CORPORATE INFORMATION MANAGEMENT AND THE JOINT UNIFORM SERVICE TECHNICAL INFORMATION SYSTEM (JUSTIS)

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Abstract: Corporate information management is receiving greater attention in connection with interests in reducing resources required to develop and maintain ADP systems or software that meet the same functional requirements. As a major initiative which has been promoted by the Office of the Secretary of Defense (OSD), corporate information management has taken on new and important dimensions. This paper explores some of the challenges, issues, and approaches used by the JUSTIS program office to develop JUSTIS as a corporate information resource. Topics covered include the corporate view which has guided the JUSTIS effort, methods being used to capture the Army, Navy, and Air Force requirement, and products which have been developed which are consistent with the goals of corporate information management.

The Joint Uniform Service Technical Information System (JUSTIS) is a program to improve the management of technical manuals for the Army, Navy, and Air Force. As a tri-service effort, the JUSTIS program is closely associated with the Computer-Aided acquisition and Logistics Support (CALS) initiative. The Air Force, as the executive service for the JUSTIS effort, has used a number of information engineering techniques to capture the tri-service requirement and to describe the technical information management functions throughout the services. The purpose of this paper is twofold. First is to describe the corporate perspective which has guided the JUSTIS effort; second is to describe the methods being used to capture the tri-service requirement and selected products which have been developed in association with the goals of corporate information management.

Corporate Perspective

Managing information from a corporate perspective has recently gained currency with the Office of the Secretary of Defense (OSD) initiative on Corporate Information Management (CIM). From a systems requirements, design, and development view the OSD CIM initiative has promoted a number of goals which parallel those adopted by the JUSTIS program. These include: 1) development of system capabilities which will satisfy the functional requirements across the services; 2) development of uniform and consistent information requirements and data formats; 3) development of a standard and integrated system capability.

The JUSTIS Program Management Office (PMO) has been working to achieve these goals within a framework which emphasizes the need to manage the requirements, design, and development effort. The JUSTIS PMO is using an approach to

corporate information management that recognizes the importance of methods, objectives, functional models, data requirements, current systems analysis, and user involvement.

Methods

To achieve the goals of corporate information management requires the use of a systematic approach to the tasks and activities to be performed and the products to be developed. The JUSTIS program, having its roots in the Air Force Technical Order Management System (AFTOMS) program, has made use of two primary guides to develop management and requirements products.

As background, JUSTIS is a major automation program which is required to develop those products to be reviewed by the Major Automated Information System Review Committee (MAISRC). As a MAISRC program, the products developed under JUSTIS include: operational requirements documentation (Joint System Operational Requirements Document), functional requirements documentation (JUSTIS Functional Description), feasibility studies (AFTOMS Feasibility Study; AFTOMS Technology Issues and Assessment Report), economic analyses (JUSTIS Economic Analysis), and Communications-Computer System Program Plans (CSPP). As a management approach to system acquisition, the MAISRC products are developed in accordance with the methods and procedures prescribed by the Department of Defense (DoD) and Air Force. As methods and procedures, DoD and Air Force instructions, directives, and regulations provide a foundation for the development of system documentation which is used for management and requirements purposes.

Focusing on requirements, the JUSTIS program has followed an approach to capturing automation requirements which is consistent with the products required for MAISRC review. The approach emphasizes the development of products which are useful for design, development, and program management. Figure 1 illustrates the approach being used on the JUSTIS program to achieve the goals of corporate information management. The approach focuses on four major topics and four major views. As a conceptual framework, this approach borrows from discussions on architectures (Zachman, 1987, 1989; Skriletz, 1990; Coleman, 1989, 1990) and data administration (AFLCR 700-6).

