

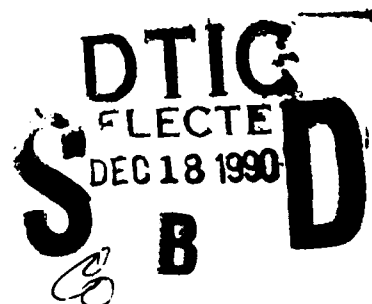
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Systematic Organizational Design (SORD) Methodology: A Primer



September 1990

Fort Bliss Field Unit
Systems Research Laboratory

U.S. Army Research Institute for the Behavioral and Social Sciences

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U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

**A Field Operating Agency Under the Jurisdiction
of the Deputy Chief of Staff for Personnel**

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ABSTRACT (Continue on reverse if necessary and identify by block number) The Systematic Organizational Design (SORD) methodology is a user-oriented, computer- assisted tool that uses a standardized process and structure to design an Army organizational unit up through company level. This report describes the background and status of the SORD development, presents an overview of the SORD methodology, and uses examples taken from a field test of SORD to illustrate each major component of the methodology. The three major components of SORD are (1) the Mission to Function System, which designates and translates mission requirements; (2) the Unit Design System, which designs a structured unit comprised of the appropriate numbers and types of major materiel and personnel assets; and (3) the Design Evaluation System, which assesses and verifies the match between mission requirements and unit capabilities. SORD also incorporates a crew and a cell database and a report pro- ducing module. The report also discusses the benefits that can be derived from the recent institutionalization of SORD and its future refinements.			
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FOREWORD

The Systems Research Laboratory of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) supports the Army with research and development on manpower, personnel, training, and human performance issues as they impact the development, acquisition, and operational performance of Army systems and the combat readiness and effectiveness of Army units. Any consideration of the combat readiness and effectiveness of Army units must take into account how the personnel and equipment in the unit are organized to conduct and support the combat operations. Consequently, there is a need to develop tools to increase the effectiveness, efficiency, and reliability of the process of designing units. The Fort Bliss Field Unit is conducting Advanced Development (6.3A) research to meet this need.

This research product is an introduction to a computer software package, Systematic Organizational Design (SORD), which standardizes the process and structure for creating and documenting initial concepts for a unit's organizational design. SORD aids in the development of a document called a unit reference sheet (URS) that has sufficient detail in personnel and equipment requirements and capabilities to permit its use in Army studies and cost analyses. The software also assures a high degree of uniformity, producing a URS that is an acceptable reference for organization documenters.

SORD was developed with the encouragement of the Deputy Chief of Staff for Personnel at Headquarters, Department of the Army. The Current Forces Directorate at the Combined Arms Combat Development Activity of the U.S. Army Training and Doctrine Command (TRADOC) was the principal proponent of the research and development effort from its inception, with continuing interest from the Organization Directorate of the Deputy Chief of Staff for Combat Development (DCSCD) of Headquarters TRADOC.

The SORD process discussed in this primer was briefed to two successive TRADOC DCSCDs. Prototypes of SORD were demonstrated at the XXVIII Army Operations Research Symposium and the 23rd Meeting of the Department of Defense Human Factors Engineering Technical Group. Version 2.0 of the software, scheduled for release during the second quarter of fiscal year 1991, will become the required, standard technique for designing Army units, as specified in draft TRADOC Regulation 71-17.



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Technical Director

SYSTEMATIC ORGANIZATIONAL DESIGN (SORD) METHODOLOGY: A PRIMER

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SYSTEMATIC ORGANIZATIONAL DESIGN (SORD) METHODOLOGY: A PRIMER

Introduction

Origin and Status of SORD

The U.S. Army Research Institute (ARI) unit design project began under GEN Thurman when he was the Headquarters, Department of Army (HQ DA) Deputy Chief of Staff for Personnel (DCSPER), and received continuing support under his successor, LTG Elton. Both DCSPERs encouraged ARI to address the Army's need for standardized and objective methods for organizing soldiers and their equipment into cost and operationally effective units. The SORD methodology was designated one of the highest priority ARI research tasks by the U.S. Army Training and Doctrine Command (TRADOC) during the final two years of its development. SORD will soon become the required, standard technique for designing Army units, as specified in a draft revision to TRADOC Regulation 71-17.

