVICE-ANALYSIS(1)  integer 3
   DEVICE-ANALYSIS(2)  integer 3
   .
   .
   DEVICE-ANALYSIS(20)  integer 3
   DEVICE-TITLE  alphanumeric 60

2. **B:TITLE (TITLE-FILE)**
   
   TITLE-KEY
   TITLE-TYPE  integer 1
   TITLE-TASK  alphanumeric 9
   TITLE-PERIOD  alphanumeric 1
   TITLE-CONTROL  alphanumeric 9
   TITLE-DESC  alphanumeric 60

3. **B:CONTROL (CONTROL-FILE)**
   
   CONTROL KEY
   CTL-TYPE  integer 1
   CTL-TASK  alphanumeric 4
   FILLER  alphanumeric 1
   CTL-SUBTASK  alphanumeric 4
   FILLER  alphanumeric 1
   CTL-NO  alphanumeric 9
   CONTROL-ANALYSIS(1)  integer 3
   CONTROL-ANALYSIS(2)  integer 3
   CORR-CTL-KEY  alphanumeric 20

4. **ASTAR3.DOC (TEXT-FILE)**
   
   REC-INDICATOR  alphanumeric 2
   FILLER  alphanumeric 1
   ANALYSIS-NUMBER  alphanumeric 1
   FILLER  alphanumeric 75
## ASTAR3 Variable Dictionary

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<th>Field Name</th>
<th>Type &amp; Length</th>
<th>Contents</th>
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### ASTAR3 Variable Dictionary

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SUBROUTINE - ASTAR3 (page 1/2)

START ASTAR3

OPEN
DEVICE-FILe

OPEN
TITLE-FILe

OPEN
CONTROL-FILe

OPEN
TEXT-FILe

CLEAN SCREEN

SET
TAK-WC = 6
RE: TAK-WC = D
OPTION = 6

READ LAST-KEY

READ OPTION

NEXT

STOP

YES

LAST-KEY = LAST-KEY + 1

GO

D-59
SUBROUTINE - ASTAR3 (page 2/2)

A

OPTION = 1?

YES

PERFORMANCE

ANALYSIS

NO

B

OPTION = 3?

YES

LEARNING

DIFFICULTY

ANALYSIS

NO

C

OPTION = 7?

YES

TRAINING

APPLICATION

ANALYSIS

NO

OPTION = 6?

YES

FUNCTIONAL

SIMILARITY

ANALYSIS

NO

OPTION = 4?

YES

TRAINING

TRANSFER

ANALYSIS

NO

OPTION = 9?

YES

EVALUATION

SUMMARY

NO

D

OPTION = 8?

YES

RESIDUAL

DIFFICULTY

ANALYSIS

NO

OPTION = 9?

YES

RESIDUAL

DIFFICULTY

ANALYSIS

NO
SUBROUTINE TRAINING ACQUISITION ANALYSIS (page 1/1)

START SUBROUTINE

SET
TYPE.PART = 0
Z = 10
Z = 30

FIND STARTING TASK

LAST-KEY

NO

RATE TASKS

EOF-DEVICE

YES

NO

F

D-63
SUBROUTINE RESIDUAL DEFICIT ANALYSIS (page 1/1)
SUBROUTINE FUNCTIONAL SIMILARITY ANALYSIS (page 1/1)
SUBROUTINE EVALUATION SUMMARY (page 1/4)
SUBROUTINE FIND SCREEN (page 2/2)
SUBROUTINE HIT ANY KEY (page 1/1)

START SUBROUTINE

HIT ANY KEY TO CONTINUE

NOTHING = ANY KEY

LAST KEY = FUNCTION KEY

CLEAR SCREEN

STOP SUBROUTINE
SUBROUTINE FIND STARTING TASK
SUBROUTINE READ TASK (page 1/1)
SUBROUTINE RATE EACH TASK (page 1/1)
SUBROUTINE RATE EACH CONTROL (page 1/3)

