An information technology architecture for change

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This paper defines a technology architecture for information processing in large corporations. It describes a matrix of processing environments consisting of three processing types: production, decision support, and office; three processing locations: centralized, departmental, and workstation; and a methodology for implementing applications in those environments. Key to the architecture is a supporting framework comprising the communications network, a data service function, an office services function, enabling software, and support organizations. This approach is designed to provide an integrated information system to support organizations whose business environment is changing, and where flexibility, responsiveness to change, and cost effectiveness are vital. The approach is representative of methods used by systems engineers in assisting customers to decide on a system configuration that best suits their needs.

Deregulation and other economic factors are causing large banks, like many other organizations in the United States, to face major changes in the way they do business. This situation has forced them to evaluate new approaches in supporting their information processing needs. The current information systems environment at most banks is heavily oriented toward the more traditional production processing systems. Although on-line systems have been implemented to support the retail branches (tellers, automated teller machines, etc.), the system of record data is generally still processed at night by large batch programs, coded many years ago and heavily modified as new products are added.

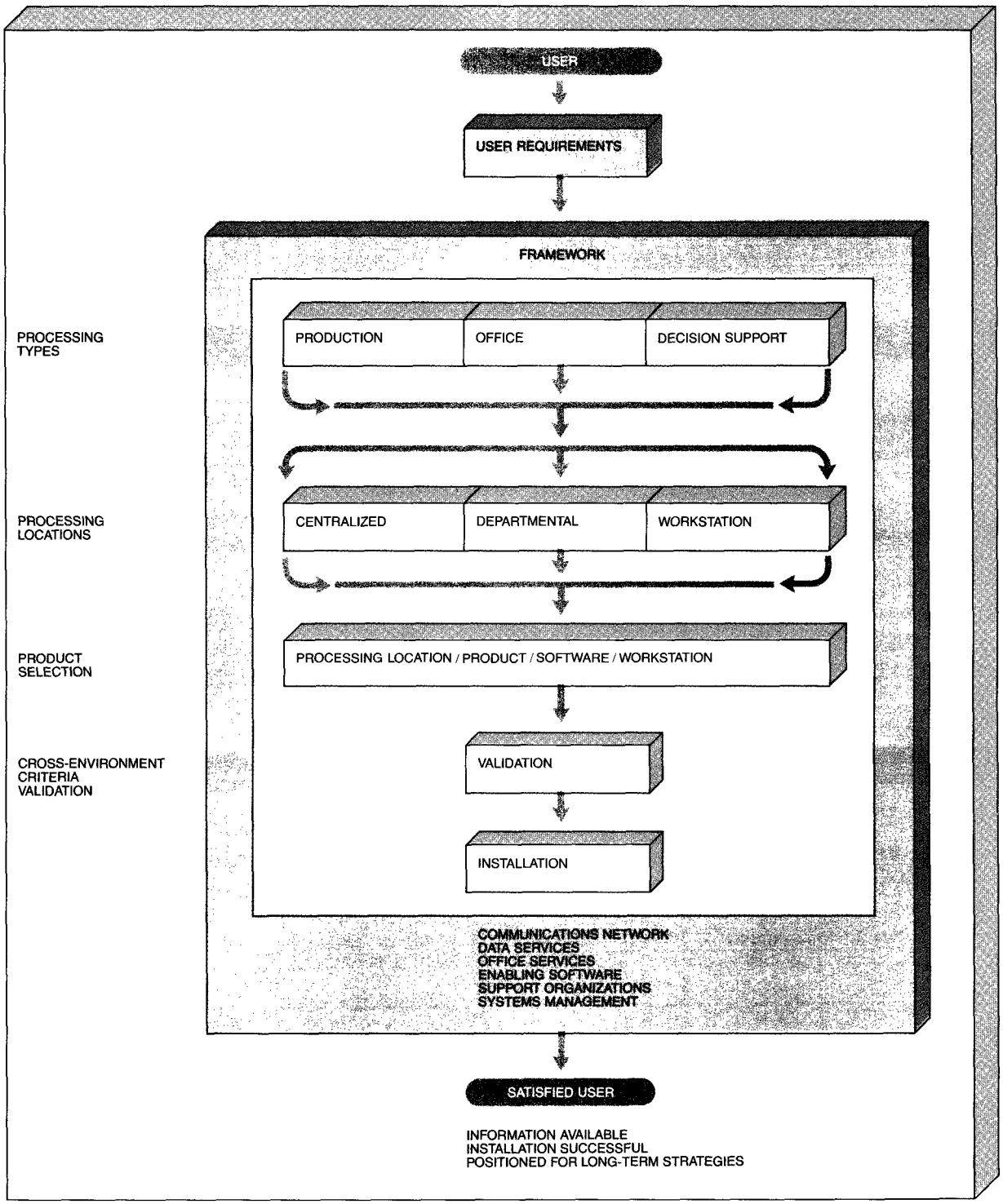
Banking is now a highly competitive industry. New products must be developed and brought to the marketplace quickly. In a manufacturing environment the speed with which a new product can be developed is affected by the time taken to retool an assembly line. In banks, the implementation of a new product in the marketplace is facilitated, or more often inhibited, by the degree of ease with which it can be integrated into existing information processing systems. The same information processing systems hold the key to the development of successful bank products: they allow the banks to have an understanding of their customers and their marketplace. Bank computer systems hold a wealth of information about customers of the banks; the challenge is how to tap those resources.