The Force Design Context and Process

Our initial review of Army and TRADOC regulations that address the force design process and our interviews with force designers at selected TRADOC facilities showed that force design is a major factor in the Concept Based Requirements System (CBRS), and is one of the first activities completed in the CBRS (see TRADOC Regulation 11-15). The processes and activities TRADOC employs to determine "How the Army will fight," require the early formulation of ideas, evolving into more detailed concepts, on how to organize units to conduct and support that fight. These initial concepts for organizing units are incorporated into a supporting document called the Unit Reference Sheet (URS). The URS supports and is a basis for later conceptual and doctrinal studies and analyses, and depicts, in summary form, the Table of Organization and Equipment (TOE) unit expected to result from approval of the study or concept (see TRADOC Regulation 71-17).

Once the organizational concepts contained in the URS are approved, there are numerous prescribed and often automated planning documents that will refine the URS and give shape, size, and detail to the organization created. For example, all of the following documentation builds on the URS: the Automated Unit Reference Sheet (AURS), the Draft TOE (DTOE), Basis of Issue Plan (BOIP), the Qualitative and Quantitative Personnel Requirements Information (QQPRI), and the results of Manpower Requirements Criteria (MARC) studies (see Army Regulations 71-2 and 570-2, and TRADOC Regulations 71-15 and 71-17).

Yet, by the very nature of processes that govern the development of concepts, the URS development process must be a creative act oriented toward the future, and relatively unconstrained by regulations and doctrine that prescribe how to organize and use "available" resources. The URS development process must portray an objectively derived design for "future" battles that may employ resources and doctrine that do not now exist.

The process that currently exists to develop a URS is designed to facilitate a search for innovative solutions to unit design issues. After HQ TRADOC initiates a major combined arms force structure study, the Current Forces Directorate (CFD) at the Combined Arms Combat Development Activity (CACDA), Fort Leavenworth, acts as the study agency. CFD-CACDA convenes a series of action officer workshops for the combat developers responsible for the functional areas incorporated into the mission of the unit to be designed or redesigned. With guidance provided by CFD-CACDA and the subject matter experts from the responsible TRADOC schools and centers, new design concepts are repeatedly revised and finally integrated into one URS. Then, the URS undergoes a lengthy review and revision process until it gets approval by HQ DA.

While "The Process" works, it is hindered by the absence of an explicit methodology, i.e., tools or aids that could facilitate the process. Consequently, it is much less efficient than it could be. Incorporated in the process are the experiences and traditions of the combat developers who participate in the process. In other words, the process by which these designs are conceived is peculiar to each combat developer. As a result, repetitive communications among decision nodes are required before various portions of the design can be integrated into one URS. The process is similarly hindered as the URS moves through the review and approval chain. This lack of efficiency in the URS development process is further confounded by the fact that the time available for the process is generally quite limited. Furthermore, there is no procedure or requirement for maintaining an audit trail. Consequently, independently convened URS development teams could each create perfectly valid designs that differ in substantial ways from each other, without anyone being able to determine what differences there may have been in the design rationale that caused the designs to be different.

Army Need

The need therefore exists to standardize the current process and make it work more effectively, efficiently, and reliably.

(1) A standardized process will drive and control the development of a URS. Once the process is in the hands of the study agency at the CACDA integrating center, the study manager

will be in a position to be proactive rather than reactive in the guidance given to subordinate schools and centers.

(2) The rapid pace of changes in mission requirements, high technology, and equipment and personnel assets has produced a high workload for force designers. Over the past several years, TRADOC has had to design or redesign over 300 TOE units per year and for each unit up to three URSs have been created. There is good reason to believe that the numbers of unit design programs will grow rather than shrink, and that the number of authorized designers will shrink rather than grow.

(3) There is a movement to centralize the TOE documentation process. Now, the same combat developers who create the URS subsequently document the TOE. If the latter process is centralized it will be critically important that the URS be completed in a manner that permits the combat developer to control the formulation of the unit -- to insert their design intelligence -- because a different agency will do the documentation.

Solution

Our approach to addressing this need was to develop a user-oriented, computer-assisted methodology that would address three basic components of the current URS development process. These components became subsystems of the overall methodology. They address, respectively:

(1) The need to insure that the unit design process is driven by the unit mission;

(2) The actual design of a structured unit up through company level, with its required assets; and,

(3) The need to verify that the designed unit does have the capabilities required.

Procedures

We have been fortunate in acquiring the guidance and direction of an excellent proponent. Working with and through the force design community at CACDA, we have interfaced with force designers at all TRADOC schools and integrating centers, and have benefited from their reactions to our developing methodology. Finally, we were able to maintain a close and mutually productive relationship with the Organization Directorate at HQ TRADOC to insure a fit between the SORD methodology and those processes that build on a URS to document a TOE unit.