START SUBROUTINE

SET EOF-CONTROL = 0

READ CONTROL FILE NEXT RECORD

EOF

YES

SET EOF-CONTROL = 1

NO

READ CTL-TYPE ++ CTL-TYPE

NO

YES

READ CTL-TERM ++ CTL-TERM

NO

YES

SET DEVICE-KEY ++ TITLE-TEST

NO

READ TITLE-FILE RECORD

VALID KEY

YES

SET TITLE-TERM ++ CONTROL-TERM

NO

READ DEVICE-FILE RECORD

BAD KEY

NO

INVALID KEY

YES

CLEAR SCREEN

NO

TITLE-CONTROL ++ TITLE-TERM

NO

YES

SET DEVICE-KEY ++ CONTROL-TERM

NO

G
SUBROUTINE RATE EACH CONTROL (page 3/3)

STOP
SUBROUTINE STOP RUN

START

CLOSE SERVICE FILE
CLOSE CONTROL FILE
CLOSE TEST FILE

EXIT PROGRAM
SUBROUTINE DISPLAY INTRO SCREEN (page 1/1)
SUBROUTINE SUM CONTROLS (page 1/1)

START

SET
RED-CTL. KEY = RED-CTL-M.C
CONTROL-KEY = RED-CTL-M.C

CONTROL-FILE
EKT = CONTROL-KEY

INVALID SET

NEXT RECORD

YES

STOP

YES

YES

YES

YES

YES

YES

YES

YES

YES

YES

YES

YES

YES

YES
SUBROUTINE DISPLAY CONTROLS (LIST) (page 1/1)

START

DISPLAY CONTROLS

TASK-TASK + TASK-TASK + TASK-TASK + TASK-TASK

TITLE-TITLE + TITLE-TITLE + TITLE-TITLE + TITLE-TITLE

STOP

STOP

DISPLAY CONTROLS

TASK-TASK + TASK-TASK + TASK-TASK + TASK-TASK

STOP

STOP

DISPLAY CONTROLS

AKE-KEY + AKE-KEY + AKE-KEY + AKE-KEY

STOP

STOP

DISPLAY CONTROLS

AKE-KEY + AKE-KEY + AKE-KEY + AKE-KEY

STOP

STOP

DISPLAY CONTROLS

AKE-KEY + AKE-KEY + AKE-KEY + AKE-KEY

STOP

STOP

DISPLAY CONTROLS

AKE-KEY + AKE-KEY + AKE-KEY + AKE-KEY

STOP

STOP

DISPLAY CONTROLS
SUBROUTINE RATE TASKS (MAINT) (page 1/1)
SUBROUTINE READ CONTROL (LIST) (page 2/2)