	DATA REQUIREMENTS	FUNCTIONAL REQUIREMENTS	LOCATION	PROTOTYPES
CONCEPT PHASE	HIGH LEVEL CONCEPTUAL - ERD	ENTERPRISE/ACTIVITY MODEL	SITES/LOCATIONS	POC
DEFINITION PHASE	DETAILED CONCEPTUAL MODEL - ERD	PROCESSES STRUCTURED ENGLISH DECISION TREES	ORGANIZATIONS	DEMO
LOGICAL PHASE	HIEARCHICAL NETWORK RELATIONAL	TRANSACTIONS STRUCTURE CHARTS PROGRAM DESCRIPTION	LAN/WAN CONFIGURATION	RAD RAD
PHYSICAL PHASE	FIELDS ADDRESSES PERFORMANCE TUNING	PROGRAM CODE	WIRE/PROTOCOLS	RAD

Figure 1: Framework for Information Management

The application of the framework suggests that, at least, four topics are of interest in connection with developing useful information for a corporate automation effort. Focusing on the columns in Figure 1, the framework suggests that JUSTIS, is concerned with developing information about data, functions, locations, and prototypes. In addition, the framework shows a number of views connected to the topics. These include: conceptual ("ballpark"/owner), definition (designer), logical (builder), and physical (e.g., programmer). Finally, in terms of products, the approach illustrates that a number of products must be developed to manage the JUSTIS requirements, design, and construction efforts. These include models which are independent of software and hardware considerations (conceptual and definition) and those which are dependent on software, hardware, performance, and distribution requirements (logical and physical).

As a final note on the approach, the framework suggests that proof-of-concept (POC), non-operational/operational demonstrations (DEMO), and rapid applications development (RAD) can play a role throughout the requirements, design, and development lifecycle. As illustrated by Rothenberg (1990), early prototypes of system capabilities can be cost effective for improving technology transfer, involving end-users, evaluating technical feasibility, and validating the abstractions inherent in the conceptual views of automated systems. The JUSTIS PMO has built a number of early prototypes to achieve these purposes. Knowledge gained has shown the technical feasibility of the system concept and has provided an opportunity to explore the types of business rules and practices that must be embedded in the system to achieve our objectives. Additional prototyping is anticipated in connection with the refinement of specifications, rapid development of applications, and achieving JUSTIS corporate automation goals.

Objectives

As part of the framework for developing JUSTIS under MAISRC guidelines, the JUSTIS PMO has captured user information on objectives and required system improvements in the JUSTIS

Functional Description and other program documentation. Focusing on objectives and their relationship to corporate information management, a number of specialists in the system requirements and design area (Howe, 1985; Martin, 1983; Hammer, 1990) have noted that one of the reoccurring themes for the successful design of data processing systems is to capture not only the existing procedures within the enterprise but, also the procedures that should exist within an enterprise. Hammer (1990), for example, writing on reengineering states:

In short, a reengineering effort strives for dramatic levels of improvement. It must break away from conventional wisdom and the constraints of organizational boundaries and should be broad and cross functional in scope. It should use information technology not to automate an existing process but to enable a new one.

Recognizing that enabling new processes can be a very complex business, the JUSTIS PMO has relied on analysts familiar with existing/emerging technologies and user representatives from across the Army, Navy, and Air Force to develop objectives in conjunction with the development of functional requirements. Figure 2, for example, shows some of the system improvements which users have identified over the course of the tri-service effort. As illustrated, some of the improvements deal directly with information about technical manuals; some deal exclusively with information contained within technical manuals. Interestingly, some goals dovetail nicely with the standardization goals of corporate information management.

- Provide On-Line Information Access for Mgt. Decision Making
- Simplify TM Requisition Process
- Reduce Need for Physical Storage Space
- Reduce Time Needed to Process Routine Changes
- Incorporate IETM Technology
- Standardize Technical Manual Formats and Procedures

Figure 2: JUSTIS System Improvements

The JUSTIS PMO is also working with policy personnel from the Army, Navy, and Air Force to resolve the inevitable policy questions that arise in connection with enabling new processes. As a formal working group, policy representatives from across the services have been working the organizational infrastructure required to support the automation of technical information processes and other issues related to JUSTIS automation objectives.

