Reengineering materiel management using computer technology

The Materiel Management Department in today's hospital is in a uniquely advantageous position. It can better support the hospital's mission by applying current techniques in materiel management systems automation together with current computing technology as part of a broad-based reengineering process. Materiel management executives, suppliers, software developers, and hardware manufacturers now have all the necessary tools to create and implement a flexible, cost-effective, complete, paperless system. The model system offers tremendous advantages in terms of increased productivity and reduced total cost. This article discusses the process and the tools and techniques that should be considered. Key words: *information system, just-in-time, paperless, stockless*

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AS THE 21st century approaches, the Materiel Management Department in today's hospital is in a unique position to greatly enhance its institutional effectiveness by adopting a broad-based approach to systems reengineering. The purpose of this article is to discuss the role that computers can play in that endeavor. Much has been written about the paperless society, just-in-time (JIT) and electronic data interchange (EDI), to name just a few of the new words, concepts, and techniques that bombard us; all are computer dependent. Are some of these procedures and concepts right for your institution? If they are right, what tools are needed to take advantage of them?

The starting point in any approach to reengineering must be an understanding of how the Materiel Management Department's goals and objectives can best support the hospital's overall strategic mission. Next, before reengineering the system aspects of materiel management, the materiel management executive should reaffirm the goals for materiel management.

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In general, most materiel management executives have the same goals:

- reduced operating expenses;
- reduced cost of supplies, equipment, and services;
- reduced capital investments in space and inventory; and
- expanded timeliness and quality of service to our customer, the hospital staff, and their customer, the patient.

The key is access to information. The processing and retrieval of information is what a computer system is all about. The cost of processing and retrieving the information is an essential part of the equation, which must balance the relative costs with the value and usefulness of the data. The equation contains other elements that are unique to hospitals; elements that are unique to materiel management; and lastly, elements that are unique to good business practices.

For what information is the executive looking? Outside of the institution, the executive seeks access to product information, technical data, pricing, availability, and sources. Inside the institution, both historical and statistical information are sought. Accessing and merging this information in an orderly and user-friendly fashion is a primary system goal. To accomplish this goal a system must be selected that is geared to access and interface with the myriad of other systems that contain the information desired. This will include hospital administrative and financial systems; other departmental, registration, clinical, and hospital information systems; supplier and manufacturer systems; equipment selection and group purchasing systems; as well as various systems involved in bar-coding, tracking, dispensing, and point of use, just to name a few.

COMMUNICATING WITH SUPPLIERS

The executive needs to be able to get prices and availability and send orders in JIT or stockless mode. As costs of creating individual purchase orders are reduced and our needs become more certain, orders can be sent in an ever-increasing frequency. The ultimate goal is a procurement program that mirrors utilization on a daily basis. The more frequent the order, the less our investment. The traditional search for economic ordering quantities (EOQ) continues, but the EOQ becomes smaller and smaller as the cost of creating orders is reduced and traditional freight charges are eliminated as a cost factor. Also, classic EOQ formulas were originally designed to support a dependent demand environment like manufacturing—with constant, known demand. These formulas have far less practical applicability in health care, which is typically an independent demand environment subject to variability.

In the traditional approach, a purchasing department would put together a variety of facts and statistics to determine what it really costs to create a purchase order. Gathering information, entering, calculating, and printing the order are all cost factors. These factors have no meaning in a modern computer environment where orders are computed automatically and should seldom have to be printed or mailed.

CONTROL THE PROCESS

Suppliers, as part of their service, now make available to the hospitals the most sophisticated plans to manage their business. From the earliest version of supplier

order entry systems have grown the most sophisticated systems to support a supplier's prime vendor management including basic JIT programs and enhanced JIT stockless programs. The supplier will be most happy to give the hospital all the tools it needs. The danger in this is that the supplier then controls the process. It does not pay to buy something that might be less expensive from another supplier. It becomes just too expensive to go off a prime contract for an item or two. If and when business benefit dictates that the hospital should change to a new supplier, the hospital often finds that it has so intertwined itself with its existing supplier that the cost of extricating itself becomes prohibitive.

Of utmost importance, therefore, is for the hospital to have the independent computer system resources to run as would a supplier's prime vendor or secondary vendor program and not be dependent on any one particular supplier for system needs. This means built-in EDI capability and the ability to read other (foreign) catalogs and connect to smaller supplier(s). When a hospital wishes to turn part of its program over to a supplier for superior pricing or quality considerations, it should have the tools to do so and offer the smaller supplier those tools as well. Having a system that contains these independent tools is an essential part of the reengineering plan.

