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Computers: Equipment and Services

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THE SUBJECT OF computer equipment and services as applied to libraries is one most often learned by the cold-water method: jump in by making a decision to automate, and by the time the shore is reached one feels like an expert. Of course one need not approach the field in that way, but it is true that as one begins to automate, the jumbled world of computers falls into place piece by piece. For that reason, this paper explores the field of computer equipment and services as libraries might encounter it while developing an automated project.

Most problems that libraries now face have been encountered for generations, and solved in more or less conventional ways by those generations of librarians. Only recently has the computer emerged as a possible tool to help solve those problems. The old solutions still exist, and many remain better choices than computerization. Increasingly, however, librarians are looking to the computer as the key to solving old problems and to providing new services heretofore considered unfeasible.

It should be pointed out in advance that contracting for computer services and systems is very different in its overall effects from purchasing other, less sophisticated library equipment. The computer often effects profound changes in any organization into which it is introduced. Roles and tasks are dramatically altered for those personnel who introduce data into the system, as well as for those who use its products. Information flow, reporting relationships, and accuracy requirements for operational data must be analyzed in detail and thoroughly communicated through frequent meetings and training sessions. Whereas in manual record-handling systems many

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people are usually able to perform or substitute in most jobs on an ad hoc basis to keep the work moving, the complexity of machine systems often precludes more than one or two people understanding the total system. Many computer-support tasks become so specialized that only trained back-up personnel can be brought in to fill the inevitable gaps that occur through absence and termination. All of this is "old hat" to experienced computer system users, but it always comes as a shock to the new user. Beware that "there are problems with owning your computer. If you don't believe this, ask somebody who owns one."[1]

The degree of computer involvement in any particular function or service is likely to vary widely for the alternative solutions or methods for performing the service. Those alternatives may range from completely manual processes to direct involvement of persons with computers through terminal-based communications. In choosing among the alternatives, the librarian juggles many factors and influences before determining the best choice.

The relative advantage of any alternative involving computers depends partly on the expected availability of the computer equipment and computer services required by that alternative. The availability of those commodities depends in turn on several factors. One such factor is the state of the art of the computer hardware design. Although not many library applications are likely to be limited by this factor, it can have some effect. Almost certainly, the librarian newly investigating automation will gain some awareness of this condition. Another factor is the state of the art of software—the programs that tell the hardware what and how to perform. This factor is much more likely to affect the availability of computer systems than is hardware development. However, the factor of greatest significance is the overall state of the marketplace: What equipment and services can be made available, commercially or otherwise, at the time and place and in the form necessary to ensure a successful application in the library setting?

In this article, we are concerned primarily with this last factor. It is assumed that for any alternative procurement decision actually taken, the library will have acquired sufficient expertise to implement and operate the system selected. However, the expertise already available in the library is likely to influence strongly the choice of alternatives. Therefore, the relative expertise required for various kinds of applications will be mentioned in this article, but since the thrust here is to examine the marketplace rather than to give decision criteria, the emphasis will be on other matters.

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INDUSTRY PROFILE

During the past two decades, the computer industry has been one of the most dynamic and rapidly growing business enterprises on record. Technical innovation, followed by commercial and scientific applications, have built one upon the other in successive waves that have brought the computer industry to a powerful and influential position in our national economy. An insight into the nature of this growth and its effects is offered in the dedication to a recent book in the field: "To the student or manager who appreciates that worldwide computer capacity rose thirty-fold in the decade before 1974 and who wishes to shape favorably the *1984* that lies just a decade ahead."[2]

Whereas the majority of the country's largest basic industries were developed near the turn of the century or soon thereafter, the computer industry has experienced its growth since World War II. This skyrocketing expansion, led by a single corporate giant (which now has 75 percent of the total business), has meant that new hardware, software and user applications have been entering the marketplace at an unprecedented rate. Major technological advances in hardware design were signaled by the first, second, third and fourth generations of computers, appearing in 1957, 1960, 1965 and 1970 respectively. Software developments have also been rapid, but have lagged behind hardware changes, partially because of incompatibility among the various computers of different manufacture, and also because of the time required to develop software standards, systems and documentation. The first applications into which computers made rapid inroads were understandably those in which large organizations (such as banks, insurance companies and corporate financial offices) were performing great quantities of repetitive, number-processing operations. The use of computers for sophisticated processing of alphabetic, text, and bibliographic records has been a later and comparatively smaller scaled development.

