COMPUTER-ASSISTED INSTRUCTIONAL SYSTEMS DEVELOPMENT/LOGISTIC SUPPORT ANALYSIS INTERFACE FOR C-17 AIRCRAFT

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ABSTRACT

The development and delivery of military training on new weapon systems is dependent on the identification of training system requirements early in the weapon system life cycle. An automated interface between Logistic Support Analysis (LSA) data and the Instructional Systems Development (ISD) procedures will provide training developers with a means to assist in identifying training requirements earlier in the weapon system acquisition phase. This paper discusses the design and development of such an interface for the C-17 aircraft being developed by McDonnell Douglas Aircraft Corporation. The interface development includes three objectives: (a) tailoring of an existing computer-aided LSA data system for an emerging weapon system; (b) developing automated ISD worksheets; and (c) demonstration of a prototype interface of the ISD automated worksheets with the aircraft system LSA engineering data. The implications of the ISD/LSA interface are twofold. First, it will aid in the development of training by providing a more efficient method of identifying training requirements earlier in the weapon system acquisition process, and second, it will provide an audit trail for LSA and ISD data being utilized in training requirements development.

INTRODUCTION

An essential requirement for effective military training is the early identification and analysis of training system requirements for emerging weapon systems. Currently, training developers encounter problems with late-to-need logistic support data in addition to non-existent, inadequate, and inaccurate data acquired during the Instructional Systems Development (ISD) process.

INSTRUCTIONAL SYSTEMS DEVELOPMENT (ISD)

Instructional Systems Development (AFM 50-2), as utilized through the Air Force weapon system acquisition process, provides an analytic approach to the decision-making process for planning, developing, and managing instructional programs. The rationale for all training and instructional programs must be documented by developers, managers, and commanders throughout the development process. In order to adequately present this rationale, an in-depth analysis of detailed job and task information must be accomplished. Through the ISD process, initial training requirements are identified from existing job data and analyses from the field, engineering data from the contractor, and judgments on the part of training developers. This process ensures that the training needs for critical tasks will be met.

The outcomes of applying ISD assist training developers in determining what to train, how to conduct training, and how to evaluate what was trained. Sound rationales for these decisions are benefits that result from applying the ISD process. In addition, the training developers can make appropriate decisions on the optimum approach to training applications and technology through the ISD assessment of alternative approaches and solutions. The capability of training developers to make these decisions is being hindered, however, due to the application of current ISD procedures being data-intensive, time consuming, and paper-and-pencil dependent. As a result, the identification and development of training requirements in the early stages of weapon system acquisition is greatly delayed. Other problems that result from the paper-and-pencil application of ISD to training development include continual rewriting of non-standard forms and trainer developed forms, and a lack of documentation to support the training developers' decisions. The solution to this problem is being sought in the development of procedures to automate the ISD process using integrated logistics support and engineering data.

LOGISTIC SUPPORT ANALYSIS

The Logistic Support Analysis (LSA) process, applying scientific and engineering principles to the acquisition cycle, integrates the design and support concepts to comply with the operational needs of the system. Many of the current weapon system acquisitions require that training data be provided through the Logistic Support Analysis Record (LSAR) which is governed by Military Standard 1388-2A. The LSA process is conducted on an iterative basis throughout all phases of a weapon system life cycle to accomplish the support analysis objectives. The intent of this standard is to achieve joint service acceptance of standard requirements, data element definitions, data field lengths, and data entry requirements for the LSAR data. Weapon system information generated by LSA during all phases of the weapon system life cycle is used as an input to follow-on analyses and as an aid in developing logistics products. It should be pointed out, however, that the LSA documentation must be tailored to each specific weapon system in all phases of the system life cycle.

Integration of MPT Data

Early identification of training requirements is dependent on the integration of manpower, personnel, and training (MPT) data in the initial stages of the weapon system life cycle. One of the goals in weapon system acquisition programs is to increase both human and hardware performance. This can be accomplished if programs are initiated early enough for cost-effective front-end analyses (FEA) to be conducted. The integration of logistics, manpower, personnel, and training analyses and data can be realized through FEA.