An Information Systems (IS) Architecture provides a structure for the development and use of applications, data, and information processing technology. This paper describes an approach to implementing the Information Technology component of the IS architecture. Although originally developed for use in a banking environment, the approach is equally applicable to other industries.

The architecture

Given that it is not always possible to predict processing needs precisely, a flexible information proc-

Figure 1 The architecture



essing environment is required that can respond to new business requirements in a timely and cost-effective manner. The approach presented by this paper outlines an architecture consisting of a matrix of processing environments, a supporting framework, and a methodology for identifying the processing types, locations, and workstations for individual applications and end users. The key to the success of this approach is the implementation of the supporting framework, which focuses more heavily on supporting the end user than do traditional information systems. The approach emphasizes the changes that need to be made to provide an end user at any location with the capability of accessing information stored at any level of the information processing system. It is also aimed at enabling that end user to interchange and share information with any other end user at any location within a single interconnected network, and at providing the potential for eventual customer access to data.

A conceptual view of the architecture is shown in Figure 1 and is described in more detail below.

The framework

The architectural framework surrounds the processing environments. It provides the "glue" that holds the structure together. It contains those components essential for the success of any and all applications. At the same time, it is conceivable that no individual application will be able to, nor should have to, justify the cost of any or all of the components.

The communications network. The data delivery system, or network, provides data and access to processing capability for all workstation users. This architecture capitalizes on the Systems Network Architecture (SNA) network technology by extending any current SNA networks to connect all centralized processing systems. This includes a centralized office service system. In this way electronic mail services can be provided to all departments with 3270-type workstations or personal computers currently attached to the SNA network, without incurring significant additional network costs. Furthermore, the SNA network can act as a "backbone" integrating networks which support other requirements such as the X.25 interface or asynchronous dial-up.

Data services. Data services is a component that addresses two functions whose values are beginning to be recognized, but which are still difficult to justify in a quantitative manner.

1. Data Administration—This function manages the current environment. A data directory records the location, format, ownership, security requirements, and other attributes of data entities. This directory is developed over a period of time, focusing on the most frequently requested items first. It is based on an analysis of the existing system of record data files. The Data Administration function controls the extraction of data from the centralized production processing systems into a "data pool," which is then made available to authorized users. Advanced query languages and relational data base systems are installed to facilitate access to the data pool. The existing network is used as the delivery system to end users wishing to download data for manipulation at their workstations.

   This function should not be confused with the traditional Data Base Administration function, which deals more with the physical storage of data on data base management systems such as the Information Management System (IMS). Data Administration encompasses *all* data, including data on sequential tape files, and theoretically even data that is stored in someone's filing cabinet. In practice, however, management is generally limited to machine-readable data.