Finally, it is perhaps noteworthy to suggest that a number of techniques have been applied to determine consistency of objectives in relation to functional requirements. For example, requirements matrices have been built to show the testability of objectives. Furthermore, objectives have been mapped to functional activities to reconcile the objectives against the functional models.

Functional Models

Top-down modeling techniques have been used to develop three types of functional models included in the JUSTIS Functional Description. The JUSTIS FD contains models of current functional activities; proposed functional activities; and functional requirements which must be supported by JUSTIS. Making use of representatives from the Army, Navy, and Air Force, the JUSTIS PMO has used working groups to develop each of these models. Since the Air Force functional models were developed prior to the participation of the Army and Navy, these functional models were used to leverage the development of functional models for each of the services.

Functional models which describe existing functional activities have been built using techniques connected to the Integrated Computer-Aided Manufacturing Definition (IDEF) language. As descriptive material of the current/existing functions, working groups made use of IDEF techniques to describe functional tasks and to identify the inputs, outputs, controls, and mechanisms associated with the performance of functional tasks. Following the development of functional models for each service, the JUSTIS PMO in concert with the working groups also developed a composite functional model as an initial step towards integrating the functional activities across the services. This composite model is shown in Figure 3 as a hierarchy of key areas and tasks.

Figure 3: Composite Hierarchical Model

In addition to the hierarchical representation of the composite model, IDEF0 models have been developed to show the functional relationships between tasks. As a composite model, the IDEF0 functional representation was built by making use of the inputs, outputs, and controls connected to each of the individual service models for the functions. The major task was the reconciliation of inputs, outputs, and controls used across the services.

In terms of proposed functional activities, this functional model was developed in conjunction with the development of the composite functional representation. Two techniques have been used to identify the proposed functional requirements. The first technique used was to identify from the IDEF0 representation which inputs, outputs, or controls required automated support. This user view of the inputs, outputs, and controls to be automated indicates whether the input, output, or control should be either fully or partially automated under the JUSTIS. The second technique used was to decompose the tasks to activities and to develop process flow diagrams (dependence diagrams) to show the relationships between the activities. This technique was used to identify over 300 activities which are related to the performance of technical information management functions.

As an additional representation of automation requirements, users have developed textual statements of their requirements in relation to the process flow diagrams. Examples provided below are from the functional area dealing with the control of publication numbering and indexing.

a. Validate Publication Numbering Request. This process requires support of the ADS to assist in the validation of a request for a publication number per a publication numbering request, request to rescind TM and data found in the rescinded TM review list reply. The ADS must allow a request for a publication number to be received from all authorized users. Requests must be routed to the appropriate OPR for evaluation. Requests received in hardcopy must be input to the ADS by converting to digital format. The requests will be loaded on the ADS as publication number data.

b. Update Status. This process requires that the requester of a publication number be kept informed of the status of the request. To accomplish this task, the ADS must support on-line queries of the status of the request. In the event that the ADS is not directly available to a user, notification must be made with hardcopy.

In connection with the development of the three models, Army, Navy, and Air Force working groups have participated in the development, review, and validation of all functional models shown in the JUSTIS FD. Working groups from each of the services have contributed to the development of this functional requirement and have been charged with the responsibility to

assure that the requirements are complete, appropriate, and representative of their needs. Additional work is underway to move the user view of the JUSTIS to a design view through the development of additional process models and data models which are extending and validating the work accomplished by the tri-service working groups. The working groups will also be involved in the review and validation of these products.

Data Requirements

Perhaps one of the most visible characteristics of a corporate information management approach is the concern with the development of data requirements and data models. To achieve corporate information management objectives, the JUSTIS PMO is performing data administration tasks and developing data models. Data administration tasks are being performed to capture data requirements for each service; data models are also being developed for each service. In addition, data administration and modeling tasks are being performed to develop an integrated data model which will describe the DoD wide data requirement which is connected to the management of technical information. The JUSTIS PMO, in concert with the Army, Navy, and Air Force functional users, is making use of both top-down data modeling techniques and data domain techniques to describe the data requirement.