MATERIEL'S TRADITIONAL PATH: PURCHASE—RECEIVE—STORE—DISTRIBUTE—INVOICE—VOUCH—PAY

Each process has relatively high costs attendant to it. How essential is each step? What if the receiving process could be eliminated along with the processing of invoices? What if inventory could be eliminated along with the cost of distributing it? How much could be saved? Traditional information systems since the 1960s have attempted to reduce the costs associated with isolated parts of these processes. But what if these steps could be eliminated? In the past the steps could be wholly eliminated but control of the process would be lost. One would never know what was on hand or never know what or how much to order (unless it was physically counted). The Accounting Department would never know what to pay.

Advanced computer processes allowed for the efficient and effective use of a primary supplier, which has accounted for the widespread use of such processes. These processes in turn allowed us to use JIT and, eventually, stockless programs in most locales. However, the advantages of JIT and stockless programs to the materiel management department became a nightmare to many accounts payable departments as they unexpectedly became forced to deal with an avalanche of receiving tickets and invoices.

THE ULTIMATE ENVIRONMENT

What then is the ultimate environment? A scenario that is futuristic and yet actually at hand could be painted today. In this system, the user works in a standard MS-Windows environment. The applications processed seem no different from any other Windows application. It is just one more tool in an arsenal of industry-recognized tools. The word processor, the spreadsheet, and the MS-Windows File Manager are all as much a part of the system as the application itself. The user can move through these applications with ease. More information required? Send some files to a

spreadsheet. Incorporate data in a report? Send a file to WordPerfect. Develop baseline statistics and track, measure, and graph statistical improvement as required by departmental objectives, hospital continuous quality improvement programs, and the Joint Commission on the Accreditation of Health Care Organizations imperatives. Graph supply usage for departmental analysis. Import photos, drawings, or images into the item catalog or into a departmental procedure manual. Electronically compose or modify hospital forms for automatic transmission to a local printer or forms facility. Electronically capture, store, index, and retrieve signatures and scanned documents like packing slips.

IMPLEMENTATION

For the purposes of illustration, the system has been divided into two phases. One is the "Traditional Phase" (Figure 1) under which most materiel management systems are operating. The second is the "Final Phase" (Figure 2), which is the goal after the operation has been reengineered. In the "Traditional Phase" 13 steps have been identified in the process, 10 of which are labor intensive; 2 are performed by the supplier; and 1 is performed by management. Our plan calls for the examination of each of the 10 labor-intensive steps with a goal toward eliminating them with the utilization of an advanced computer system. In the "Final Phase" all labor-intensive steps have been eliminated and replaced with a different mode of operation or the computerization of the step. Several tasks that must be addressed are shown in the box entitled "Key Tasks."

The elimination of labor-intensive procedures, while enhancing reliability, revolves around three basic reengineering changes. First is the implementation of a stockless program. Second is the implementation of an automated payment program. Lastly is the implementation of an automated point-of-use system. The difference between success and failure of these three endeavors will rest squarely on the ability of the existing or in-house computer system to support the programs.

This article is directed toward materiel management systems. However, as one can see from this reengineering approach,

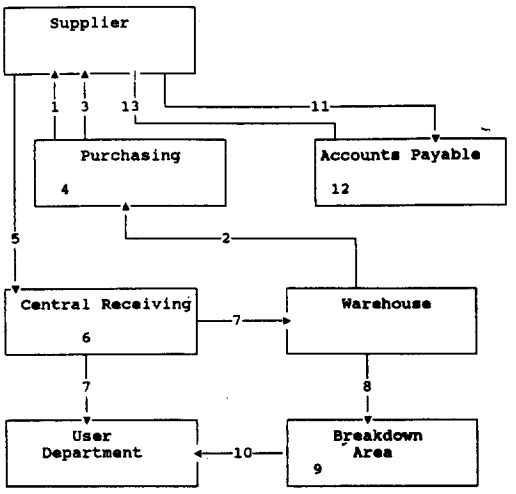

Figure 1. Traditional phase. (1) Negotiate annual contract (management); (2) Determine order needs based on usage and inventory balances (labor intensive); (3) Create and send purchase order (labor intensive); (4) Expedite order (labor intensive); (5) Ship materiel (supplier); (6) Receive materiel (labor intensive); (7) Deliver stock to warehouse, nonstock to departments (labor intensive); (8) Break down stock into user units of measure (labor intensive); (9) Count and fill exchange carts (labor intensive); (10) Deliver carts (labor intensive); (11) Send invoices (supplier); (12) Match invoices and process vouchers (labor intensive); (13) Run and send checks (labor intensive).