Since the beginning, the capability of the hardware has exceeded the capacity of people and organizations to apply it productively. The evidence of this is seen in the widespread and inefficient utilization of earlier generation software on later generation hardware, and in the comparative difficulties and delays experienced in the design, production, and implementation of software for new applications.

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THE LIBRARY MARKET

In spite of the rapid growth and enormous size of the computer industry, library data processing systems have lagged far behind many business applications. Since the library market is comparatively small and very specialized, one must wait for devices developed primarily for other, larger markets to become available which will meet library needs. Most computers now used by libraries were developed as large-scale, general-purpose systems, or as special-purpose equipment for other application areas. The hardware and software products that we may select generally need to be adapted to the requirements of library record processing, and that often requires special ingenuity and expertise.

The library market for computers and data processing systems has been steadily growing, but at a rate far slower than in other, larger enterprises and service groups. One reason for this has been the lack of available hardware and software system components tailored to suit library requirements. An important obstacle has been this relatively small scale of the library market compared to the larger, industrial applications. In terms of numbers and budgets, libraries simply have not had the visibility that would cause the large manufacturers to invest extensive resources into the development of systems designed specifically for the library market.

Among the most promising of the new computer-industry products for the library market are the minicomputers and the point-of-sale (POS) data collection systems. Minicomputers that can be flexibly paired with other special-purpose, peripheral equipment enable the library to assemble a versatile, low-cost component system suitable to its own needs. The POS system, using optical sensing of standardized item numbers, offers a particularly promising approach to one of the major data-handling problems in the library setting: data collection and input.

COMPUTER PROCESSING WITHIN THE LIBRARY

One of the fundamental decisions made in planning a computer application is the locus of operations: Where will the processing be performed? In the library? At a nearby computer center? The choice depends, of course, on the equipment available. However, even having made the choice of locus of operations, the library still faces other related decisions.

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For example, suppose that the library elects to procure its own equipment. There remains a choice among computers of various sizes, and among various combinations of peripheral equipment, some of which do not necessarily involve a local computer. We will discuss each of these possibilities in turn.

MAIN-FRAME COMPUTERS

As described above, the computer industry is large and growing larger. The chief entries in the marketplace in past years have been the so-called main-frame computers: large-memoried, high-speed machines designed as general-purpose data processors that may be connected to an assortment of peripheral devices and intended for a broad range of applications. These main-frame computers are the backbone of the industry. Large computer centers may have one or more such machines, each processing simultaneously many different programs. Not many libraries have chosen to acquire large main-frame computers for in-house operations, although given the finances and expertise required, there is very little that a library might want to do that could not be performed on these workhorses. The machines are expensive, costing in some cases millions of dollars, but they may be leased for long terms for thousands or tens of thousands of dollars each month.

Libraries represent such a small portion of the potential market for main-frame computers that very little special attention has been paid to libraries by the vendors of those machines. A librarian dealing with the sales personnel handling these devices will likely encounter very little familiarity with the unique problems of libraries. The salesman will be very familiar with his product, however, and can probably tap the resources of his company to find persons familiar with problems similar to library problems. One must expect long discussions over this point, however. Two incurable biases are those held by computer application specialists and by librarians: the former hold that there are no problems that they have not seen before; the latter believe that no other situation is quite like that found in the library, and that if someone thinks otherwise, he does not understand the situation.

Main-frame suppliers are as near as the classified section in the phone book. More information about the availability and applicability of these computers may be found in industry-oriented publications such as *Datamation, Computer World* and *Computer Yearbook*. It should be remembered that the acquisition of a main-frame computer im-

plies a relatively sophisticated level of expertise for its care and feeding.