2. Data Architecture—This function addresses the future data needs of the corporation. Data entities and their relationships are analyzed, and data models are built. Models of the existing production systems are reconciled against the data models that conform to the architecture, and discrepancies are recorded. These processes lead to greater understanding of the information requirements and reduce the possibility of errors when extracting data for summarization in management reports. Future applications can then be designed according to the data models that conform to the architecture; this data-driven approach leads to more stable systems which are easier to modify when functional requirements change.

These functions constitute a pragmatic approach to the problems of information management in large corporations. While in theory it is best to start with a top-down corporate-wide analysis of the data requirements before embarking on the implementation of data directories, data pools, and the like, in practice most companies cannot afford to wait for the completion of this process.

Table 1 Enabling software

Function	Typical Software Products
Data delivery	VTAM, IMS/VS, CICS/VS System/36 ICF, Retrieval/36 Mainframe Communications Assistant
Data storage	IMS/VS DL/I, DB/2 Retrieval/36 Personal Decision Series
Data security	RACF
Data access	QMF Query/36 Host Data Base View
Electronic mail	PROFS, DISOSS
Personal services	PROFS, PS/370 PS/36 PS/PC
Word processing	PROFS, DisplayWrite/370 DisplayWrite/36 DisplayWrite 1, DisplayWrite 3
Decision support	QMF, TIF, IC/1 Query/36 Personal Decision Series
Application development	TSO, CMS, COBOL, IMSADF, CSP System/36 RPG Personal Decision Series
Operational support	MVS/XA, HSM System/36 SSP PC DOS
Systems management	Info/System
Network management	NLDM, NPA

Office services. It is desirable to place office services as close to the end user as possible. At the same time, a requirement exists for communication across organizational boundaries (electronic mail and calendaring) and for access to corporate documents such as telephone directories and procedures manuals. This requirement is addressed by the establishment of a central office service system, with which all other systems and workstations can interface. This central system also provides word-processing capability and personal services for those individuals whose job requirements do not justify an intelligent workstation, but who do have access to a fixed-function workstation.

The provision of this central office system and the establishment of standards for connectivity ensure that any end user can communicate with any other end user at any location in a cost-effective manner.

As a long-term objective, the central office system should be based on products that support the Document Interchange Architecture and the Document Content Architecture. These office information architectures define functions and formats for interchanging documents and other information between separate office systems that are connected by an SNA network. Examples include the DisplayWrite and Personal Service products which provide a three-level integrated office system running under Multiple Virtual Storage (MVS), the System/36, and the Personal Computer Disk Operating System (PC DOS).

Enabling software. Enabling software products provide the functions necessary to support the environment. They are installed as a result of a corporate decision that such functions are required, rather than being justified by the first user community that requests such function.

Table 1 is a list of the functions supported by enabling software products and identifies some products that provide those functions. This list is intended to illustrate the concept rather than to provide an exhaustive list of software. Some product selection criteria are discussed later in this paper.

Support organizations. The support organizations focus on the marketing of IS technology products and services and on user satisfaction. The functional interfaces of the recommended support organizations as seen from a user perspective are described below. Figure 2 shows the interactions during the initial implementation of an application. Figure 3 shows the flow when the user experiences a problem after his system has been installed.