LISTING

RET FTAK KEY + DEVC KEY

TYPE PART 0

YES

TRAINING DEVICE

NO

DISC INFORMATION

RET ANY KEY

YES

LAST KEY . EQL

YES

RET

NO

READ CONTROL

D-108
SUBROUTINE HIT ANY KEY (LIST) (page 1/1)
SUBROUTINE TIMER & NO OP (LIST) (page 1/1)
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<tr>
<th>Field Name</th>
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</tr>
<tr>
<td>OPTION</td>
<td>alphanumeric 1</td>
<td></td>
</tr>
<tr>
<td>PREVIOUS-RATING</td>
<td>numeric 009</td>
<td></td>
</tr>
<tr>
<td>RATING</td>
<td>numeric 3</td>
<td></td>
</tr>
<tr>
<td>READ-TASK-NO</td>
<td>numeric 1</td>
<td></td>
</tr>
<tr>
<td>READ-TYPE</td>
<td>numeric 4</td>
<td></td>
</tr>
<tr>
<td>READ-TASK1</td>
<td>alphanumeric 1</td>
<td></td>
</tr>
<tr>
<td>READ-SUBTASK</td>
<td>alphanumeric 4</td>
<td></td>
</tr>
<tr>
<td>REQ-TASK-NO</td>
<td>numeric 1</td>
<td></td>
</tr>
<tr>
<td>REQ-TYPE</td>
<td>numeric 4</td>
<td></td>
</tr>
<tr>
<td>REQ-TASK</td>
<td>alphanumeric 1</td>
<td></td>
</tr>
<tr>
<td>REQ-SUBTASK</td>
<td>alphanumeric 4</td>
<td></td>
</tr>
<tr>
<td>TASK-KEY</td>
<td>alphanumeric 1</td>
<td></td>
</tr>
<tr>
<td>TYPE-PART</td>
<td>alphanumeric 9</td>
<td></td>
</tr>
<tr>
<td>TASK-TASK</td>
<td>alphanumeric 9</td>
<td></td>
</tr>
<tr>
<td>PERIOD-PART</td>
<td>alphanumeric 1</td>
<td></td>
</tr>
<tr>
<td>CONTROL-PART</td>
<td>alphanumeric 9</td>
<td></td>
</tr>
<tr>
<td>TASK-NO</td>
<td>numeric 0009.9999</td>
<td>0</td>
</tr>
<tr>
<td>TITLE-FLAG</td>
<td>numeric 4</td>
<td></td>
</tr>
<tr>
<td>TITLE-STATUS-WORD</td>
<td>alphanumeric 2</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>numeric 2</td>
<td></td>
</tr>
</tbody>
</table>
MAINT file descriptions:

1. **B:DEVICE (DEVICE-FILE)**
   - DEVICE-KEY: alphanumeric 10
   - DEVICE-ANALYSIS(1): integer 3
   - DEVICE-ANALYSIS(2): integer 3
   - DEVICE-ANALYSIS(20): integer 3
   - DEVICE-TITLE: alphanumeric 60

2. **B:TITLE (TITLE-FILE)**
   - TITLE-KEY
     - TITLE-TYPE: integer 1
     - TITLE-TASK: alphanumeric 9
     - TITLE-PERIOD: alphanumeric 1
     - TITLE-CONTROL: alphanumeric 9
     - TITLE-DESC: alphanumeric 60

3. **B:CONTROL (CONTROL-FILE)**
   - CONTROL-KEY: alphanumeric 20
   - CONTROL-ANALYSIS(1): integer 3
   - CONTROL-ANALYSIS(2): integer 3
   - CORR-CTL-KEY: alphanumeric 20
SUBROUTINE MOVE NINES (MAINT) (page 1/1)

START

SET DEVICES

STOP

D-118
SUBROUTINE TIMER (MAINT) (page 1/1)

START

YES

NO

START

NO

INTERNAL COUNTER = 0

YES

STOP
SUBROUTINE MAINT (page 1/14)
SUBROUTINE MAINT (page 4/14)

1. RED DEVICE
   - SET DEVICE-TITLE = SPACE
   - DEVICE-KEY = G (C2)
     - YES ENTER TITLE OF TANKING DEVICE
     - NO
   - DEVICE-KEY = 10, 0
     - YES ENTER TITLE OF OPERATIONAL EQUIPMENT
     - NO
   - TITLE
   - ACCEPT DEVICE-TITLE
   - DISPLAY MENU
     - YES
     - ACCEPT LAST-KEY FROM PIC. OR FUNCTION KEY
     - NO
   - CLEAR SCREEN
   - INVALID KEY
     - YES
     - BAD KEY
   - MOVE MENU
     - YES
   - DEVICE FILE
   - DISPLAY FUNCTION KEYS

2. DEVICE TITLE + DELETE
   - YES
   - DISPLAY MENU
   - NO

3. MOVE MENU
   - YES
   - DEVICE FILE
   - NO

4. DISPLAY FUNCTION KEYS
   - YES
   - DEVICE FILE
   - NO

D-125
SUBROUTINE MAINT (page 9/14)