MINICOMPUTERS

If main-frame computers form the backbone of the industry, then minicomputers form the rapidly growing flesh. The upsurge in production of minicomputers in the past several years has brought computing to the masses of small users. In typical applications of minicomputers, the computer is dedicated to the performance of a single function rather than a diverse mix of jobs. That function may be complex, involving multiple files and external devices, but still that function is the only task assigned to the computer. While in some instances main-frame computers may be assigned to a single task and minis may perform a mix of functions, the distinction by function is generally accurate. Other differences include size of memory, repertoire of executable instructions, and speed of execution. As might be expected, the minicomputers occupy the lower end of the spectrum in all of these categories.

Minis are not low in versatility, however, and therein lies their appeal. Typical areas of library computerization, such as circulation control and book acquisition, can readily be handled by dedicated minicomputers at costs far lower than those for an in-house main-frame computer. The costs may or may not compare favorably with the costs for operation on a larger computer not maintained by the library, an alternative discussed later.

The rapidly growing mini market has a variety of wares. Minicomputers range from sophisticated devices only arbitrarily distinguishable from the smaller of the main-frame computers, down through devices more commonly called intelligent terminals, because of their characteristic uses as keyboard devices augmented with some memory and computing capability. Supplementing these devices in typical applications is a variety of types of peripheral equipment, such as extra memory, tape and disc drives, printers, card and paper tape readers, punches, etc. The computer requires some peripheral devices for input and output of the data it processes; selection of the proper combination is a major part of the design of the application.

The vendors of the minicomputers are likely to be quite helpful in the task of defining the equipment needed for the library application. Unlike the main-frame computers, minis are marketed primarily for the small user who has a particular problem to solve. The suppliers are likely to be attuned to specialty applications and will see the library

as a "natural" application of the specialty devices they offer. There is probably as slim a chance for agreement with mini vendors as with the main-frame suppliers about the applicability of previous solutions to library problems. However, in the experience of the writers, the vendors of minicomputers are more likely to acknowledge the uniqueness of library problems, since they deal so often with unique applications.

Beyond the selection of the proper equipment based on a rough system design, the library cannot expect much detailed work from the vendor. The supplier is much more likely to offer a training course in how to program and operate its equipment than to provide personnel who might perform the detailed programming of the application. The library must provide for itself the programs and expertise for most applications. While the level of expertise required to operate the component system based on a minicomputer is lower than that for a main-frame, the programming task is likely to be at least as difficult, due to the limited instruction set or vocabulary of the minicomputer and the unavailability of high-level programming languages.

The library may also be faced with the complex technical task of connecting the computer to the peripheral devices needed for the application. While the vendors of the mini and of the peripheral devices will be helpful, it will be the library's responsibility to make sure the interfaces are proper, especially when devices from different manufacturers are interconnected. Establishing the source of malfunction as being on one side of a plug connection or the other frequently is less a problem of technology than one of politics.

OTHER IN-HOUSE EQUIPMENT

In some cases a library may decide against acquiring a computer, but may still need some equipment in the library to allow processing of data for a computer to manipulate later. In many cases, the vendors of data entry devices and data collection systems are the same ones who supply the computers themselves. Since these devices are used primarily for preparing data for later use by a computer, there is little difference between their application in libraries and elsewhere. Therefore, their acquisition and installation will be fairly straightforward and will not require modification for special library use.

There is a variety of data entry devices on the market, the most abundant of which are the keyboarding machines. Each of these devices has a keyboard at which an operator enters the data for processing on the computer. The devices differ in the ways they store

the data and present them to the computer. The old standby for data entry is the keypunch machine, which punches holes in cards to record the information. Key-to-disc machines record information on the surface of magnetic discs. Some such discs may be read directly by a computer by mounting them on the computer's disc drive, but much more frequently an intermediate step is required. The disc may be read by a transmitting device that communicates directly with the computer, or information may be transferred from the disc to another medium such as a standard magnetic tape before transmission. Typically handled in the latter case are the popular "floppy disc machines" which stand alone as do keypunches, but which store the information on small, flexible, reusable magnetic discs rather than on the more bulky cards.

Another device available for data entry records directly on magnetic tape. In most cases, the tape will be compatible with some standard computer tape drive, but before making a commitment the user should be certain that the computer to be used will accept the tape produced by the key-to-tape machine.