It was necessary to undertake an ambitious research task to develop a useful computer-based methodology. After developing a macro-model of the URS development process, we developed and

verified design specifications, and created and demonstrated rapid prototypes of computer screens. As the various utility and other functions were coded, we demonstrated, verified, and refined successive prototypes of the methodology on the basis of feedback received from the proponent and user community. A pilot test of the complete methodology was conducted at Ft. Leavenworth under the sponsorship of the Current Forces Directorate.

After making refinements to the software and user's manual based on the results obtained during the pilot test, the SORD methodology was field tested in January, 1989. There were six players in the field test whose experience with personal computers and with the unit design and documentation processes ranged from zero to over 10 years. Each player used SORD to design two units from scratch. Collectively, a total of six different types of units were designed ranging in complexity from a headquarters and headquarters company of an armored brigade through an air defense artillery weapon firing battery to a personnel service company. After some fine-tuning based on results from the field test, the SORD methodology and a user-verified user's manual were handed over to the government in February 1989.

Since then, TRADOC has funded development of SORD Version 1.5, which was fielded to selected TRADOC facilities in January 1990. Presently, TRADOC has allocated funds for SORD Version 2.0 which will incorporate some additional fine-tuning of the software and will also address changes in the methodology driven by feedback from the user community. SORD Version 2.0 is scheduled for fielding throughout the Army in January 1991.

THE SORD PROCESS

Computer Hardware Requirements

The equipment required to operate SORD is an IMB-PC, IBM-XT, or compatible personal computer. The computer must have a hard disk drive with at least 5 megabytes of memory, 640 kilobytes of system memory with 560 kilobytes free, and a graphics board with a resolution equal to or compatible with a color graphics adapter. The printer must have graphics capability; a graphics capable dot-matrix printer will be adequate if it is accompanied by a program which will convert screen graphics into a graphics form for the printer.

Assumptions and Conditions

The point that must be stressed here and elsewhere is that while SORD will create a standard structure in which a combat developer will design an Army unit, SORD cannot be used as a substitute for the thought processes of an experienced unit designer or, at least, an experienced combat developer. The

following conditions both drove and constrained the development of the SORD methodology.

(1) The user of SORD is an 03/04 branch-qualified commissioned officer or a civilian with comparable military knowledge and experience. SORD further assumes that the user has access to and is aware of sources of information that are required to develop a URS. In short, SORD assumes an expert user.

(2) SORD assists the expert user in moving in one standard and manageable step at a time, from the receipt of a unit's mission through to the printout of a completed URS report. During the process, SORD gives appropriate structured guidance through the use of probe questions, keywords, examples, and other prompts. Throughout the process, SORD provides a pre-formatted working file in which the user will record inputs to the development of the URS. When the URS is completed, the user will also have recorded a complete audit trail so that others will be able to reconstruct each step of the development process.

(3) SORD is generally a serial process, but one that maintains specified elements of flexibility. The user may skip some steps in the process and come back to them after finishing other steps. The user also is allowed the flexibility to review at any time steps already completed in the process. Most importantly, SORD is transportable; different components of the SORD process may be performed, sequentially or simultaneously, by several geographically dispersed individuals.

(4) SORD is fast. A guiding rule in the development of the SORD methodology was that it is better to have an 80 percent solution in hours than a 95 percent solution in weeks. The speed at which SORD will permit the development of a URS is, of course, a function of the extent to which the user has relevant experience and access to pertinent information. The objective is that an experienced user working full time should be able to produce 5 or 6 versions of a particular unit in 3 to 5 days.

The Process

The flow diagram in Figure 1 shows the three major components of SORD, the Mission to Function System (MFS), the Unit Design System (UDS), and the Design Evaluation System (DES). As can be seen in Figure 1, SORD also incorporates a Crew/Cell Database, and a report producing module. Each of these components of the SORD methodology will be described in succeeding sections.