1. CLEAR SCREEN
2. DISPLAY FUNCTION KEYS
3. LAST KEY + ESC
4. DISPLAY MENU
5. SET 1 = 1
6. DISPLAY INSTRUCTIONS
7. CLEAR SCREEN
8. DISPLAY INSTRUCTIONS
9. RATE ITEM
10. DISP-TREE LST+ESC
11. YES
12. SET 1 = 1
13. DISPLAY
SUBROUTINE MAINT (page 14/14)
ANNEX 5

ASTAR II SCREENS

E-1
## AStar II Tutorial

**Welcome to AStar II!**

**Enter Name:**

**Select One of the Following Options with Cursor and Press Enter**

<table>
<thead>
<tr>
<th>No.</th>
<th>Lesson</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to AStar II</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>How to Collect Data</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>How to Create and Manage the Data Base</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>How to Conduct AStar II Analyses</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>How to Generate AStar II Results</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>How to Interpret AStar II Results</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Run AStar II Exercise</td>
<td></td>
</tr>
</tbody>
</table>

F1 = HELP

F8 = MAIN MENU

F10 = QUIT
NAME OF SYSTEM __

F1=HELP  F2=TUTOR  F9=DOS  F10=QUIT
ASTAR analyses can be performed at three different levels. Which level to use depends upon the amount of information you have about the training system, operational equipment, the tasks to be trained, and the trainees themselves. The more specific the information, the higher the level you can use in ASTAR. For examples of required information at each level, refer to the ASTAR II Tutorial.
SETUP

SPECIFY PRINTER:
IBM GRAPHICS COLOR QUIETWRITER
EPSON FX
COLOR
QUIETWRITER
HP LASERJET QUIETJET
CGA COLOR
VGA COLOR
EGA COLOR
MONOCHROME
EPSON FX
RX
LQ 800
XEROX 4020
4045

SPECIFY MONITOR:

SPECIFY DEFAULTS:
STORAGE PATH
A: B: C: D:
MOUSE AVAILABLE
YES NO
F1=HELP  F2=TUTOR  F9=DOS  F10=QUIT
F6=DIR
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CREATE FILE</td>
</tr>
<tr>
<td>2</td>
<td>IMPORT FILE</td>
</tr>
<tr>
<td>3</td>
<td>EXPORT FILE</td>
</tr>
<tr>
<td>4</td>
<td>MERGE DATA FILES</td>
</tr>
<tr>
<td>5</td>
<td>COPY DATA BASE</td>
</tr>
<tr>
<td>6</td>
<td>DELETE DATA BASE</td>
</tr>
<tr>
<td>7</td>
<td>MANAGE DATA BASE</td>
</tr>
<tr>
<td>8</td>
<td>DEVELOP REPORT</td>
</tr>
</tbody>
</table>

F1=HELP                 F6=DIR        F7=SAVE       F8=MAIN MENU   F9=DOS       F10=QUIT
### FILE OPERATIONS MAIN MENU

1. CREATE FILE  
2. IMPORT FILE  
3. EXPORT FILE  
4. MERGE DATA FILES  
5. COPY DATA BASE  
6. DELETE DATA BASE  
7. MANAGE DATA BASE  
8. DEVELOP REPORT

**HELP:** The CREATE FILE option allows you to set up, or modify the data base structure for a system and activate an audit trail log of commands used during that ASTAR session.

You will need to specify a file name and number of training system(s) and the name of the operational system.

F1=HELP  
F6=DIR  
F7=SAVE  
F8=MAIN MENU  
F9=DOS  
F10=QUIT
CREATE FILE

ENTER FILE NAME:  
LABEL AUDIT TRAIL LOG: 
NAME OPERATIONAL SYSTEM: 
NUMBER OF TRAINING SYSTEMS: 
NAME TRAINING SYSTEMS:  