The typewriter, one of the oldest keyboard devices of all, may also be useful in preparing data for the computer. Optical character recognition devices are now on the market that will read the output of a wide variety of conventional typewriters. The devices are expensive and usually require extreme care in document preparation, but with some applications they may be ideal. Although the typewriters now in the library may be used as the primary data entry devices, the machines that read the typewritten documents are likely to require special, optical paper and precise document layout for proper operation. The computer center the library expects to use may already have a document reader. It could be well worth an inquiry before acquiring other kinds of data entry devices.

Data collection is not limited to keyboard devices. Card readers have been available for many years for taking information from punched cards and either transmitting it directly to a computer or recording it on tape or disc for later processing. Most of the automated circulation systems installed in libraries in the past decade have used some form of card reader at the check-out point. The concept is still very much alive, although inroads are being made by systems that do not require a punched card for every book being circulated. Magnetic label readers are a common sight at department store cash registers and may yet become prevalent in libraries. Currently of high interest is the application of optical code readers to

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library circulation systems. All of these methods of data collection are more likely to be used by the library as part of a package system prepared by the vendor or manufacturer than as an adjunct to a locally devised computer system in the library.

PROCESSING OUTSIDE OF THE LIBRARY

Having looked at some of the options for equipment to be located in the library, we can now investigate the alternatives for the library which decides not to procure its own equipment. If a library elects to use someone else's equipment, it may choose various types of computer centers and service bureaus with widely varying degrees of accessibility and versatility. Depending on the type of service needed, the library may select a commercial computer service bureau, or may buy some of the slack time on computers owned and/or operated by other institutions not primarily in the business of selling computer services. For purely terminal-oriented applications, the library may go to a wide variety of sources for timesharing services.

SERVICE BUREAUS

Commercial service bureaus offer a full range of computer services with customers paying for what they want. Such agencies abound in any large city and usually thrive mainly on contracts with businesses needing data processing, but not desiring to operate a computer center themselves. Because of the nature of their business, the service bureaus are likely to have a staff of programmers and analysts who will help to set up a new application when the computing is to be done at their center.

The nature of the interaction of the library with a service bureau after the system is operating depends both on the kind of application and on the operating procedures of the service bureau. In some cases, the library will send data and programs completely prepared for running on the computer. In other cases, the library may send only the data in appropriate machine-readable format, and the bureau will marshal the appropriate programs from their files and apply them to the data submitted. The library may elect to send the raw data to the bureau in the form of documents, forms, catalog cards, etc., and have the bureau perform the conversion to machine-readable form. In any case, the procedures and costs will be specified in detail through negotiation with the bureau early in the project. Once the procedures have been finalized, they should be followed with little variation. The

service bureau makes its money by processing high volumes of data in standardized procedures, and is likely to balk at frequent exceptions and variations. At a cost, however, the service bureau is willing to attend to almost any special computer request.

In some cases, a library may use a variety of service bureaus to satisfy its computing needs. For example, one service bureau may offer a good service on production of purchase orders and accounting records for an acquisition system, but can produce the in-process listing in a paper format only. The library may have that bureau write the weekly listing on a magnetic tape and then send that tape to another bureau specializing in computer-output microfilm (COM) services for the production of the list on microfiche. These details, as well as such matters as format of input, frequency of operation, expected turnaround time, and cost, should be specified clearly to ensure satisfactory relations with the service bureau.

OTHER COMPUTING CENTERS

Computers operated by other institutions for their own purposes broaden the range of options for the computer user and provide some competition for the commercial service bureaus. Often banks, insurance companies, or other businesses, will have time remaining on their main-frame computers after completing their own processing, and may be willing to sell computer services to outside users. In many ways, these computer centers are like the commercial service bureaus in the facilities they offer, even though they are much less likely to provide programming and analysis services. However, the needs of the parent company will always come first, and when they conflict with those of the outside users, there is no question who will have priority. Unpredictable priorities for the use of the computer may result in unexpected delays in production runs. Users of leftover computer time travel only as standby passengers with excess baggage.

A major noncommercial source of computing service is often available to libraries affiliated with organizations having computer centers of their own. The computing facilities operated by universities for their research or administrative processing, or by municipalities for their governmental computing, may interact with the library exactly as a service bureau would. In such cases, the library would negotiate the system and cost in the same way that it would with the commercial firm. Fortunate indeed is the library having access to an organization-owned computer where no charge is made for comput-

ing services and supplies. As with other centers where library processing is not first priority, however, the library may have to do most of its own programming, and will likely get squeezed out at high-use periods.