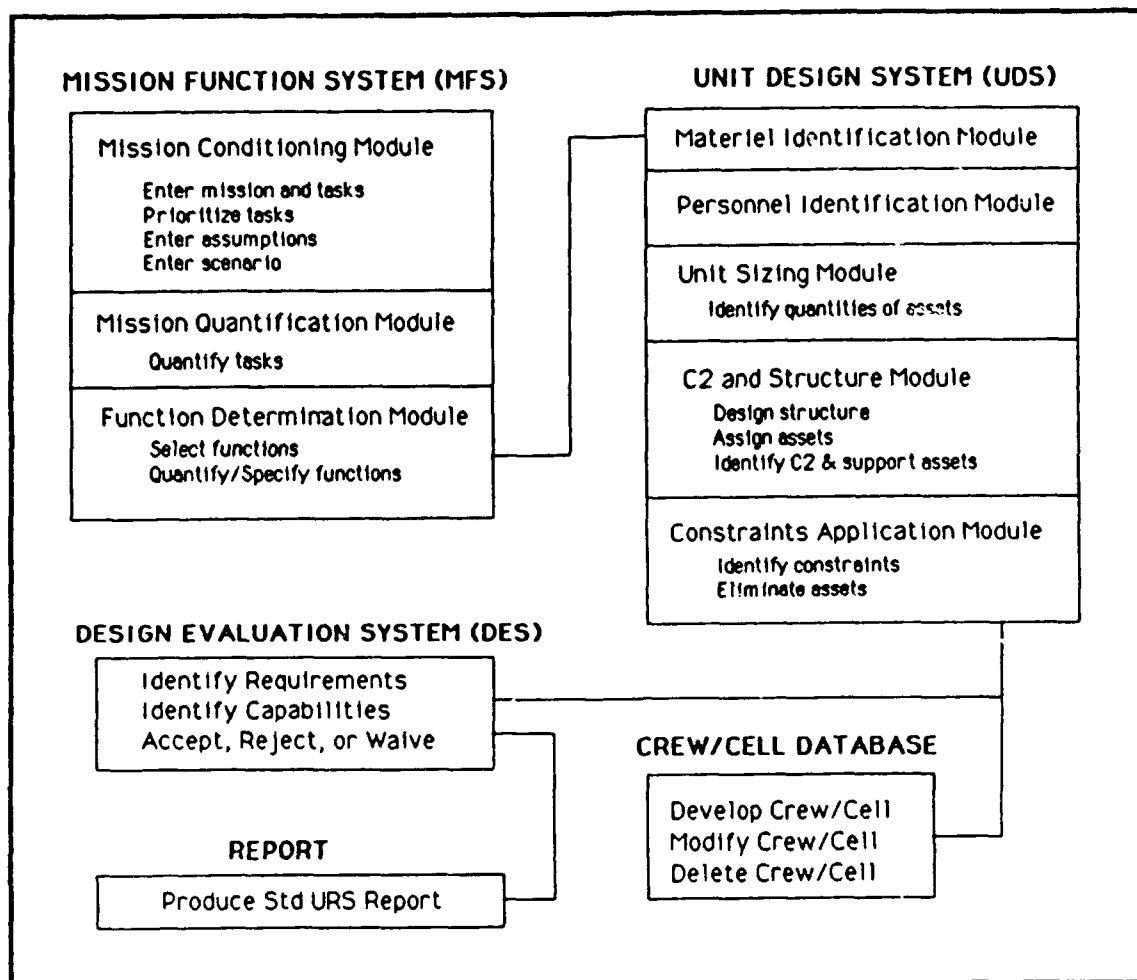


Figure 1. A flow diagram showing the components of the SORD methodology and the possible transition among these components.

Mission to Function System (MFS)

The mission to function system is designed to ensure that the unit's design is driven by its mission. This requirement is one of the weaker steps in the current URS development process. Presently, mission analysis is often derived in an unstructured, subjective manner from information contained in concept papers and doctrinal literature. Furthermore, the results of a mission analysis are rarely as quantitative as they should be. This step in the design of units (in which mission requirements should be designated and translated into quantified statements of required functions and subfunctions) is probably the largest source of variation in URSs produced by different combat developers. The MFS contains three modules.

The first module in this system, called Mission Conditioning, is designed to insure that the mission to be accomplished contains all its required components or tasks and that the user fully understands the unit mission and its related context. The system prompts the user to create an organized database, worksheet, or schematic that will be used to define the unit's required capabilities. Specifically, the system offers suggestions on the type of information that is important and where to locate it. This information includes the concept of operations, area of operations, and threat specifications, much of which may be included in a standard scenario. A record is created to document the precise source of this information, to include personal, unpublished sources (e.g., a local "expert"). Upon completion of this module, the user has a clear, documented expression of the unit mission, the mission conditions, the assumptions made, and a prioritized task list.