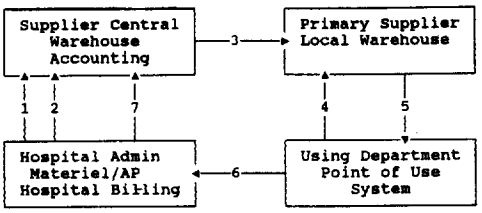

Figure 2. Final phase. (1) Negotiate annual requirements contract as blanket purchase order including schedule of anticipated needs (daily or weekly basis) (management-supplier); (2) Revise needs on a periodic basis based on usage and census statistics (automated); (3) Stock warehouse based on requirements contract, usage, and periodic revisions to plan (supplier); (4) Transmit blanket order releases daily based on usage (automated); (5) Fill releases and ship (supplier); (6) Create internal invoice out of usage (automated); (7) Pay supplier electronically based on automated invoices (automated).

the need to automate accounts payable must also be addressed. In today's systems environment it is essential that materiel management and accounts payable be addressed as one common system. The payment of nondirect (purchase order based) invoices can only be handled efficiently if the payables system is completely tied to the materiel system.

REVISE NEEDS ON A PERIODIC BASIS

The user requires a system with an inclusive database of use and census history. Properly using such a database, the hospital can better revise its delivery schedule for estimates and forecast patterns of demand. This allows the supplier to plan for the daily deliveries being made to the departments. Since the supplier is periodically updated regarding forecast demand, the warehouse or other distribution system can be properly prepared and stocked. Using the database and sending out delivery and order revisions establishes the relationship dynamics to enable the system to better react to changes and anticipate new demand.

EXAMPLE

Based on a projected census of 300 beds and past-usage history, it is estimated that 36,500 of "item A" will be used at a rate of 100 per day and, therefore, the system has estimated that blanket order releases from the various departments will total 100 each day. Utilization for the first month has averaged 130 a day, 30 percent higher than originally anticipated. Safety levels have been set at two days or 200 units. Current estimates by the system now anticipate that 47,500 units will be needed for the year, so the order is increased by 11,000 annual units. Blanket order releases are not affected as they had always been based on actual utilization, but now the supplier has sufficient lead information to ensure that the supply pipeline will be kept ahead of anticipated demand.

TRANSMIT BLANKET ORDER RELEASES DAILY BASED ON USAGE

Using a materiel computer system that integrates with an automated "point-of-

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Key Tasks

Task:	Determine order needs based on usage, census, and inventory balances
Solution:	Eliminate inventory through stockless program
Task:	Create and transmit many purchase order releases
Solution:	Adopt automated blanket order release program
Task:	Expedite order
Solution:	Establish standardized daily deliveries program
Task:	Receive material
Solution:	Eliminate receiving for selected items and areas through stockless departmental packaged delivery
Task:	Break down stock into user-defined units of measure
Solution:	Prepack at unit subcase/pack/dosage convenience level including custom procedure sets
Task:	Count and fill exchange carts
Solution:	Modify par/exchange program through stockless program tied to an "automated par stocking/point-of-use" system
Task:	Deliver carts
Solution:	Optimize stockless par level areas
Task:	Match invoices and process vouchers
Solution:	Eliminate invoices through automated invoice program
Task:	Run and send checks
Solution:	Eliminate vouchers and checks through automated funds transfer program

use" system, blanket order releases will be automatically generated and transmitted to the primary supplier on a daily basis for daily replenishment.

CREATE INTERNAL INVOICE OUT OF USAGE AND PAY SUPPLIER ELECTRONICALLY

Each blanket order will generate an automated invoice. This eliminates the need for entering invoices, matching them, and creating vouchers (orders to pay). This is also the most sensitive area. It raises the question of whether or not the hospital is willing to make payment without the traditional three-way match of purchase order, receiver, and invoice. By maintaining departmental stock balances under control and matching payment to actual utilization, there can be assurance that payments will not exceed goods actually delivered. Another system component enables the hospital to gather the invoices for a supplier and transmit funds electronically via EDI.

SYSTEM STANDARDS

It is suggested that in order to accomplish the foregoing systems reengineering as well as the many other tasks involving departmental computer automation, the system selected by materiel management must be what is called an *open system.* Such an open system is shown in Figure 3. This means that the system should, as much as possible, meet the current standards for open system compatibility, standard operating systems, connection and communication conventions, languages, and devices.