FEA would enhance the effects of training requirements identification. A source for all this MPT data, if delivered to the training developers in a timely manner, is in the LSAR data. Needed information for the MPT decisions as they relate to both maintenance and aircrew training capabilities can be obtained from 24 of the LSAR data records and their associated reports. The flow of information needed to feed the MPT utilization requirements for weapon system acquisition programs is shown in Figure 1.

The Manpower, Personnel, and Training Analysis reports assist in the timely identification of the technical tasks that operators and maintainers perform. In addition, it identifies job descriptions, employment doctrine, personnel requirements, the support concept, maintenance and repair systems, and operational manpower requirements. Additional report information includes specified data as skills needed, frequency of task performance, time to perform the tasks, personnel required, location, and a description of the task steps required to complete the performance of the task. (DI-ILLS-80077)

A listing of the minimum requirements of all knowledge and skills required for personnel to effectively operate and maintain a system or subsystem is provided in the Personnel Performance Profiles. These profiles also provide the knowledge and skills to perform a task or function. These profiles can be used to determine training requirements, develop personnel evaluation criteria, standardize training material, develop course objectives for curricular and training material, and minimize duplication of reporting knowledge and skills. (DI-ILSS-8078)

The documentation for the Training Path System identifies the training requirements for all categories of personnel in a training program, thus ensuring the effective development of skills and knowledge necessary to coordinate, direct, and perform operation and maintenance of a system. (DI-ILSS-80079)

Data to evaluate the extent to which equipment having an interface with maintenance meets the human performance requirements and the human engineering design criteria is provided by the Human Engineering Design Approach Document--Maintenance. This document utilizes several records from the LSAR in conjunction with applicable sketches, drawings, and photographs to satisfy the human-equipment interface evaluation. (DI-H-7057)

COMPUTER-AIDED ISD

State-of-the-art technology provides the potential to alleviate some of the problems with the current procedures used by training developers of new weapon systems. A system is needed that will automate the LSA data and allow for tailoring of the data to conform to the requirements for the aircraft. In addition, the system must provide the ability to annotate additions, deletions, and changes on the LSA data being provided by the contractor. Also as ISD is required for educational and training programs, this system must accommodate the entire ISD process. A primary requirement of the CAISD system is to adapt new design information into the ongoing ISD process, to include engineering data and data from system specialists. Figure 2 depicts the flow of LSAR data required to feed the ISD training model.

The Computer-Aided ISD (CAISD) is currently being developed to create an interface between LSA and ISD data to facilitate the ISD process being used by the training developers on the C-17 aircraft. This system includes three components: (a) tailoring of the Computer-Aided LSA (CALSA) system to interface LSA/ISD data for use by the 3306 Air Training Command's (ATC) Test and Evaluation Squadron; (b) the development of automated ISD worksheets that incorporate engineering data/documentation and provide convenient access procedures; and (c) feasibility test, demonstration, and user training on the prototype systems. In addition to designing procedures for developing new technologies into the ISD process, CAISD will support existing state-of-the-art technology by implementing the government-owned Computer-Aided Logistic Support Analysis (CALSA) system.

Computer-Aided Logistic Support Analysis (CALSA)

CALSA is a centralized and automated Logistic Support Analysis Record (LSAR) developed for the government by Dynamics Research Corporation. CALSA has previously been implemented by the U.S. Army and Air Force Government Surveillance and Target Attack Radar System (Joint STARS) program, the U.S. Navy MK 50 Torpedo program, and other LSA defense programs that substantiate its use as a flexible and easy way to use the tailoring system for LSA.

CALSA can be tailored to meet the logistic needs of an particular weapon system. The tailoring is accomplished by a user who manipulates the functions of CALSA. These functions allow the user to accomplish the following: (a) enter and revise data; (b) generate reports; (c) compare different data bases and list the differences; (d) generate models; (e) perform administrative duties, and (f) manage the system. CALSA is an essential component required for the timely and cost effective development of the CAISD. In addition to the specifications required in MIL-STD 1388-2A, CALSA can also serve as an integrated data base for LSA and for other program elements such as ISD.

Tailoring of CALSA

The CALSA data system will be tailored for Air Training Command's (ATC) 3306 Test and Evaluation Squadron (TES), for use on the McDonnell Douglas C-17 aircraft LSA data. One of the missions of the 3306 TES is to determine weapon system aircrew and maintenance training requirements during the early stages of weapon system acquisition. A basic assumption of the 3306 TES is that training, regardless of its setting, should result from an ISD analysis of the weapon system requirements.

