

useful as a safety design aid. Various changes in operation and alternative equipment designs may be rapidly evaluated.

References

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Design and Implementation of an Integrated Information System

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IN this note are described the elements that comprise the Army's Integrated Information System. It is being designed and developed in the context of the Army's goal to promote maximum information exchange on a timely, relevant, and economical basis. The incentives that activate this information network are "1. The need to store and retrieve the results of research and development. 2. The need to protect the investment in information. 3. The need for better management of research and development efforts. 4. The requirement for national survival."¹ The systems are designed to store and retrieve various data generated by Army research, development, test, and evaluation (RDT&E) activities, including document references. There are a number of different data files being developed and others are in the planning stages. The five main data files are Technical Effort Locator/Technical Interest Profiles (TEL/TIPS), Technical Information Functions and Activities (TIFA), Research and Technology Resume (DD Form 1498) Reporting System, Document Control Data - R&D (DD Form 1473), and Qualitative Development Requirements Information (QDRI). The elements of one can be related to those of another; not only can queries be made of each file separately, but the elements from one can be correlated directly with those of another.

The files are designed to permit machine retrieval of various combinations of data elements to answer specific queries. The several data files, which are in either development or planning stages, and the major contributions of each to the total information system are shown in Fig. 1 and summarized as follows.

Data Files

TEL/TIPS

The TEL/TIPS file^{2,3} contains a number of statements concerning the education, capabilities, accomplishments, and subject interests of nearly 14,000 individuals in the Army Research and Development community. It is structured to permit identification of personnel in certain programs. For example, officers participating in the R&D Specialist Program are identified by a special character coded into their profiles. It is not used as a personnel file in the sense that individuals are selected from it because they possess certain job qualifications, but rather it is used to profile organizations based on

their assigned personnel. It defines information needs of individuals and outlines information system requirements. One of the systems being considered would relate the subject interests of individuals in the file to descriptions of newly completed technical documents. Another product of the interaction of the TEL/TIPS file with another file could produce technical manpower distributions for different work units, subject disciplines, or geographic locations.

TIFA

The TIFA file^{2,3} contains descriptions of data holdings and the technical information functions being performed at various Army installations, and the place of the functions within their respective organizations. Its elements may be related to elements in the TEL/TIPS file and may be used to determine data holdings in relation to elements in a file of work units. Holdings in the TIFA file have been described in terms found in the "Army Vocabulary of Technical Descriptors." Thus data holdings may be related to proposed or ongoing work at a location.

Funding data

This file describes the funding of the various Scientific and Technical Information (STINFO) activities and relates directly to the TIFA file.

DD Form 1498 reporting system

Form 1498 reports research and development work at the unit level. All RDT&E activity, over which the Department of Defense has cognizance, is reported on these forms to the Chief of Research and Development, Department of the Army.⁴ Army 1498 records have been made machine-readable in order to permit rapid, coordinated searches of the information contained within them. For example, cost of specific activities can be determined and possible duplication of work units can be highlighted. In addition to descriptions of the work being performed, the progress made, the locations at which the work is being done, etc., the form contains keywords that are suggested by the originator of the 1498. These keywords and others chosen from the "Army Vocabulary of

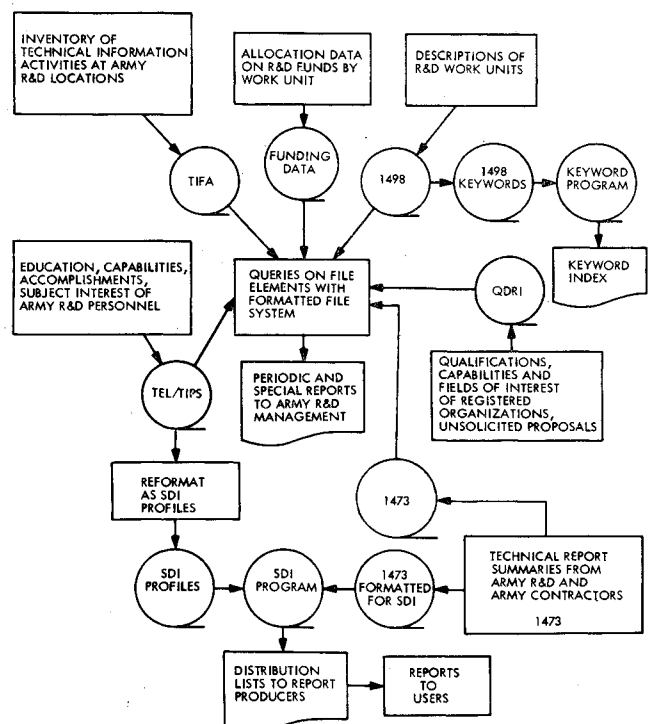


Fig. 1 A schematic of the information system at the present stage of planning and development.