UNIX operating system

Our model is a system that employs a UNIX processor for its main processing capabilities but allows users to work in an MS-

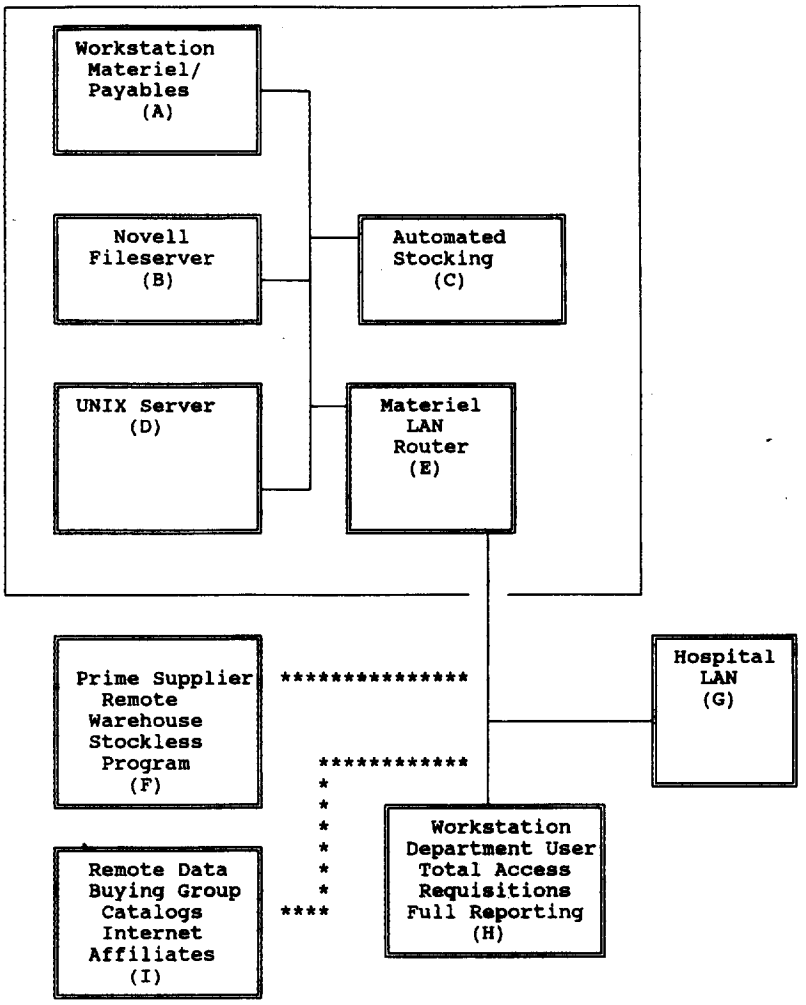

Figure 3. Final computer system configuration. (A) *Workstation materiel.* Each user who is part of the materiel/payables system group will process on a personal computer (PC) running under MS-Windows. This PC will be used for the dual purposes of acting as a terminal device to manage screen processing and report management software to access the UNIX server and acting as a PC to access desktop software both on a stand-alone basis and integrated into a NOVELL fileserver system for example. (B) *NOVELL fileserver.* Dedicated to the materiel/payables system users, this system will hold common software and files such as spreadsheet, EDI, word processing, and others as well as the network software that links the UNIX processor to the MS-Windows processors. (C) *Automated stocking.* In the example, an automated point-of-use stock system such as Pyxis will be used. Pyxis and other such systems can integrate with the MS-Windows PCs and interface their records with a RDBMS. It is most probable, but not certain, that many prime suppliers can also conform to these standards. (D) *UNIX server.* The RDBMS (for example, ORACLE) would reside on this computer

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along with an integrated structured query language (SQL) report writer. The screen programs all reside on the PC in MS-Windows. With the NOVELL fileserver and network software residing on both the PC and the UNIX processor, the user will access the database and use the report writer. In addition the computer should contain its own screen management software (a combination of X-Windows and character-based screen handlers so that hospitalwide users who do not have PCs, but rather have "dumb" terminals tied to other systems can access the screens and process order entry through the system. (E) *Materiel local area network (LAN) router.* The LAN router connects the closed network PC users and UNIX processor with the hospital network. (F) *Prime vendor remote warehouse.* The prime vendor remote warehouse will be accessed through EDI functionality. An electronic interface essentially joins each supplier's system to the hospital system. Price-contract verification is linked. *(G) Hospital LAN.* Most hospitals will have instituted wide local area networks such as NOVELL. The hospitalwide system should be connected to the materiel LAN so that departmental users throughout the hospital can access the materiel system from their own terminals. Software required would reside on the UNIX processor. (H) *Workstation department user.* Under this scenario, a user workstation can be a PC operating under MS-Windows or a dumb terminal connected to another system and used for other purposes. (I) *Remote data.* Through EDI functionality, users on any PC would be able to go outside the system to access or import compatible data such as complete item and catalog information located in supplier or other systems or to transmit or receive contract data to or from the hospital's group purchasing organization or through the Internet to connect to the world!