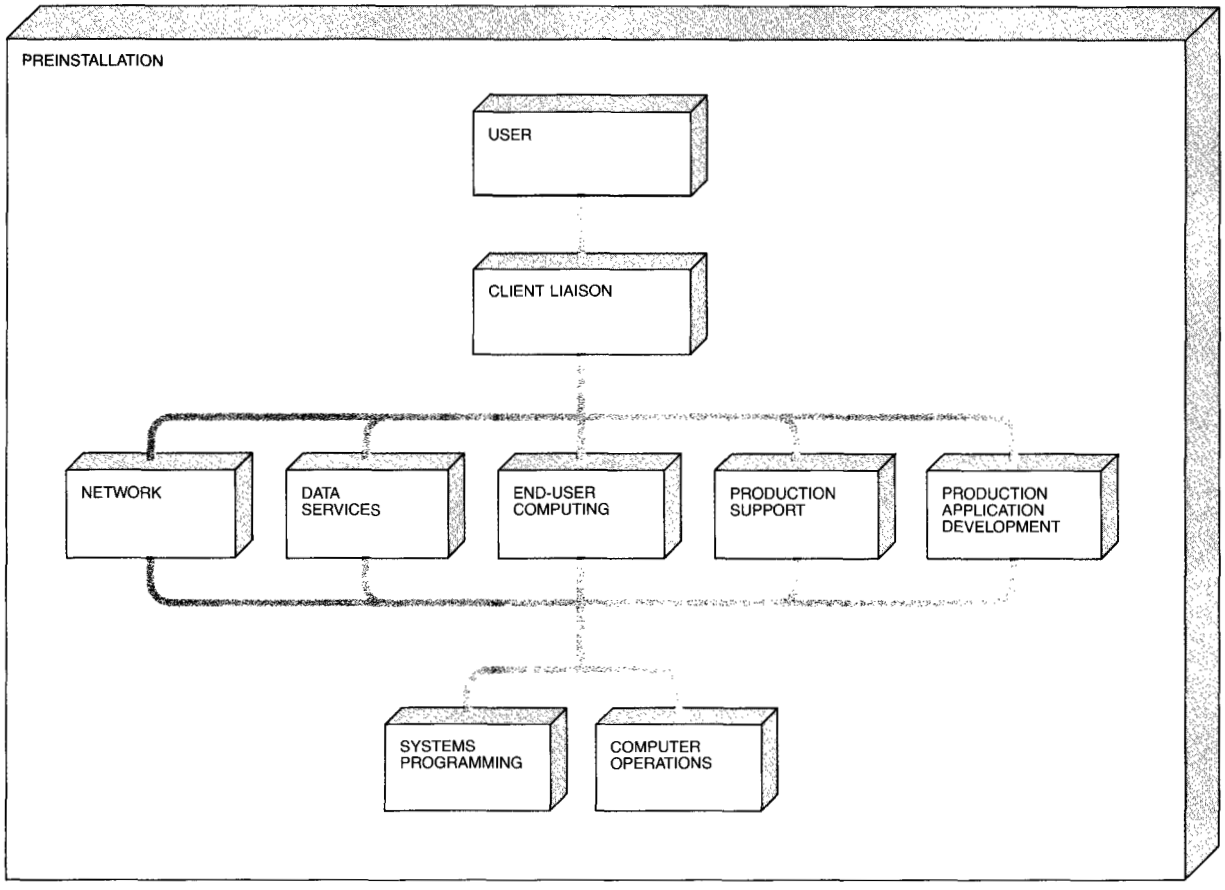
The responsibilities of each group are outlined below:

Client Liaison—Markets centralized IS services, performs strategic planning and systems assurance, and interfaces with vendors for procurement and administration. Assists users with project planning and establishes Service Level Agreements with them.

Help Desk—Provides primary focal point for user interface after initial installation. Monitors and tracks all calls and Service Level Agreements and keeps Client Liaison informed.

Network Support—Interfaces with communication carriers, operates the network, performs problem determination and resolution and monitoring and tuning of the network.

Figure 2 Initial implementation support flow



Data Services—Administers current data environment, provides data extract procedures, and establishes long-term data plan.

End-User Computing—Installs workstations, provides support and training in office systems and decision support systems, performs problem determination and resolution, and evaluates new products and trends in the microcomputer industry.

Production Systems Support—Supports the production systems and performs problem determination and resolution.

Systems Programming—Provides systems programming support for all IS-operated computing facilities, provides input for capacity planning, monitors performance and tuning, and supports connectivity for departmental systems and workstations.