Using top-down data modeling techniques, the Air Force has developed an information model which is being used as a conceptual model for the development of the Army, Navy, and integrated data models. As an example of the information modeling which is being performed, Figure 4 shows a portion of the information model which supports the control of publication numbering and indexing across the services.

Figure 4: Portion of Information Model for Control of Publication Indexing

This conceptual model shows a number of differences between the services in relation to indexing by line item number and national stock number (Army), equipment identification code (Navy), and part number (Air Force). In using conceptual/information modeling techniques, the JUSTIS PMO is bringing visibility to both unique data requirements and common data needs.

Figure 5: Technical Information Data Domains

Centering on common data requirements, the JUSTIS PMO has made use of the idea of data domains to focus the Army, Navy, and Air Force data administration and modeling efforts. As shown in Figure 5, there are three broad domains which must be supported by the JUSTIS: publications, operational, and decision support.

As a program under the CALS initiative, the publication domain is concerned with the exchange, receipt, storage, and management of technical manuals. As defined by the services JUSTIS must support the management and distribution of technical manuals in three distinct forms:

- Paper TMs (Type A). These technical manuals are hardcopy products. JUSTIS will manage the prepublication, publication, reproduction, inventory, and distribution of paper TMs.
- Page-Oriented Digital TMs (Type B). The first type of digital TM handled by the JUSTIS is primarily page-oriented. JUSTIS will store digital TMs on magnetic, optical media, and/or other state-of-the art media. Page-oriented TMs may be stored as raster images, and/or other MIL-STD-1840A compliant formats.
- Nonpage-Oriented Digital TMs (Type C). The second type of digital TM handled by the JUSTIS is nonpage-oriented TMs. These TMs are also stored on magnetic, optical, and/or state-of-the-art media. These types of TMs will be delivered and stored in accordance with the specifications and standards on interactive electronic technical manuals (IETMs).

From a JUSTIS view, the receipt and management of Type B and Type C manuals is common across the services and will be made in compliance with military specifications and standards. These include the standards related to mark-up, imaging, vector graphics, and interactive electronic technical manuals (IETMs).

In addition to the publications domain, the Army, Navy, and Air Force have also identified the requirement to support the receipt, storage, creation, and maintenance of information about technical manuals. Generally known as technical manual management data, the JUSTIS PMO in concert with the services has separated management data into two domains.

The services have identified the information which they exchange or use on a day-to-day basis in support of their technical information management tasks. As operational data, users have identified those forms, reports, transactions, and files which are used to carry technical information management data. Figure 6 illustrates some of the operational data requirements in connection with processes to be supported by the JUSTIS.

TM Operational Data	Reoccurring Activities
AFTO 22 TPDR DA 2028	• Create Improvement Report • Prepare Reply to Improvement Report
AFLC 189 TMNR	• Request Publication Number • Validate Publication Number Request
DA 4569 DD 1348 AFTO 187	• Requisition Technical Manuals
AFLC 252 Source Data Pkg.	• Record Publication Changes • Develop Technical Manual Revisions/Changes
DD 1423	• Prepare Contract Data Requirements List (CDRL) • Approve CDRL
DI-TMSS-80067	• Receive and Record CFAE/CFE Notice • Retrieve CFAE/CFE Notice by SERD Number

Figure 6: Operational Data and Functional Activities

The last domain of interest to JUSTIS is the decision support domain. This domain includes those products which are used by technical manual managers for decision support purposes. Currently a number of automated systems throughout the services support management information system (MIS) requirements. These requirements include support for summarizing and aggregating information about technical manuals on an ad hoc, scheduled, or exception basis. For example, MIS capabilities to be supported include: monthly, quarterly, yearly summaries of the number of recommended changes received, in-process, or completed; number of technical manuals received on monthly, quarterly, yearly basis; number of requisitions received, in-process, or completed based on selected weeks, months, or quarters.