Windows mode. UNIX processing permits the widest possible range of integration and interconnectivity with different computer systems and hardware platforms. UNIX has enabled the creation of client-server computing and large systems based on interconnection of small, specialized systems. This was the same approach and vision used by the Internet, which has become the global computing standard for remote connectivity. The UNIX operating system will likely become the most common mainframe operating system with the best connectivity to other systems through a communication protocol called TCP/IP (Transmission Control Protocol/Internet Protocol).

MS-Windows

The MS-Windows environment presents the user with the capability to use all the standard personal computing desktop tools such as FAX/modem for electronic faxing and data communications, database, file manager, word processing, and spreadsheet.

Network

Our network design would incorporate common industry standards such as Ethernet, Token Ring, and NOVELL for interconnection of workstations and personal computers.

Relational database

Our system would be written using relational database technology. The relational database management system (RDBMS) is the most efficient database tool available, providing users with immense flexibility and adaptability as well as access to all data in virtually limitless ways.

Hardware

The system could reside on many types of hardware platforms including existing as well as state-of-the-art Reduced Instruction Set (RISC)-based machines, which combine unprecedented processing speed and power together with relatively low cost.

Optical technology

Finally, our system would include use of optical technology in terms of mass storage of data, imported photographs and video, multimedia, CD-ROM, scanned images, and fiberoptic connections.

CHECKLIST OF REQUIREMENTS FOR A SYSTEM

A. *Integrated materiel and accounts payable.* From a systems perspective, materiel and accounts payable are one and the same. If a payment cannot be made based on information collected by the materiel system, then redundancy will follow. If that same materiel management system becomes highly automated, then it creates problems far worse than redundancy. All the labor saved in materiel will be transferred to accounts payable. What must be kept in mind is that as the automated program grows, the number of transactions/documents generated by the Purchasing Department grows in exponential proportion. This volume of documents is of no consequence as long as the entire process is automated. But if the process loses its automation at any step along the way, then the voluminous buildup of problems and mismatches becomes overwhelming.

B. *RDBMS.* RDBMS is the most efficient database tool available. More importantly, as more and more computer systems move to RDBMS, the ability of the hospital to exchange database information with other sources grows in proportion. In addition, this database is most complementary to desktop databases such as the user may wish to employ or to extend reach of the system provided by the computer system supplier. In effect, this creates a custom system while still maintaining the base system in its supplier mode.

C. *Desktop MS-Windows environment.* Supports integration to word processing, spreadsheet, local database, FAX, and EDI programs. There are literally hundreds of desktop systems running under MS-Windows. The list grows longer every day. Many of these systems have the potential to supplement the processing needs of a user. If the user has a system that integrates with these systems, the user's system capability is greatly expanded.

D. *Tools.* Create user capability in forms and screens, graphics database, archive and retrieval, user backup, standard EDI set including ANSI X.12 conversion software. When selecting a system, one should look for the tools that are available with that system. The average hospital spends a substantial amount of money buying forms and quite possibly supporting its own print shop. Electronic forms creation is available to any system user that buys the screen management capabilities of a software product. Creating a computer screen and creating an electronic form are virtually one and the same. Document filing in computers (waybills as an example) requires that the system has the capability to support graphic file structures and integrate these structures into its database. The potential system buyer should keep this well in mind. Every computer system has a finite ability to store data on-line. There is

no reason why a hospital should not have the ability to store all its records in perpetuity. This task can be accomplished by making sure that the system has a built-in archival and retrieval system that will not only store data but will also readily integrate data back into the main system when required and in its archive mode, can take advantage of search or reporting tools in the same manner as in a live mode.

E. *JIT or Stockless program.* Possibly of most financial and operational importance is the inclusion of a strong JIT or Stockless program coupled with EDI an ANSI file capability. It is of equal importance that this is a system that has been programmed for the unique needs of health care institutions and is not one developed for commercial enterprises.

F. *Report writing.* Input, database, and output are the three key functions of any computer system. By controlling output, the user exerts major control over a main function of the computer system. A standard structured query language (SQL) report writing system that allows the user to control the database and structure the output will give the flexibility to obtain the maximum amount of needed information from the computer system.

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Today the materiel management executive functions in a time where a vast array of computer (software and hardware) tools are available. The executive must become aware of what these tools are and how they can assist the executive in fulfilling the mandate from the hospital to save money and, most importantly, deliver a quality service and product to the hospital, its staff, and patients. Once familiar with these tools, the executive should implement them as a part of a hospital system that can fulfill the mandate.