ANY MODIFICATIONS NEEDED?  YES  NO

F1=HELP  
F6=DIR  F7=SAVE  F8=MAIN MENU  F9=DOS  F10=QUIT
IMPORT FILE

NAME SOURCE LOCATION AND FILE NAME: _

NAME DESTINATION LOCATION AND FILE NAME: _

F1=HELP
F6=DIR     F7=SAVE     F8=MAIN MENU     F9=DOS     F10=QUIT
IMPORT FILE

NAME SOURCE LOCATION AND FILE NAME: _

NAME DESTINATION LOCATION AND FILE NAME: _

CONFIRM: YES NO
SOURCE =
DESTINATION =

ANY MODIFICATIONS NEEDED? YES NO

F1=HELP  F6=DIR  F7=SAVE  F8=MAIN MENU  F9=DOS  F10=QUIT
EXPORT FILE

NAME SOURCE LOCATION AND FILE NAME:   
NAME DESTINATION LOCATION AND FILE NAME:   

CONFIRM: YES NO

SOURCE = 
DESTINATION = 

ANY MODIFICATIONS NEEDED? YES NO

F1=HELP  F6=DIR  F7=SAVE  F8=MAIN MENU  F9=DOS  F10=QUIT
MERGE DATA FILES

NAME SOURCE LOCATION AND NAMES OF FILES TO BE MERGED:

NAME DESTINATION LOCATION AND NAME OF MERGED FILE:

F1=HELP
F6=DIR     F7=SAVE     F8=MAIN MENU    F9=DOS     F10=QUIT
COPY FILE

NAME SOURCE LOCATION AND FILE NAME:  

NAME DESTINATION LOCATION AND FILE NAME:  

F1=HELP  F6=DIR  F7=SAVE  F8=MAIN MENU  F9=DOS  F10=QUIT
DELETE FILE

NAME FILE LOCATION AND FILE NAME: ___

WARNING!
ALL DATA WITHIN THE FILE WILL BE LOST!
ESC TO CANCEL ENTER TO CONTINUE

F1=HELP  F7=SAVE  F8=MAIN MENU  F9=DOS  F10=QUIT
<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ENTER DATA</td>
<td>2</td>
<td>SIMILARITY MATCHING</td>
<td>3</td>
<td>COMMONALITY ANALYSIS</td>
</tr>
<tr>
<td>4</td>
<td>SKILL ANALYSIS</td>
<td>5</td>
<td>KNOWLEDGE ANALYSIS</td>
<td>6</td>
<td>EDIT DATA</td>
</tr>
</tbody>
</table>

F1=HELP  
F6=DIR  
F7=SAVE  
F8=MAIN MENU  
F9=DOS  
F10=QUIT
<table>
<thead>
<tr>
<th>ENTER DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 TASK LIST</td>
</tr>
<tr>
<td>2 DISPLAY LIST</td>
</tr>
<tr>
<td>3 CONTROL LIST</td>
</tr>
<tr>
<td>4 SKILLS LIST</td>
</tr>
<tr>
<td>5 KNOWLEDGE LIST</td>
</tr>
</tbody>
</table>

F1=HELP  F6=DIR  F7=SAVE  F8=MAIN MENU  F9=DOS  F10=QUIT
TASK LIST
SEAWOLF IAL SYSTEM

ENTER TASK NUMBER [FORMAT X.X]
AND TASK NAME [MAX = 50 CHARACTERS]

1.0 Prepare IAL for manual hydraulic operation

2.0 Open breech door and inspect barrel

F1=HELP   F7=SAVE   F8=MAIN MENU   F9=DOS   F10=QUIT
SIMILARITY MATCHING

Identify the training tasks/subtasks that are in the operational system

Task List for: SEAWOLF IAL

1.0 Prepare IAL for manual hydraulic operation
   1.1 Establish comm. with Command and Control center
   1.2 Energize LCDP, position Power On switch to "On"