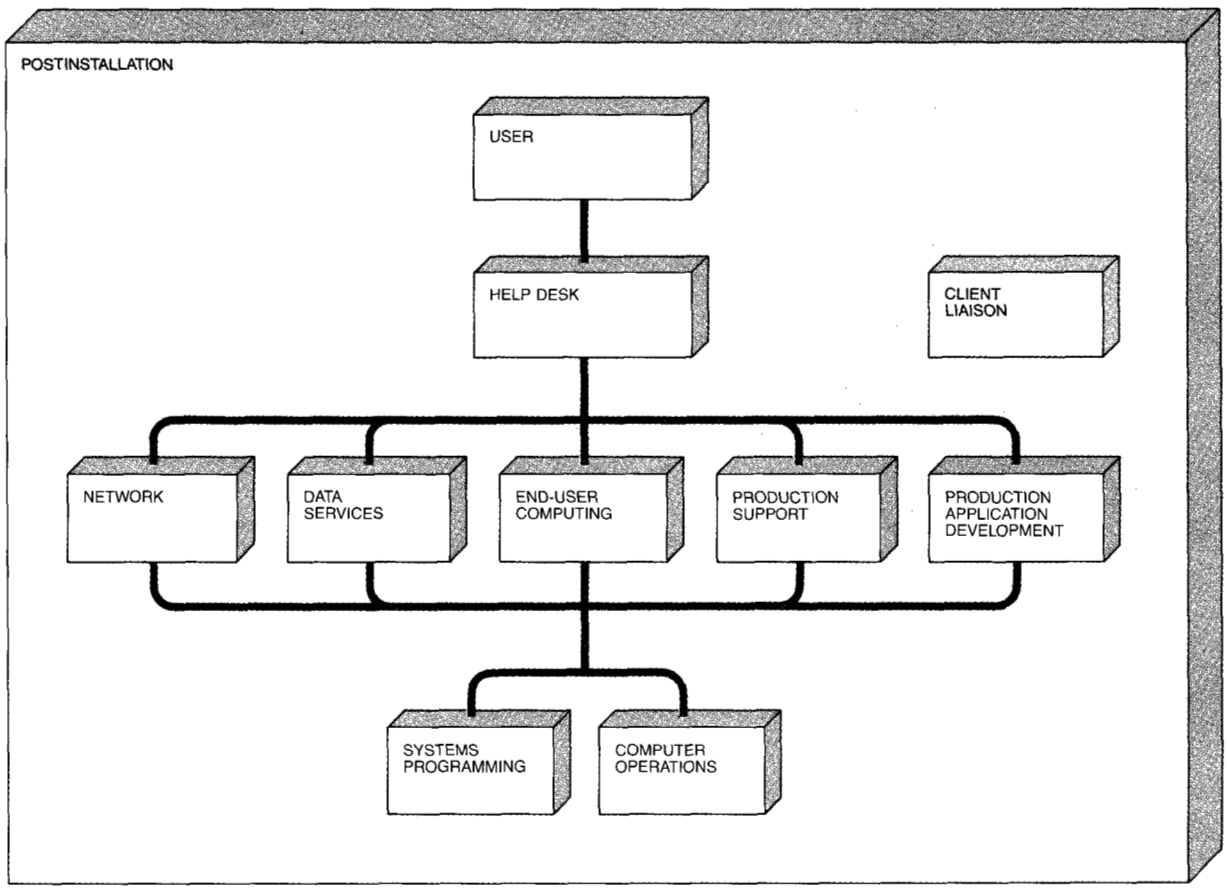
Computer Operations—Operates the IS computing facilities, performs job scheduling, systems management, and change management, and performs problem determination and resolution.

Production Application Development—Develops and maintains production applications and performs problem determination and resolution. (Note that this function may or may not reside entirely in the central IS function.)

Systems management. Systems management is a set of ongoing management processes that are used to plan, measure, and control the information processing environment. There are eight functional areas of systems management:

1. Change management
2. Problem management

Figure 3 Postinstallation support flow



3. Recovery management
4. Capacity management
5. Audit/security management
6. Performance management
7. Processing management
8. Management reporting

Clearly stated objectives are defined for each functional area, along with the appropriate procedures and activities necessary to reach those objectives and the techniques for measuring performance.

The processing environments

Processing environments are characterized by processing type and location.

Processing types. The three processing types are defined as follows:

1. *Production processing systems:* These generally have a predictable repetitive workload and maintain "system of record" data. They are required to meet firm schedules and deadlines, and traditionally have a long system life.
2. *Decision support systems:* These typically have unpredictable processing requirements, volumes, and schedules. They are often heavily interactive and are developed and scheduled by the user.
3. *Office systems:* These support text and document processing, personal services such as calendaring and scheduling, and communication between individuals across an organization. This includes both electronic mail and document distribution.