Training developers from the 3306 TES determine these training requirements through the ISD process using hard copy LSA data from the C-17 contractor. In order to tailor the ISD model to the objective of identifying training requirements, the squadron has developed a 14-step process for that purpose. Nine of these steps that directly impact on the early identification of training requirements are discribed as follows:

1. Identify system maintenance requirements--all of the duties and tasks that make up a job are identified to include the

Manpower, Personnel, and Training Flow
from Logistic Support Analysis Records

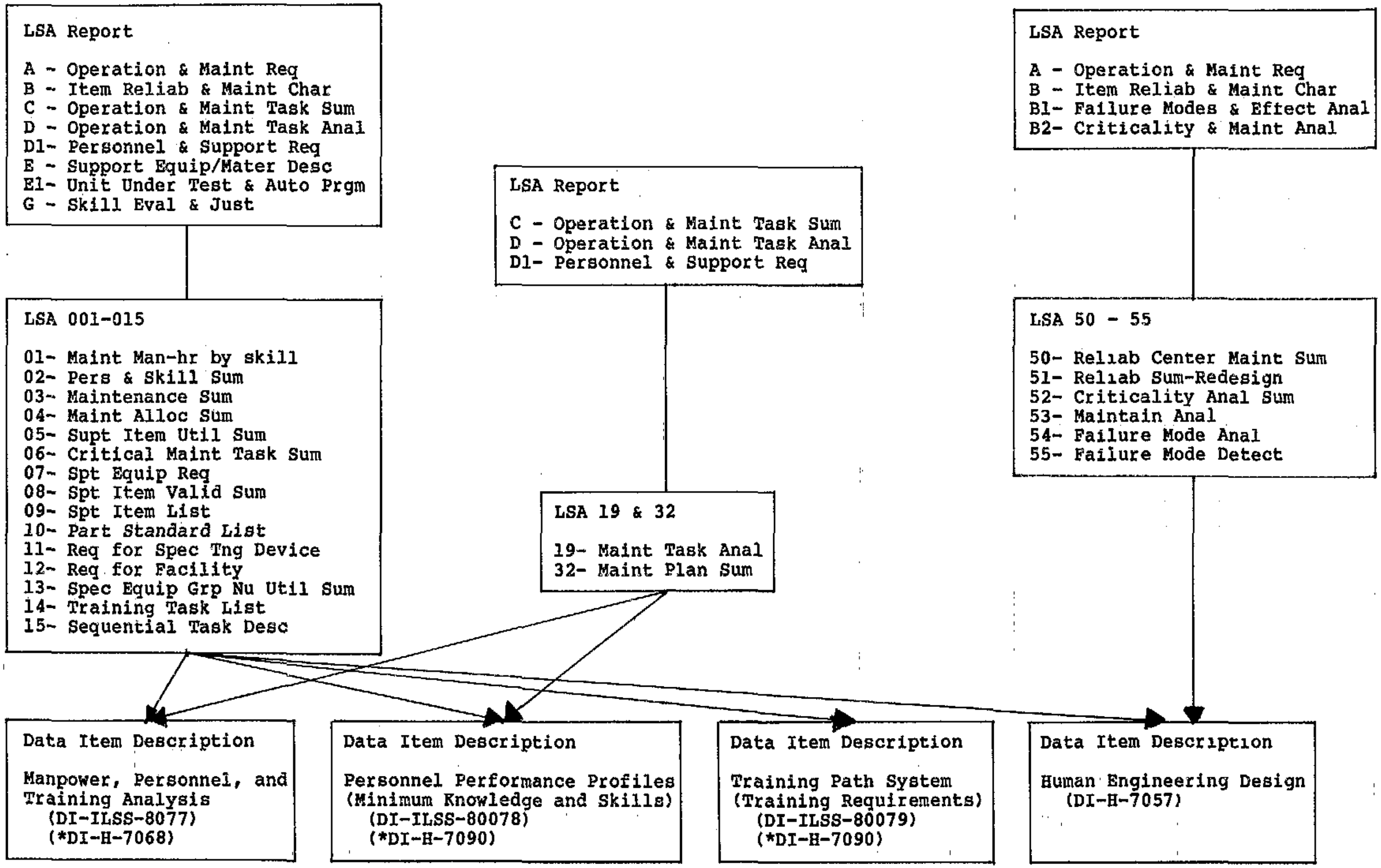

Figure 1.