2.0 LCDP: Ensure Vent and Drain Valve "Shut" Lights are On
   2.1 LCDP: If not, override Hydraulic Valve Actuator

3.0 Open Breech door and inspect barrel
   3.1 Prepare device for launch

4.0 Load device and shut Breech Door

5.0 Position Load/Unloaded Switch to "Loaded"

Select appropriate tasks/subtasks and hit enter

F1=HELP  F6=DIR  F7=SAVE  F8=MAIN MENU  F9=DOS  F10=QUIT
<table>
<thead>
<tr>
<th></th>
<th>TASK LIST</th>
<th>DISPLAY LIST</th>
<th>CONTROL LIST</th>
<th>SKILLS LIST</th>
<th>KNOWLEDGE LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1=HELP</td>
<td>F2=INSERT</td>
<td>F3=MODIFY</td>
<td>F4=DELETE</td>
<td>F10=QUIT</td>
</tr>
<tr>
<td></td>
<td>F7=SAVE</td>
<td>F8=MAIN MENU</td>
<td>F9=DOS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F1=HELP F2=INSERT F3=MODIFY F4=DELETE F5=HELP F6=INSERT F7=SAVE F8=MAIN MENU F9=DOS F10=QUIT
EDIT TASK LIST
SEAWOLF IAL SYSTEM

USE F2 TO INSERT TASKS, F4 TO DELETE TASKS, AND F3 TO MAKE CORRECTIONS

1.0 Prepare IAL for manual hydraulic operation
2.0 Open breech door and inspect barrel

F1=HELP F2=INSERT F3=MODIFY F4=DELETE
F7=SAVE   F8=MAIN MENU   F9=DOS F10=QUIT
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DISPLAY RATINGS</td>
</tr>
<tr>
<td>2</td>
<td>DISPLAY FILES</td>
</tr>
<tr>
<td>3</td>
<td>DISPLAY ANALYSIS RESULTS</td>
</tr>
<tr>
<td>4</td>
<td>PRINT AUDIT TRAIL LOG</td>
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</table>

F1=HELP  F6=PRINT  F7=SAVE  F8=MAIN MENU  F9=DOS  F10=QUIT
<table>
<thead>
<tr>
<th></th>
<th>1 PERFORMANCE DEFICIT</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2 LEARNING DIFFICULT</td>
</tr>
<tr>
<td></td>
<td>3 QUALITY OF TRAINING - ACQUISITION</td>
</tr>
<tr>
<td></td>
<td>4 RESIDUAL DEFICIT</td>
</tr>
<tr>
<td></td>
<td>5 RESIDUAL LEARNING DIFFICULT</td>
</tr>
<tr>
<td></td>
<td>6 PHYSICAL SIMILARITY</td>
</tr>
<tr>
<td></td>
<td>7 FUNCTIONAL SIMILARITY</td>
</tr>
<tr>
<td></td>
<td>8 QUALITY OF TRAINING - TRANSFER</td>
</tr>
</tbody>
</table>

F1=HELP    F2=FIND    F3=QUERY    F4=REPEAT    F5=RESULTS
F6=TSK/STSK F7=SAVE    F8=MAIN MENU    F9=DOS    F10=QUIT
ASTAR 1

PERFORMANCE DEFICIT

Examine the training objectives and consider what you know about the typical trainee's background, work experience, and prior training. What proportion of the skills and knowledge required by the training objectives will the typical trainee have to learn in order to reach criterion performance on the training device?

Enter this proportion using the following scale:

0 20 40 60 80 100

0 = None - the trainee does not have to learn anything.

100 = All - the trainee has to learn all of the skills and knowledge needed to meet the training objectives.

Enter Rating -999

Use Tab or Enter to select system(s) to be rated:
1) SEAWOLF (2D)
2) SEAWOLF (3D)
3) SEAWOLF (PROTO)

More ▼
### ASTAR 2

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PERFORMANCE DEFICIT</td>
</tr>
<tr>
<td>2</td>
<td>LEARNING DIFFICULTY</td>
</tr>
<tr>
<td>3</td>
<td>QUALITY OF TRAINING - ACQUISITION</td>
</tr>
<tr>
<td>4</td>
<td>RESIDUAL DEFICIT</td>
</tr>
<tr>
<td>5</td>
<td>RESIDUAL LEARNING DIFFICULTY</td>
</tr>
<tr>
<td>6</td>
<td>PHYSICAL SIMILARITY</td>
</tr>
<tr>
<td>7</td>
<td>FUNCTIONAL SIMILARITY</td>
</tr>
<tr>
<td>8</td>
<td>QUALITY OF TRAINING - TRANSFER</td>
</tr>
</tbody>
</table>