Processing locations. Each of the processing types can be performed at any one of three locations: central, departmental, or intelligent workstation. Each of these locations is defined below.

Centralized systems. Typically these are large mainframe computers, owned and operated by the IS organization. These computers may be located at multiple sites, and work is run for multiple divisions and departments.

Departmental systems. These are generally medium-sized mainframe computers, owned and operated by a division or a department, and located on the premises of the division or department. Departmental systems may also be operated by the IS function under a facilities management agreement.

New applications arise as a result of the introduction of a new product.

Intelligent workstations. These are personal computers owned by the division or department and managed and operated by the individual user.

The methodology. New applications arise as a result of the introduction of a new product, such as Home Banking, or as a means of cost reduction, such as by improving processing methods for existing applications. The following steps determine the best environment in which to develop and implement an application:

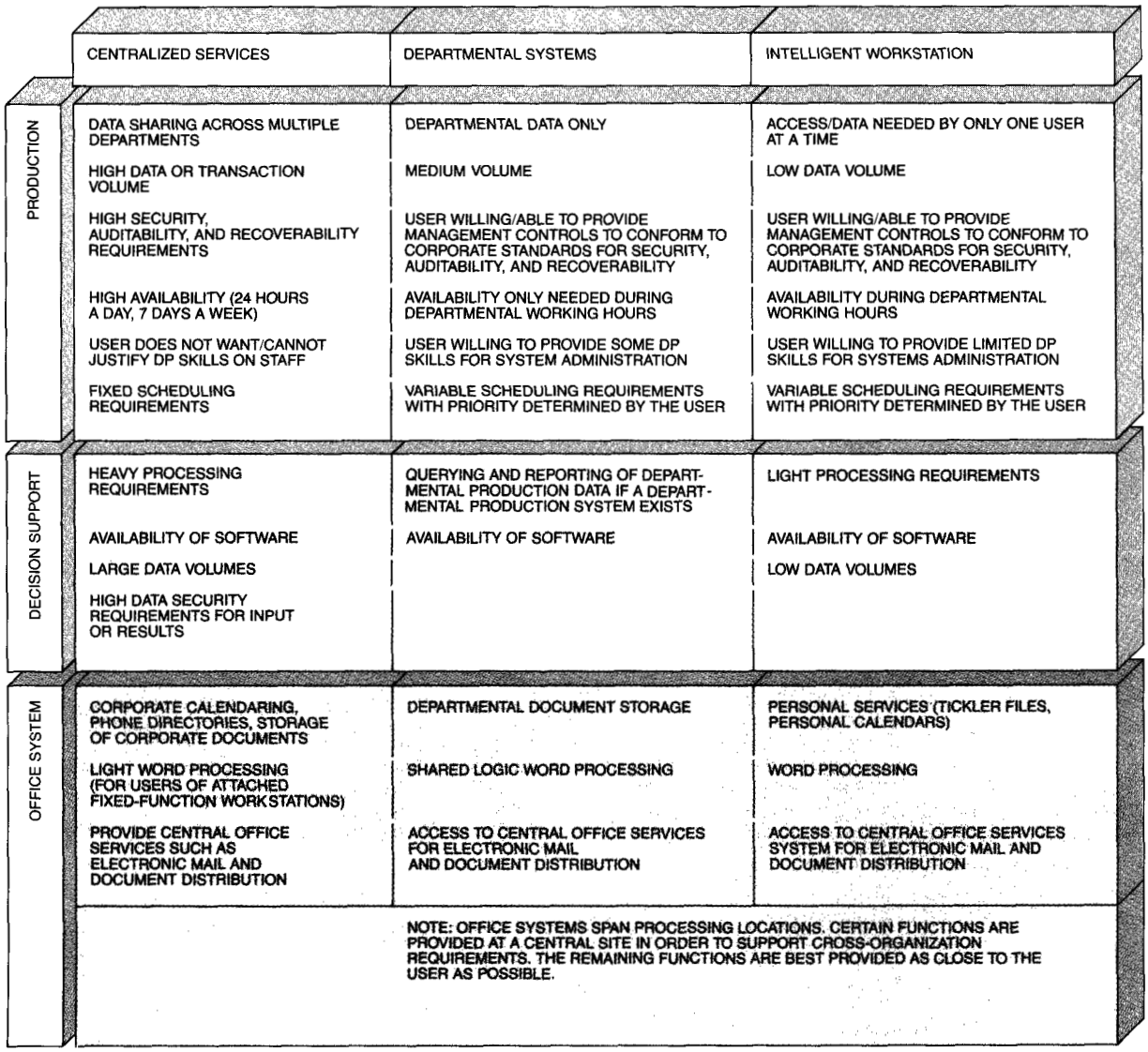
1. Determine the application processing type—The attributes described earlier are used to identify the major processing requirements of an application. Some applications span processing types; each component is identified for analysis in the second step.
2. Determine the processing location—Figure 4 provides a matrix for determining the appropriate processing location for each processing type. Generally the production processing component of an application that spans processing types is considered first, as the installation of a departmental computing facility may affect the location of the other components.
3. Select the appropriate products—Products suitable for the processing type and location are then selected. These products may be developed in-house or purchased from software suppliers.
4. Select workstations based on the individual user's requirements—Different workstations may be used for users of a single application. For example, a clerk whose prime function requires interaction with a production processing system would be allocated a fixed-function workstation. An intelligent workstation would be justified for a business professional who uses personal computer-based decision support tools, does some word processing, and occasionally interacts with the production system.
5. Validate products and workstations—Users are free to select products that suit their requirements, as long as they meet the cross-environment selection criteria detailed below. This is necessary to ensure that connectivity between different organizational entities is maintained with minimum cost and effort. Users are also encouraged to select products from a list of "preferred products." Products are placed on this list because of their suitability, connectivity capability, and cost effectiveness. Products on this list are supported by the central IS function.