Specified Weapon System LSAR
Input to ISD Training Model

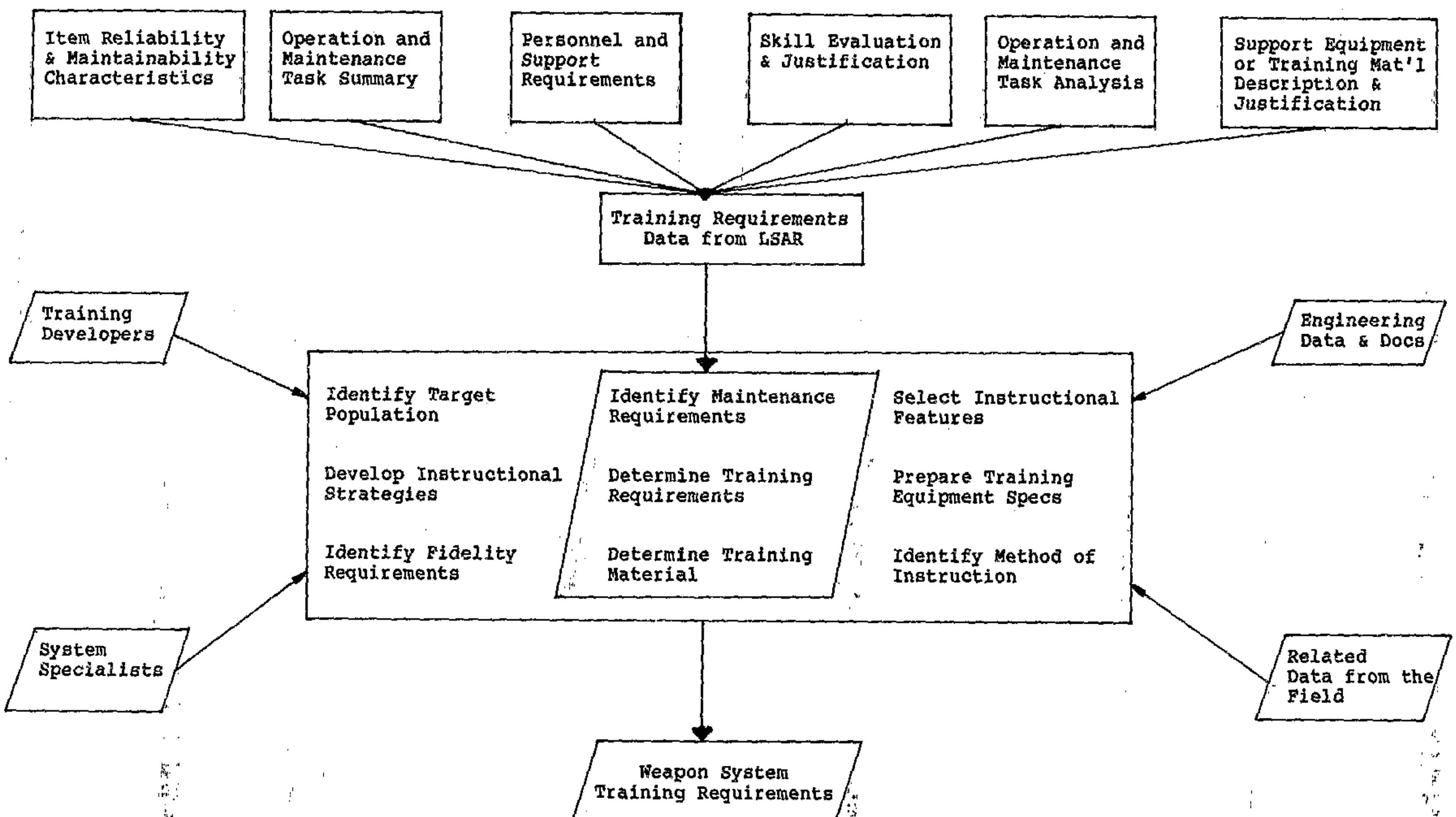

Figure 2.