When the computer service required is less of a repetitive production job, and more of a specialized communication task—such as file searching, instruction, or information retrieval—a terminal-oriented service may be desired. Many commercial service bureaus provide access to their main-frame computer via timesharing terminals, giving each user a powerful tool seemingly dedicated to his exclusive use. For applications suited to this type of computing, timesharing provides relatively efficient service.

PROGRAMS AND PROGRAMMING

Obtaining the equipment or otherwise arranging the location for computer processing is a large part, but not necessarily the major part, of implementing a computerized operation in a library. In addition, the operation itself must be completely defined and programs must be written. The software for the chosen computer may be obtained in a variety of ways. The programs may be standard or specially designed packages from commercial software vendors, programs from other libraries or computer users, programs developed in-house for the particular application, or even programs applied as part of a turn-key system for which both hardware and software are supplied and maintained by a vendor.

Standard packages are available in common configurations for commercial and industrial applications, but only to a lesser extent for library applications. However, several companies offer prepackaged "library systems" which are worth investigating. *Caveat emptor.* In any case, software suppliers may be engaged to design and implement special library programs. If this course is taken, the library must specify in detail exactly what it wants. The specification and negotiation period is critical to the success of the operation. The vendor will want to know exactly what criteria will be used to establish the acceptability of their product, and the exercise of specifying those criteria can be helpful to the librarian in understanding the limitations of the system. There are advantages to getting the software written, tested and approved quickly, but unless provision is made for modifications after experience, the library may be locked into programs that cannot be modified with changing needs.

A good source for proven library programs is the world of experienced users—other libraries. If another library has successfully automated a function, the programs used there might be directly applicable to a new situation. In cases where the other library procured the programs commercially, there may be strings attached, requiring the receiving library to negotiate directly with the original supplier. Even after stipulated clearances have been obtained, minor adaptations will undoubtedly be required in order to make the programs operate properly on the computer chosen. However, the sources of programming expertise already mentioned may be called on to help in these adjustments. The critical requirement for a smooth application is the availability of documentation for the programs acquired. Many knowledgeable experts would refuse to tackle the adaptation process unless the existing version of the program has extensive documentation to describe what the program is and how it is supposed to work. If the receiving library does not insist on comprehensive documentation from the program supplier, the odds are against a rapid or successful completion of the project.

Of course, a library may choose to hire a systems and programming staff of its own. By doing so, the library is assured of having the application tailored to its own needs. While this was perhaps the most common way to computerize in the past, this trend may be changing. Richard de Gennaro asserts that: "the day of the one-man or small group library systems development effort is past. . . . It is now quite acceptable, even for a large library, to have no in-house automation program and staff. In-house systems librarians are not essential to implement the local interfaces to these centralized networks or to install the turnkey systems."[3]

TURNKEY SYSTEMS

For a library with more faith than expertise, a turnkey system may in fact be the answer to its automation problems. Increasingly, commercial vendors are offering packaged systems for particular applications, in which the vendor provides all the equipment and programs and teaches the library how to operate them. While in-house expertise may be helpful in getting such a system functioning, it is by no means necessary.

As with commercially obtained software products, the library purchaser of turnkey systems is somewhat at the mercy of the vendor for maintenance and design of programs and hardware. Since it is

unlikely that the vendor will allow the library to tamper with the program without voiding the warranty agreement, the library should be certain either that the system being installed meets the needs of the library, or that the company will agree to modify the system as required. Depending on its performance and the capability of the vendor, the turnkey system is likely to be rather quickly implementable compared to systems designed from scratch. Turnkey systems require relatively little in-house systems expertise, but they are correspondingly inflexible in design and operation. Nevertheless, the library in need of a sophisticated system that performs its function well may find that this is precisely what is wanted.

SYSTEM DESIGN AND DEVELOPMENT

Because the library market is a relatively small one, and manufacturers have been slow to provide the special-purpose systems and equipment that it requires, a number of librarians have become interested in conceptually designing new devices themselves, and then working with manufacturers to develop the desired products. This process can provide a special kind of excitement for the librarian with an interest in engineering, but it is also extremely time-consuming and fraught with unforeseen pitfalls.