- **F1** = HELP
- **F2** = FIND
- **F3** = QUERY
- **F4** = REPEAT
- **F5** = RESULTS
- **F6** = TSK/STSK
- **F7** = SAVE
- **F8** = MAIN MENU
- **F9** = DOS
- **F10** = QUIT
QUALITY OF TRAINING - TRANSFER

Consider what you know about the training device and operational situation, a typical instructor (if there is one), and how the device will be used.

What percentage of the tasks that must be learned in the training device are similar to the tasks that are performed in the operational situation?

Rate the percentage using the following scale:

<table>
<thead>
<tr>
<th>0</th>
<th>20</th>
<th>40</th>
<th>60</th>
<th>80</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>= None - none of the training tasks are similar to the operational tasks.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>= All - all of the training tasks are identical to the operational tasks.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Task.Subtask =
Enter Rating -999

Use Tab or Enter to select system(s) to be rated:
1) SEAWOLF (2D)
2) SEAWOLF (3D)
3) SEAWOLF (PROTO)

More ▼
<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PERFORMANCE DEFICIT</td>
<td>2</td>
<td>LEARNING DIFFICULTY</td>
<td>3</td>
<td>QUALITY OF TRAINING - ACQUISITION</td>
<td>4</td>
<td>RESIDUAL DEFICIT</td>
</tr>
</tbody>
</table>

F1=HELP      F2=FIND      F3=QUERY      F4=REPEAT      F5=RESULTS
F6=TSK/STSK  F7=SAVE      F8=MAIN MENU   F9=DOS        F10=QUIT
LEARNING DIFFICULTY

Consider the skills and knowledge needed to meet the training objectives for this subtask that the trainee must learn (the Performance Deficit that you identified). Answer the following.

Will the trainee use job aids or memory aids to perform this subtask in the training device?

Definition - Job and memory aids assist in doing a subtask correctly. Some examples are:
- Documents (Tech manuals, etc.),
- Instructions printed on the equipment, and
- Memory joggers (S-A-L-U-T-E).

Enter on of these ratings:
0 = Job or memory aids ARE used.
1 = Job or memory aids ARE NOT used.

Task.Subtask =
Enter Rating -999

F1=HELP F2=FIND F3=QUERY F4=REPEAT F5=RESULTS
F6=TSK/STSK F7=SAVE F8=MAIN MENU F9=DOS F10=QUIT
RESIDUAL LEARNING DIFFICULTY

How many steps are required to do this subtask?

Definition - A step is a separate physical activity with well defined, observable beginning and end points. A subtask may have one step (identify enemy vehicles) or many steps (those involved in disassembling a rifle).

Enter one of these ratings:

QUERY
1) VIEW OTHER RATINGS WITHIN ASTAR 3
2) VIEW OTHER RATINGS FROM ASTAR 1
3) VIEW OTHER RATINGS FROM ASTAR 2

SELECT OPTION WITH CURSOR BAR

F7=SAVE  F8=MAIN MENU  F9=DOS  F10=QUIT
ANALYSIS RESULTS REQUEST PAGE

RATINGS  SCORES  TASK  SUBTASK
AVERAGES  INDIVIDUAL

OUTPUT
GRAPHIC  TABULAR

SELECT WHICH TRAINING SYSTEM(S)  SELECT WHICH CATEGORY
1) SEAWOLF (2D)  1) PERFORMANCE DEFICIT
2) SEAWOLF (3D)  2) LEARNING DIFFICULTY
3) SEAWOLF (PROTO)  3) QUALITY OF TRAINING-ACQUISITION
                      4) RESIDUAL DEFICIT
                      5) RESIDUAL LEARNING DIFFICULTY
                      6) PHYSICAL SIMILARITY
                      7) FUNCTIONAL SIMILARITY
                      8) QUALITY OF TRAINING - TRANSFER