mission and equipment used. Data gathering for this task list includes identifying all duties, identifying and recording task statements, verifying the task list, and developing group tasks. An end product of this step is the development of job performance requirements;

2. Identify characteristics of the target population--characteristics of the students who are to be trained are determined based on the target population or estimated target population provided by the using command. The target population definition includes the students' entering AFSC and all prior WS experience. Familiarity of skills and knowledges of the target population are obtained from training course/standards, occupational surveys, and subject matter expertise;

3. Determine training requirements--decisions as to what is and is not to be included in training are made based on the difference between results of Steps 1 and 2. Activities of remaining tasks and skills are assessed for potential training requirements. Those activities not eliminated are then matched with appropriate skills and knowledges associated with it;

4. Determine types of technical training material required--determination is made on how the identified skills and knowledges (step 3) can best be acquired by the students. This determination assesses training modes such as hardware, visual aids, printed material, and computer-assisted instruction;

5. Develop instructional strategies--this step focuses on the development of a preliminary overview of the entire training program. Each task for an identified training requirement is analyzed on a separate worksheet that includes the preliminary criterion objectives, a draft of the media description, a brief instructional strategy, and the sequence tasks;

6. Identify fidelity requirements of hardware components--the degree of fidelity of hardware to train specified skills and knowledges is determined by how realistically the hardware must be represented to achieve those training requirements;

7. Select instructional features for hardware media--this step is performed only on sophisticated trainers or where there is complicated student interaction. The four components, steps, or aspects of learning principles are assessed; stimulus, response, feedback, and next activity;

8. Prepare ISD-derived training equipment specification--this is the model for recording the training equipment design written in a military specification format. This model includes the training objectives, training application, simulation characteristics, instructional features, and trainer configuration; and

9. Identify method of instruction--this step includes the selection and identification of the method of instruction for each behavioral requirement based on the media class selected to teach each skill or knowledge. A draft course chart for entire training programs is developed. Estimations of lesson times, block times, and total course length are determined.

Functional specifications for a CAISD process, using the C-17 LSA data to support the ISD decision-making process, will be determined by the training developers at the squadron. Subsequent to that endeavor, automated ISD worksheets, incorporating engineering data/documentation, will be developed. These automated worksheets will provide the user with the capability to globally search and update data, to include the ability to identify the currency of entered data and whether or not it is the most recent available. The user will also be able to integrate LSA data with individual system expert judgments. The feasibility of interfacing the automated ISD worksheets with the C-17 LSA and engineering data will be assessed through a prototype CAISD system. Final functional specifications shall document the approach in the development of the C-17 ISD management information system. These specifications will recommend a design approach to implement the LSA/ISD interface.

DISCUSSION

The development of the CAISD interface with LSA will greatly enhance the performance of training developers in their requirement to identify and document initial training requirements for a new weapon system early in the system life cycle. Although this interface is currently being developed using data for the C-17 aircraft, it is designed for general applicability to other weapon systems that possess LSA.

CAISD provides two main benefits for the development of military training on new weapon systems. First, this interface system will automate and streamline the process of identifying training requirements from LSA using the ISD model. This process will be more efficient in that training developers will be able to access, manipulate, and interact with LSA data through the ISD model in a computer-assisted mode, rather than performing these functions in a lengthy and cumbersom paper-and-pencil mode. Thus, training developers will have a state-of-the-art, efficient technology to assist in identifying training requirements earlier in the life cycle.

Second, CAISD will provide an audit trail of the training requirements identification process. This will allow training developers to accurately document their decisions. In addition, documented, easily accessible data will be available for system reviews.

Early identification of training requirements in the weapon system life cycle directly affects the ability to develop and deliver military training for the maintenance and support of weapon system prior to delivery. The CAISD will assist in the identification of these training requirements.

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ABOUT THE AUTHOR

Dr Sorensen is a research scientist and psychologist at the Air Force Human Resources Laboratory. She has a Masters in Educational Psychology, Measurement, and Statistics, and a Doctorate in Instructional Design and Computer Technology. Her 14 years of education and training systems experiences include the design, development, implementation, and evaluation of those systems throughout her career with the Army, Navy, Air Force, and civilian communities. She began working for the Air Force in 1985 and in addition to other Laboratory projects, currently heads a joint-service project responsible for designing a tri-service weapon system maintenance training interface for instruction through the UBD2000.