More typically, librarians wanting to purchase data processing equipment will simply want to search the marketplace for devices that are already available which can either be used directly or adapted with minor modifications. In either case the search for the proper service or device should begin with the preparation of written specifications outlining the needed functions of the system to be obtained.

SPECIFICATIONS AND ACCOUNTABILITY

Specifications are widely understood in industry and the military to refer to the advance documentation that is prepared to define the need, purpose, function and operation, as well as environmental characteristics, of a system or piece of equipment. The specifications are needed to translate the requirements of a library application area (such as circulation or acquisitions) into terms that designers and company representatives can understand and work with. A computer programmer must have precise and detailed specifications of functions, processes and parameters in order to write a complicated program for a specific application area. Similarly, an engineer or

salesman must have specifications in order to design a new device or select an available piece of equipment to meet a given library's needs. Now that more libraries have acquired significant data processing experience, the concept of specification writing is not so new; however, there are still many library managers who will not have had this exposure, and whose first impulse when considering a data processing purchase will be to call in the salesman. The difficulty with consulting the salesman immediately is that this omits the crucial first step of determining the specific needs of a library. As mentioned at the outset, the purchase of data processing services entails complicated decisions which have such fundamental, costly, and long-range implications for the total library that they cannot be entrusted by the library director to anyone other than his own management team. The library systems analyst or consultant and the library's department heads must do the major work in the writing of the specifications, in order to assure that the systems considered are responsive to the total scope of the library's needs. If this process is omitted, the library management will not have clarified its thinking on what it wanted to achieve, the vendor will have an open field to push and promote whatever best suits his interests, and the operations personnel in the library will have no concrete objectives from which to criticize the system once installed.

The exercise of writing specifications requires visionary acumen in order to project future needs, as well as a high degree of patience to describe current operational realities meticulously. The document is a blend between the future and the present, as well as between the general and the specific. If one lacks experience in this area, there is a body of literature which can be helpful:

> Specifications can be general or detailed. General specifications should be application-oriented and define what the system is expected to accomplish. Although easier to write, general specifications make evaluation of performance much more difficult. Detailed specifications are more time-consuming to complete and much more difficult to establish. They can also limit the number of computers that can meet your requirements. A practical alternative is a mixture of general and detailed specifications. This provides you with something valid to evaluate and forces you to think through the situation.[4]

The specifications should follow naturally from an overall state-

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ment of objectives and service needs that should be prepared early in the project. While the writing of the specifications is necessary, both to clarify the library's specific requirements in the minds of its decision-makers and as a prelude to the examination of vendors' wares, it is by no means sufficient to guarantee success. It does, however, prepare one to begin the next step, which is the selection of the appropriate system or service to meet the library's needs.

SELECTION AND EVALUATION

Once a library's need for data processing services of a particular kind has been established, the next step is to examine the available suppliers of services or equipment. The range of potential choices has already been described in detail. Up to this point, the library's interest and attention has been largely internal and directed toward its functional needs. When the manager turns his attention to the marketplace, however, he is struck by a bewildering variety of suppliers and gadgets competing for his interest. Exhibitors at national conferences and advertisers in the library press are the most conspicuous in this regard. Often, salespeople are encountered who know something about their own wares, but little or nothing about the ways in which libraries operate. Few experienced librarians have been hired to market data processing systems to libraries. Furthermore, since many library managers are better characterized as traditional humanist/scholars than as businessmen, they often do not make very good purchasing agents. This situation is worsened by the generally low level of useful information available from vendors or their representatives about a given system regarding its library applicability. In spite of this, the librarian must make a choice on the basis of a survey of available vendors; although to a degree one simply proceeds with common sense, it is usually helpful to outline the alternatives. A document summarizing the library's general and detailed specifications is a fitting starting point for this survey. The specifications may be sent to several vendors, and responses (perhaps including bids) may be requested. Once these responses have been received, it is time for evaluation.

EVALUATION

There are basically four types of input to a system evaluation:

1. Vendor's documentation of equipment or service—This includes

the detailed, technical specifications of system capability. This material should be readily available, and although difficult for the nonspecialist to understand, it must be examined and critiqued by someone familiar with both the system and the application.