In relation to our efforts to capture data requirements connected to the three domains, the JUSTIS PMO is currently working all three types of data requirements. The initial focus, however, has been on capturing the operational data requirement across the services. There are two basic reasons for this focus.

First, operational data is usually used to "feed" decision support processing. In connection with corporate information management, the complete understanding of the operational data should lead to eliminating the labor intensive activities currently connected with the reentry of data for decision support purposes. By eliminating this reentry of data, JUSTIS will be able to improve data consistency, detect and correct errors early, and avoid the delays associated with the manual processing of information requirements. Finally, the JUSTIS PMO has also recognized that prototyping techniques are more valuable and cost effective for detailing decision support needs. As Inmon (1989) has suggested, decision support processing tends to change over time and lends itself to quick and heuristic construction.

The second rationale for focusing on the operational data requirement is that Army, Navy, and Air Force functional representatives have centered on this requirement in their functional modeling efforts through the identification and description of the inputs, outputs, controls, and mechanisms connected to functional tasks. In addition, users have identified many objectives related to automating the processes currently accomplished by existing forms, reports, transactions, and files. Following these requirements, the JUSTIS PMO has been working with each of the services to build a data dictionary and detailed data models of the operational data.

Making use of data administration techniques and data modeling procedures, the JUSTIS PMO is capturing descriptive information about the operational data found on documents which are used on a daily basis. The metadata being captured is used to determine common data requirements across the services and to identify unique data needs. Functional users have been involved in both the capture and validation of their data requirements. In addition, data administration efforts have also focused on capturing the business rules and practices connected to the use and creation of operational data.

These efforts are all intended to promote the standardization of information requirements and data formats across the services. In addition, the intent is to build a normalized data structure of the operational requirement which will promote the modular development and integration of JUSTIS capabilities, improve reusability of JUSTIS modules, and support the maintainability of the JUSTIS configuration.

Current Systems Analysis

One of the elements of corporate information management which does not receive much attention in connection with the use of top-down information engineering or systems analysis techniques is the analysis of legacy systems. Throughout the DoD, many current systems support the performance of technical information management tasks. In connection with this, the JUSTIS PMO, in concert with the Army, Navy, and Air Force users, has begun to analyze those electronic publishing systems

(EPS) and automated data processing (ADP) which support technical information management functions. Provided below is a discussion of the approach used to catalog, profile, and assess the DoD systems which support technical information management.

Army and Navy users identified current, planned, and interfacing systems which support their technical information management functions. Systems selected for initial review included EPS which support the creation of technical manuals (new, revisions, or page changes) and ADP systems which support the maintenance of information about technical manuals.

Initially, the Army identified 20 systems to be reviewed in connection with an analysis of the functions to be supported under JUSTIS and the data exchange requirement to be supported as interfaces to JUSTIS; Navy identified 15 systems for this analysis. Data collected on each system was captured in conjunction with site visits, workshops, and collection efforts performed by Army and Navy personnel. Data collected or developed on each system includes:

- OPR: Person responsible for ADS.
- Location: Geographic location of the system.
- Major Functions: Primary functions of the system.
- Major Products: Primary output products of the system.
- Interfaces: Identifies interfaces to other ADS.
- Data/Data Dictionary: Identifies format of data stored and/or status of data dictionary.
- Hardware: Identifies major hardware components of system.
- Software: Identifies major software components of system.
- Planned System Enhancement: Identifies planned improvements.
- Discussion: Identifies major issues, similarity of functions, and/or projected portability problems.
- Recommendations: Statement on whether the system should be interfaced or functionally supported under the JUSTIS program.