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Technical Descriptors" may form the basis for periodically produced keyword indexes. Several experimental indexes have been produced and are being tested. The keywords in these indexes are organized so that coordinate searches can be easily made from an inspection of the printout. The computer program also will accommodate multiple subject searches of the machine readable file of 1498s. Elements of the DD Form 1498 file have significant relation to elements in the TEL/TIPS file and the TIFA file.

DD Form 1473

The feasibility of a machine-readable file of these records was described by IBM in a study⁵ conducted for the Army Research Office in September 1965. The 1473 form is intended for reproduction as the final page in all copies of technical reports and is required by the Department of the Army and ordered by the Secretary of the Army of all those who perform work under the Army RDT&E program. By definition, a technical report describes in detail the results obtained from the work performed under the Army RDT&E program.⁶ In its machine-readable format the form will become the basis for a Results Data File. This file could be searched by individual or combined data elements including subject keywords. It will be constructed in such a way as to allow it to be used in a Selective Dissemination of Information (SDI) system.

SDI

The purpose of SDI in the context of the Integrated Information System would be to reduce the net delay in transmitting research results from producer to user and at the same time to improve the effectiveness of primary distribution. The SDI system would make possible the receipt by Army R&D personnel of new technical reports in their areas of interest. SDI is conceived as part of a primary distribution service in contrast to the secondary distribution service performed by the Defense Documentation Center. Under this new system, advanced abstracts of documents would be recorded on the DD Form 1473 and sent to the Chief of Research and Development, Department of the Army.⁶ These 1473s would describe reports that were a step before publication. The 1473s would be converted to machine-readable form and then matched by the SDI computer program against user profiles developed from the TEL/TIPS file. Because of the large number of user profiles involved, a clustering technique would be employed to reduce the number of individual profiles matched. Distribution lists would be printed from the matches and sent to the report producer, who would send a copy of the document from the original printing to the individual. In addition, the originating activity would continue to send the usual number of copies to DDC for secondary distribution. A successful application of SDI in the area of primary distribution could reduce the requirement and cost for secondary distribution. The feasibility of the SDI approach for this application was established in September 1965 by IBM under a contract to the Army Research Office.⁷

QDRI

This file contains records of industrial capacity and interests that could support Army R&D activity. Besides identifying capable and approved contractors the file can also be accessed for unsolicited proposals that are received by various Army R&D organizations. Because of the close relationship of the subject matter in this file with that of other files, such as DD Form 1498 and TEL/TIPS, the Army has declared its intention to add it to the Integrated Information System.

Computer Programs

The computer programs that have used or are planned for use in the implementation of the Integrated Information System are all off-the-shelf programs written by IBM. They

include the Formatted File System, a keyword indexing program, and a Selective Dissemination of Information program. Use of tested and proven computer programs has minimized information system development costs. During the initial development of the Integrated Information System the programs have been run on the IBM 1410 Data Processing System. Conversion to the IBM System/360 Model 40 is planned.

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- ³ "STINFO Functions and Activities Data Bank TEL/TIPS Data Bank, Phase II," Final Report, June 14, 1966, IBM Corp., Federal Systems Div., Gaithersburg, Md.
- ⁴ "Research and Development Research and Technology Resume. Work Unit Level," Army Regulation 70-9, (DD Form 1498), May 24, 1966, Headquarters, Department of the Army, Washington, D.C.
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- ⁶ "Research and Development Standards for Technical Reporting," Army Regulation 70-31, (DD Form 1473), Sept. 9, 1966, Headquarters, Department of the Army, Washington, D.C.
- ⁷ "Selective Dissemination of Information Feasibility Study Report," Sept. 10, 1965, IBM Corp., Washington Systems Center, Bethesda, Md.

The Long-Life Spacecraft Problem

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THIS Note summarizes selected investigations of the Martin-Marietta Corporation directed toward the achievement of long-life, reliable spacecraft. It discusses the causes of unreliability of mechanical devices, presents specific design recommendations for selected troublesome components, and describes some employee motivation programs that have aided the production of high-quality hardware.

Design Margins and Mechanical Equipment Reliability

Spacecraft frequently fail long before the expected wear-out and the failure is usually associated with mechanical or electromechanical devices rather than electronic equipment. Our studies concluded that the prevalent cause is inadequate design margin, not discovered and corrected during the hardware development program. Further investigation led to our conviction that mechanical design margins tend to be inadequate because:

- 1) They frequently are not established during early design. The mechanical designer is usually not as disciplined as the electronic designer, who rigorously employs computer-aided circuit analyses, worst-case analysis techniques, and standard derating policies.

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