2. Testimony of users—Purchasers of data processing services and equipment become very other-directed in the evaluation stage. No sensible manager wants to commit large resources in personnel and finances to dependence on a machine system that has not been extensively field-tested for capability and reliability. As pointed out earlier, the acquisition of a computer system has a profound effect on an organization and how it works. Not infrequently, disillusioned librarians have found themselves serving the needs of the machine, rather than the other way around. The system can be ten times more exacting than the most compulsive cataloger.

The wise purchaser checks early with other users of the candidate system—both those whose names are volunteered by the vendor, and others not given that he is able to uncover on his own. The questions he asks are many and detailed; he wants to know what to expect from the system under all circumstances, so he can make some assessment of how it would work in that most demanding of all situations—his own. Such information is crucial to the evaluation of any system.

Unfortunately, it may not always be possible to acquire all of the optimally desired information, particularly if the system is new. There may be few, if any, experienced users of the system, and the manager's need for the services may be such that he is willing to risk being one of the first users. This is not a comfortable position for a buyer to find himself in. With qualified staff and adequate definition of systems need, a buyer may feel that it is worth the risk to work with a vendor to develop and apply an untested system in order to acquire the needed service capability. This course of action places a strong requisite upon the library to have an expert systems analyst, either as a staff member or as an ongoing consultant. In the more typical case, in which a library is purchasing a system for which a user clientele has been identified, it is generally quite simple to locate a number of users whose installations can be visited, and whose reports can be compared for accuracy, reliability and relevance to one's own situation.

3. Vendor's custom-written proposal and verbal claims—Usually a vendor will submit a comprehensive written proposal with each bid for a computer system or services. These proposals are often

built up from "boiler plate" (modular elements developed for other proposed applications where the vendor has bid the system) and are very general in nature. Promises and claims made in such documents, or in word-of-mouth reports from company representatives, are apt to exceed operational capabilities for even the most respected computer vendor. Needless to say, the proposal or vendor's claim is simply the first response in a long and elaborate negotiation process, whereby the buyer tries to reduce the risks of failure or disappointment to manageable proportions.

4. Consumer reports—There are a number of published services comparable with *Library Technology Reports*, providing documented descriptions of hardware and software capability for the more standard products. These may be identified by scanning any of the standard trade magazines in the field.

STANDARDS

Various standards organizations, such as the American National Standards Institute (ANSI), have been instrumental in defining some basic standards (usually covering materials or methods) for hardware or software capability, as well as data formats. However, these standards have not been made sufficiently specific at the applications level so that they could be useful in selecting one manufacturer's product over another. For other types of library supplies, we have been able to establish useful industry standards, and it is hoped that some of the professional bodies in the library world will promote these agreements in the complicated area of data processing applications. Heinritz has indicated that: "Product standards have helped push manufacturers in the direction of increased standardization. This has in turn had a salutary effect on the quality of such items as book bindings, and has made the purchasing of equipment much easier."[5]

The Technical Standards for Library Automation (TESLA) Committee of the ALA Information Science and Automation Division has begun to envisage a useful role for itself as a liaison between system users and producers by providing a meeting ground for representatives of both groups. TESLA is now working toward the rationalization of optical coding structures, and methods of physical encoding, that can be useful to libraries in the application of existing codes, such as the International Standard Book Number (ISBN) and the International Standard Serial Number (ISSN), as well as ensuring compatibility with codes developed in other industries, such as the Uni-

versal Product Code (UPC) now being used to mark grocery merchandise. In this way library industry standards may be developed to meet universal library needs, somewhat in the manner in which microform industry standards have been promulgated by the National Microfilm Association.

MODE OF ACQUISITION

Quite often in high-technology equipment areas, where rapid innovation contributes to the obsolescence of existing equipment, consumers will tend to lease rather than purchase. Many, if not most, main-frame computers are acquired on lease because of this factor and because of their high cost. Minicomputers, which are priced at fractions of main-frame computer costs, are more often purchased outright. Frequently, lease%purchase agreements can be arranged for computer-related equipment, whereby lease fees can be converted to partial purchase payments at an established schedule, such as 30 percent%30 percent%40 percent, payable in those proportions in successive years.