The second module, called Mission Quantification, prompts the user to provide short answers to a series of questions keyed to each task of the mission. The user will have to "look up", calculate, or otherwise formulate the answers to these questions in the process of quantifying or specifying the key attributes of the mission. The questions address unit capabilities such as: "How much?, how far?, how fast?, how long?, and how accurately?" The user may ask, then answer a question not given by the system to further quantify an important attribute of the mission.

In this and other components of SORD, the user may freely move among modules and steps within a module until required data (i.e., inputs) become available. The user may also default a question or probe; some broad attributes may defy quantification or specification or simply not be applicable for a given mission or task. Upon completion of this module, the user has a collated list of the composite requirements for each task of the mission.

The third and last module in MFS, Function Determination, assists the user in partitioning each mission task into the functions and subfunctions required for accomplishment of the task. For the purposes of the URS, it is sufficient to partition each task into up to 19 functions, where the functions are defined by seven action verbs and some direct objects of the verbs. These generic functions are all inclusive and capable of capturing the actions required of any type of unit. Then, by working through a different but similarly structured and menu-driven worksheet for each of the applicable functions, the user will further specify and describe the functions that must be accomplished if the mission is to be successfully accomplished. For example, if a function of the unit is "to move cargo," the user could specify function attributes such as what types of cargo (bulk, fuel, or water), how it is to be transported (foot, ground, air, or water), and over what distance (less than 3 km, 4 - 10 km, or more than 10 km).

After completing the three modules contained in the MFS, the user has documented the results of a mission analysis that

specifies, down to the function level, the precise requirements that must be fulfilled by the unit. Given this information, and the experiences acquired in the process of documenting it, the user is ready to actually design the unit.

Unit Design System (UDS)

The unit design system will aid the user in designing a structured unit comprised of the appropriate numbers and types of major materiel and personnel assets required to accomplish the mission. Basically this is done by matching functional requirements of the mission with the capabilities of key materiel and personnel, and then sizing out the unit and organizing it into a structured entity.

The UDS consists of five modules. The first two modules, Materiel Identification and Personnel Identification, operate in a similar manner to assist the user in identifying candidate materiel systems and soldier specialties to be used in the unit to perform the functions previously specified. Currently, the user must have access to and manually input to SORD information on potential materiel and personnel assets. For example, each member of a particular class of tanker trucks can transport 2500 gallons of fuel and a trailer mounted storage tank can hold 600 gallons. Or, two military occupational specialties (MOS 76Y and 77F) have the capability to satisfy a mission requirement for receiving, storing and processing fuel.

Once candidate materiel systems and personnel have been identified, their relative capabilities must be matched against the mission requirements. In the Unit Sizing Module, SORD will assist the user in assigning the necessary numbers and types of candidate materiel systems and personnel to the unit. SORD reminds the user of any unassigned candidates and makes available any of the information previously input into the working file. For example, the user may designate that a specific number of 2500 gallon tanker trucks are required to move a required volume of fuel under conditions specified in the mission scenario; SORD would remind the user that 600 gallon fuel tanks carried on trailers also had been identified as satisfying the requirement to transport fuel.

The Command and Control (C2) and Structure Module assists the user in creating an organizational structure for the unit, and in assigning additional personnel and materiel to satisfy requirements imposed by command, control, and other support functions. There are two submodules. The Structure submodule prompts the user to review relevant doctrine, concepts of operations and other documentation to identify any guidance that may suggest how personnel and materiel assets could be organized. For example, organization guidance generally recommends symmetry in structuring a unit; like elements have the same number and types of assets. Then, working from the lowest level organizational elements, the user names an element and assigns

assets to it. The process is repeated until all lowest level elements have been named and all assets have been assigned. SORD will keep track of and display assets not yet assigned. Once all the lowest order elements have been defined, the user is guided into naming the next higher-order elements and assigning to them lower level elements.

The C2 Submodule starts with the assignment of C2 personnel to the lowest level elements of the unit and moves up through higher level elements. SORD presents to the user the grade structures recommended for each element (based on guidance in the AR 611 series). For example, a typical infantry platoon is authorized a platoon sergeant and an infantry company, a first sergeant. Finally, the user will be encouraged to determine if any of the C2 or support assets added to the unit call for the assignment of additional assets (e.g., a vehicle for the first sergeant).

The last module in the unit design system, called Constraints Application, permits the user to determine if the unit, as tentatively designed, has exceeded any materiel or personnel constraints that had been imposed. If so, the user is directed to AR 310-31 for guidance in TOE reduction. SORD also will display tasks that were previously rated as having the lowest priority for the unit. After reviewing these materials, the user will select specific assets to be eliminated from the unit design. At this point, a unit will have been designed that possesses the assets required to accomplish its assigned mission.