In developing the initial recommendations connected to whether systems are candidates for support under JUSTIS or candidates for exchanging data with JUSTIS, three constraints and five criteria were used. The three constraints were:

- a. JUSTIS will not require the services to scrap existing systems.
- b. JUSTIS will not do bulk printing.
- c. JUSTIS will not provide field level user presentation systems (e.g., desktop, portable display devices)

Five major criteria were used in our evaluations of current/planned systems. These criteria included:

- a. Modularity of system application.
- b. Ada support for existing platforms.
- c. Use of DoD approved higher order languages (HOL)
- d. Electronic publishing system (EPS) capabilities and software portability.
- e. Portability of system software at binary, source code, or functional levels.

In terms of portability, the following questions were used in our evaluation of binary, source code, or functional portability of existing applications. Information collected on languages (3GL & 4GL), operating system, hardware, and the use of commercial products was used for this analysis.

- a. Is it likely that the executable code associated with a system could be ported to other platforms (i.e., binary portability).
- b. Is it likely that the source code associated with an existing system could be recompiled to work on other platforms (i.e., source code portability).
- c. It is likely that the functions performed by a system will be similar to the functions to be performed on a JUSTIS platform (i.e., functional portability).

In addition to the portability of application programs, we also considered the portability of database schemas. Information collected on databases, master files, and the availability of data dictionary and system documentation was used for this analysis.

In term of candidate systems, eleven Army systems have been identified as candidates for support under JUSTIS and nine Navy systems have been identified as candidates. These systems currently support a wide range of functions including technical information management, acquisition, improvement, publishing, stock, and distribution. In terms of supporting interfaces to JUSTIS, nine Army systems have been identified as candidates for support of the data exchange requirement; Navy has identified six systems to be supported as potential interfaces to JUSTIS.

In terms of our efforts to develop a corporate solution to the management of technical information, the JUSTIS PMO recognizes that additional analysis of functions, data, and communications requirements are necessary. In connection with this effort, the JUSTIS PMO has been collecting information on data base schemas, master files, and transactions currently supported by existing systems. This effort will lead to the development of both process and data models which will support our corporate information management objectives.

User Involvement

User involvement has been a reoccurring theme throughout our discussion of objectives, functional models, data requirements,

and current systems analysis. In conjunction with the JUSTIS effort, functional representatives from the Army, Navy, and Air Force have been involved in developing, reviewing, validating, and updating system documentation devoted to defining requirements for automated support of technical information management tasks. As a tri-service effort, each of the services have provided valuable insight into the common and unique service requirements.

In noting the importance of user involvement, the JUSTIS PMO has attempted to make effective use of functional representatives with the formation of working groups which have met periodically to discuss requirements, develop the JUSTIS FD, and to define tri-service issues. Throughout this effort, users familiar with policy, functions, and automated systems have been used to aid in the development of requirements documentation. As an adjunct to the working groups the JUSTIS PMO has also performed site visits to Army, Navy, and Air Force facilities to collect requirements data. In addition, structured reviews (walk-throughs) have been performed with functional users to validate data requirements, data dictionary information, and functional models.

In addition to user representatives and working groups, the JUSTIS PMO has also been working with an Infrastructure Working Group on organizational infrastructure and related policy issues that have arisen in connection with the collection of requirements information and the development of the JUSTIS FD. This group has been working issues related to standardization, business practices, scope, technology exchange, and the reduction of redundancy across the services.

Summary

As suggested at the beginning of this text, the goals attributed to corporate information management require a systematic approach to managing requirements, design, and development efforts. In this context, the approach being used by the JUSTIS PMO reflects the concern with capturing information from functional users for inclusion in requirements documentation and the use of a number of techniques to model corporate requirements.

This paper has described one approach to managing the development of requirements which is consistent with the goals of corporate information management. In addition, this paper has described a number of techniques which have been used to build products that capture the DoD-wide corporate requirement for the automation of technical information management tasks. Our efforts provide a continuing challenge and opportunity to increase standardization, improve efficiency, and reduce redundancy across the services.

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