A purchase price for a computer system or services is usually submitted in bid form in response to specifications, since each application usually has some unique combination of hardware and software requirements. Sometimes bid prices may be negotiable, based upon a range of variable market and delivery factors. In any case, the conditions of delivery and payment can introduce fundamental and important characteristics into the relationship of vendor to purchaser. These stem from the the long-term nature of the purchase, mentioned earlier. A purchaser of computer equipment must usually plan for a long-term close relationship—almost a kind of marriage. This is generally necessitated by the purchaser's ongoing need for specialized service and maintenance of the hardware and software components of the system. In fact, the demonstrated competence of the vendor to guarantee rapid, responsive, and reliable service for a computer system is a major factor in any contract negotiation. Once a library acquires a computer, it may not later be able to function without it. It will have become an integral, essential part of its operations.

Often the first tangible commitment to a vendor for computer services or equipment will be a letter of intent requested by the vendor. This document represents a semiformal contract to acquire services or equipment as of a certain date at a specified cost. Because

of the lead time required for manufacture, sales, delivery, and installation of computer services, a vendor may require this advance letter of intent in order to be able to schedule his pre-installation activities better. The buyer, on the other hand, may wish to commit a vendor to a specified current price for the sale of equipment to be delivered at a later date, when inflationary factors may be expected to have produced a price rise. Letters of intent can be worded so that there is no financial loss if the transaction does not take place.

FACTORS TO BE COVERED IN CONTRACT

The delivery and installation of computer systems and services is usually tightly scheduled in terms of a complex network of interrelated planning, staffing, service and financial factors. Often, operational problems and increased costs may be incurred if there is an unforeseen delay in delivery and successful installation. Sometimes, there may also be cost benefits to the buyer if the system could be made operational before the scheduled deadline. For these types of situations, it may be possible to negotiate penalties for the vendor (perhaps in the form of discounts to the buyer) for delayed delivery, and bonuses for advanced delivery. It is usually desirable for the librarian to check in advance with his institutional legal and purchasing offices to ensure that the contract meets all regulatory requirements and will not later be a source of embarrassment to the institution.

SAFEGUARDS

When purchasing equipment from a large, reputable company, the known service record and integrity of that company often provide some measure of security and assurance to the signing of a contract. If the company's capability and service record appears good, but the company is small (size and limited capitalization is a factor of concern in terms of their future viability), the buyer may wish to demand a performance bond. This instrument can provide protection and reimbursement to the buyer for damages suffered from noncompliance, or a default in meeting contract obligations. Unfortunately, a small company might not be able to acquire such bonding except at an intolerable cost or dislocation to current operations.

An alternative method of reducing the risk of damages or contract default is the negotiation of an incremental payment contract, which

provides that only partial payments will be made until final delivery and equipment acceptance is assured. In some cases, payment may be made in escrow so that it may not be touched until satisfactory system performance has been demonstrated. Of course, in these cases, it is of crucial importance that there be a clear definition of "satisfactory performance," such that all necessary functions and tasks are precisely specified. The buyer should be aware that this last condition may be easier to fulfill in theory than in practice.

It should be evident from the foregoing observations and warnings that the writers believe that the quality of the decision-making process which leads to the purchase and installation of computer systems is very much an ingredient of whatever success or failure is experienced in the system's operation. Once a computer system has been installed, it is seldom possible simply to unplug it, replace it, or abandon it if its operation proves less than satisfactory. This might easily be done with the electronic equipment, but the total system includes much more than hardware. A computer information system is different from a malfunctioning television set that can be repaired simply by calling in a competent serviceman. The total system includes other subsystems: the software, the data to be input, the procedures and tasks to be executed, and the trained personnel to perform all of these operations. Because of the interlocking effects of change among these subsystems, the need for a fundamental change or replacement of an inadequate computer system may be identified and resolved only after months or years of frustration, characterized by recurring patron discontent and administrative malaise.

For all of these reasons, the buyer is urged to be circumspect about vendors' future claims that are not substantiated by verified experience, and to be exacting in the specification of suitable conditions to define system acceptability.

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