F1=HELP  F3=QUERY  F4=ANALYSIS
F6=PRINT  F8=MAIN MENU  F9=DOS  F10=QUIT
<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td>Performance Deficit</td>
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<tr>
<td>Learning Difficulty</td>
<td>70</td>
</tr>
<tr>
<td>Training Problem</td>
<td>63.00</td>
</tr>
<tr>
<td>Quality of Training - Acquisition</td>
<td>100</td>
</tr>
<tr>
<td>Acquisition Efficiency</td>
<td>1.00</td>
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<tr>
<td>Residual Deficit</td>
<td>20</td>
</tr>
<tr>
<td>Residual Learning Difficulty</td>
<td>60</td>
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<tr>
<td>Physical Similarity</td>
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<td>Functional Similarity</td>
<td>80</td>
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<tr>
<td>Transfer Problem</td>
<td>12.00</td>
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<tr>
<td>Quality of Training - Transfer</td>
<td>67</td>
</tr>
<tr>
<td>Transfer Efficiency</td>
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<tr>
<td>Transfer</td>
<td>14.81</td>
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<td>sum</td>
<td>77.81</td>
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</tbody>
</table>

**SEAWOLF 3D**

F1=HELP  F2=QUIT  F3=QUERY  F4=ANALYSIS  F5=PRINT  F6=MAIN MENU  F7=DOS  F10=QUIT
APPENDIX F

SAMPLE ASTAR II OUTPUTS
(This Page Intentionally Left Blank)
## ASTAR II Level 1 Evaluation Summary

<table>
<thead>
<tr>
<th>DEVICE NAME</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Performance Deficit</td>
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<tr>
<td>Learning Difficulty</td>
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<tr>
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<td>Quality of Trn-Acq</td>
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<tr>
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<td>.91</td>
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F1=HELP   F3=QUERY   F4=ANALYSIS
F6=PRINT   F8=MAIN MENU   F9=DOS   F10=QUIT
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F6=PRINT
F8=MAIN MENU
F10=QUIT
MULTIPLE DEVICE
Summary Scores

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F6=PRINT
F3=QUERY
F8=MAIN MENU
F4=ANALYSIS
F9=DOS
F10=QUIT
SEAHOLF PROTO-TYPE Trainer
SELECTED CATEGORY GROUP

F1=HELP
F3=QUERY
F4=ANALYSIS
F6=PRINT
F8=MAIN MENU
F9=DOS
F10=QUIT
MUTIPLE DEVICES by
SUMMARY SCORE

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F3=QUERY
F8=MAIN MENU
F4=ANALYSIS
F9=DOS
F10=QUIT
MULTIPLE DEVICES FOR TREK 1.0
PERFORMANCE DEFECT RATING

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F1=HELP  F3=QUERY  F4=ANALYSIS  F6=PRINT  F8=MAIN MENU  F9=DOS  F10=QUIT
### ASTAR II Level 2

**Raw Ratings, Tasks 7.0-12.0**

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The following two Rating Categories are not made on a task basis.

**Quality of Training-Acquisition**

1. Directions Provided = XX
2. Practice Provided = XX
3. Feedback Provided = XX
4. Varying Practice Levels = XX

**Quality of Training-Transfer**

1. Similar Performance = XX
2. Similar Conditions = XX
3. Extensive Practice = XX
ASTAR II Level 2
Raw Ratings, Tasks 1.0-6.0
DEVICE NAME

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The following two Rating Categories are not made on a task basis.

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1. Directions Provided = XX
2. Practice Provided = XX
3. Feedback Provided = XX
3. Varying Practice Levels = XX

Quality of Training-Transfer
1. Similar Performance = XX
2. Similar Conditions = XX
3. Extensive Practice = XX

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F4=ANALYSIS
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