Product selection criteria. All products (hardware and software) should satisfy the following criteria to ensure that they fit into the overall architecture. They should:

- Interface with the SNA network
- Allow users to access the central office service and decision support systems
- Support current levels of vendor system support programs such as MVS/XA
- Support existing SNA network management facilities
- Conform to corporate standards for security, auditability, and recoverability
- Provide either data extract tools or user-friendly data query facilities if the products are used as a repository for system-of-record data
- Support or provide a bridge to support SNA distribution services and the Distributed Office Support System (DISOSS)

Organizations which control all information processing centrally can extend this list to specify explicitly other general-purpose products such as personal computer word-processing software and mainframe data base products. In a decoupled environment, the central organization can provide incentives to user departments to use standard software by providing

Figure 4 Processing site selection matrix



	CENTRALIZED SERVICES	DEPARTMENTAL SYSTEMS	INTELLIGENT WORKSTATION
PRODUCTION	DATA SHARING ACROSS MULTIPLE DEPARTMENTS	DEPARTMENTAL DATA ONLY	ACCESS/DATA NEEDED BY ONLY ONE USER AT A TIME
	HIGH DATA OR TRANSACTION VOLUME	MEDIUM VOLUME	LOW DATA VOLUME
	HIGH SECURITY, AUDITABILITY, AND RECOVERABILITY REQUIREMENTS	USER WILLING/ABLE TO PROVIDE MANAGEMENT CONTROLS TO CONFORM TO CORPORATE STANDARDS FOR SECURITY, AUDITABILITY, AND RECOVERABILITY	USER WILLING/ABLE TO PROVIDE MANAGEMENT CONTROLS TO CONFORM TO CORPORATE STANDARDS FOR SECURITY, AUDITABILITY, AND RECOVERABILITY
	HIGH AVAILABILITY (24 HOURS A DAY, 7 DAYS A WEEK)	AVAILABILITY ONLY NEEDED DURING DEPARTMENTAL WORKING HOURS	AVAILABILITY DURING DEPARTMENTAL WORKING HOURS
	USER DOES NOT WANT/CANNOT JUSTIFY DP SKILLS ON STAFF	USER WILLING TO PROVIDE SOME DP SKILLS FOR SYSTEM ADMINISTRATION	USER WILLING TO PROVIDE LIMITED DP SKILLS FOR SYSTEMS ADMINISTRATION
	FIXED SCHEDULING REQUIREMENTS	VARIABLE SCHEDULING REQUIREMENTS WITH PRIORITY DETERMINED BY THE USER	VARIABLE SCHEDULING REQUIREMENTS WITH PRIORITY DETERMINED BY THE USER
DECISION SUPPORT	HEAVY PROCESSING REQUIREMENTS	QUERYING AND REPORTING OF DEPARTMENTAL PRODUCTION DATA IF A DEPARTMENTAL PRODUCTION SYSTEM EXISTS	LIGHT PROCESSING REQUIREMENTS
	AVAILABILITY OF SOFTWARE	AVAILABILITY OF SOFTWARE	AVAILABILITY OF SOFTWARE
	LARGE DATA VOLUMES		LOW DATA VOLUMES
	HIGH DATA SECURITY REQUIREMENTS FOR INPUT OR RESULTS		
OFFICE SYSTEM	CORPORATE CALENDARING, PHONE DIRECTORIES, STORAGE OF CORPORATE DOCUMENTS	DEPARTMENTAL DOCUMENT STORAGE	PERSONAL SERVICES (TICKLER FILES, PERSONAL CALENDARS)
	LIGHT WORD PROCESSING (FOR USERS OF ATTACHED FIXED-FUNCTION WORKSTATIONS)	SHARED LOGIC WORD PROCESSING	WORD PROCESSING
	PROVIDE CENTRAL OFFICE SERVICES SUCH AS ELECTRONIC MAIL AND DOCUMENT DISTRIBUTION	ACCESS TO CENTRAL OFFICE SERVICES FOR ELECTRONIC MAIL AND DOCUMENT DISTRIBUTION	ACCESS TO CENTRAL OFFICE SERVICES SYSTEM FOR ELECTRONIC MAIL AND DOCUMENT DISTRIBUTION