Design Evaluation System (DES)

The last major component of SORD, the design evaluation system, will aid the user in assessing and verifying that the capabilities of the unit designed in the UDS will match the mission requirements that were determined in the MFS. The DES also will maintain a file of all unit designs (including alternative designs for a specific set of mission requirements) and provide a format for report generation.

Two key terms to note here are verify (as opposed to validate) and capability (as opposed to effectiveness). At this stage in the CBRS it is necessary only to confirm that the mission requirements, derived in the top-down MFS process, are matched by the capabilities of the designed unit, derived in the bottom-up UDS process. Also, at this stage in the CBRS, it is necessary only to address the aggregated capabilities of the materiel and personnel assets that were organized into the designed unit. It would be premature at this point, and not cost effective, to attempt to validate the actual operational effectiveness of the designed unit. These steps are more properly assigned to wargaming exercises.

SORD will assist the user in comparing the capabilities of the designed unit and the requirements for each function within

each task of the unit mission. The unit's capabilities and the mission requirements are presented side-by-side on the computer screen to facilitate these comparisons.

After examining the capabilities and requirements for each function, the user must accept or reject that aspect of the proposed design. As an intermediate action, the user may wait, but flag that particular feature of the unit design for additional scrutiny by indicating that there is either an over or under capacity designed into the unit for a particular function. Some mismatches between requirements and capabilities may lead the user to consider redesigning the unit, or reassigning a function to a higher, supporting, or supported element. The rationale necessary to support or clarify any decision can be recorded in a memo field for later reference.

Once the user has completed reviewing and acting on all the comparisons of capabilities and requirements, he or she can store the entire working file for that design exercise into a history file for later reference, or instruct SORD to prepare and print a report based on information contained in the history file. All the information used in developing the unit design, including sources of data and rationale for decisions are available in the file for later examination.

Crew/Cell Database

The Crew/Cell Database is a component of SORD that can be used to develop crews or cells of personnel and materiel assets. The idea behind this database is that there will be specific clusters of assets that will be used repeatedly in designing different elements within a unit and also across different units. The crew/cell database will permit the user to develop such a cluster of assets and then store that information. Once stored in the database, the assets that define a crew or cell can be called up and used at several points in the UDS.

SORD treats a crew and a cell differently. A crew is defined by SORD to be a group of personnel that are employed in conjunction with a particular materiel system (e.g., a M109 155-mm self-propelled howitzer); if that system is assigned to a unit while the user is in the UDS, SORD can automatically call up and include the crew of the system into the personnel assets file for the unit. On the other hand, SORD defines a cell as a cluster of personnel that perform a function within a unit but are not linked to a particular materiel system (e.g., an S1 section of a headquarters and headquarters company). When operating within the UDS of SORD, the system will prompt the user to include as appropriate any cells that had previously been developed and stored in the database.

Report Generator

At present, SORD has the capability to generate a single, standard formatted URS report only. This feature of SORD can be upgraded to permit the production of a variety of customized reports. Exercising this option in the main DES menu will call up a computer screen that prompts the user to provide information for the report title page, such as the title, proponent, author, editor, reviewer, and date of creation. Once this information is provided, SORD will complete and generate the entire URS report. The report can be produced either on the screen or on paper.

CONCLUSIONS

Summary

The SORD methodology is a user-oriented, computer-assisted tool that addresses three basic components of the unit design process: (a) insuring that the unit design process is driven by the unit's mission; (b) designing a structured unit with all its required materiel and personnel assets; and (c) verifying that the designed unit does have the capabilities required to accomplish its mission.

SORD assists the unit designer in preparing a standardized unit reference sheet. SORD does not replace the experienced unit designer; it is not an expert system that employs artificial intelligence. SORD does not alter the unit design process; it makes that process more efficient and reliable.

Benefits

(1) SORD will permit the rapid development of alternative conceptual designs and the efficient transfer of those designs to others in the combat development process and to those who are responsible for the prescribed and increasingly automated process of preparing organizational documentation.

(2) Because of the thoroughness of the designs it helps to create, SORD will, in most instances, eliminate the need to develop an Automated Unit Reference Sheet in the process of developing draft TOEs.

(3) SORD will permit the centralization of TOE documentation within the Army. Such a realignment will result in substantial personnel and monetary savings.

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