	NOTE: OFFICE SYSTEMS SPAN PROCESSING LOCATIONS. CERTAIN FUNCTIONS ARE PROVIDED AT A CENTRAL SITE IN ORDER TO SUPPORT CROSS-ORGANIZATION REQUIREMENTS. THE REMAINING FUNCTIONS ARE BEST PROVIDED AS CLOSE TO THE USER AS POSSIBLE.		

good support for those products and obtaining volume discount agreements to reduce the price.

Niche products. These products fulfill unique requirements of an application. Most of them would be industry specific, such as automated teller machines (ATMs) or check reader/sorters in banks. They may not always satisfy the cross-environment selection criteria and go through a "systems assurance" process before being selected.

Summary

It is expected that the major benefits will accrue in the following areas:

Data availability. There is a growing requirement for access to information at all levels of large corporations. This requirement is increased by the influx of personal computers and the consequent ability/desire on the part of users to manipulate data to

support their decisions. This leads to the questions "Where is the data?", "What format is it in?", "How do I get it?", and, for the operational staff "Should this user be allowed to access this kind of data?". The establishment of the data services function provides the answers to these questions.

Repair/recovery. Network management, data base recovery, problem management, and change management are all facilitated by the recommended enabling software products and the support organizations.

Design, implementation, and growth. The establishment of standards, particularly in the area of connectivity, ensures that growth will not be impeded artificially. The use of standardized products facilitates the sharing of skills and in-house development across the organization. New applications and workstations can be installed in remote locations by using the existing network. Enabling software products for capacity planning, performance monitoring, and tuning keep the operational environment in step with the users' processing requirements.

Cost effectiveness. The setting of standards for connectivity can often lead to reduced costs as a result of network integration. User-friendly productivity tools reduce development costs. The use of a preferred product set will sharpen skills and reduce training and other personnel costs.

User responsiveness. An organization structured to support the end users of all types of systems (production, decision support, and office) dramatically increases the satisfaction of the end user. The implementation of "easy-to-use" software and the establishment of the "data pool" function enables more end users to develop their own solutions, thus reducing the application backlog. The establishment of a cooperative environment in which the end user and the central IS organization can define new business requirements with use of techniques such as prototyping enhances the image and value of the IS organization.

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