CHAPTER 4

DATA ANALYSIS, OBSERVATION AND FACILITIES PLANNING FOR INFORMATION TECHNOLOGY

Data analysis is necessary for a scientific study and for ensuring that the relevant data is available for making comparisons and analysis. Processing implies editing, coding, classification and tabulation of collected data. Analysis of data, in a general way involves a number of closely related operations, which are performed with the purpose of summarizing the collected data and organizing these in such a manner that they answer the questions posed.

Regarding Data Analysis Busha & Harter say:

"An explanation of techniques to be used for data analysis is an important part of most research proposals. The proposal should contain a clear outline of methods that will be employed to collect, describe, and analyse data, as well as a description of safeguards that will be applied to help ensure the correct application of investigative techniques" (58).

In the present study, the data analysis of the questionnaire will lead to the findings which will help in assessing and ascertaining the existing floor space and the future plans for the library facilities, co-operation and resource sharing in the University Libraries of Maharashtra.

Looking into the above aspects of the study, the data collected from the questionnaire was analyzed for each of the item and interpreted accordingly. Information technologies and library facilities affect one another in both design and physical space: (1) the introduction of information technologies into a library influences the design of existing space and the characteristics of available space may constrain the use of the technology; and (2) the technologies themselves can affect the overall space requirements for a library by reducing the requirement in some cases, increasing it in others.

This thesis discusses a variety of information technologies focusing on mature applications-those that have demonstrated their utility and reliability, and require neither leaps of faith nor suspension of disbelief by funding/administrative authorities. Reflecting the researcher's beliefs and his experiences working with libraries, this thesis also acknowledges resource sharing as a significant and growing factor in space planning, technology utilization and collection development.

While a significant percentage of core reference materials will be accessed electronically in future years, University Libraries will likely continue to have substantial collections of print materials. Lesser-used monographs will increasingly be stored compactly in movable aisle compact shelving or in automated storage and retrieval systems. Statistical directories and bibliographical works will become more widely available in machine-readable form, the format in which they are most effectively used. Electronic publications—both full-text and image formats—which need to be revised only a few times a year will probably be distributed on CD-ROM or other optical media with updates sent by e-mail. Publications needing to be revised more frequently will be distributed on rewritable optical media, which can be updated either by downloading information from a remote resource database or by loading new data from diskettes, sent by the supplier.

Backfiles of journals, patents and other types of materials now often maintained on microform will increasingly be stored as images or full-text on optical media for rapid retrieval—both from within the library and remotely from elsewhere in the organization, but libraries are not likely to convert their extensive existing microform holdings to other formats. A majority of journals will continue to be published only in print format; thus there will continue to be a need for telefacsimile (or a related technology) to scan and transmit document images.

Far more terminals and PCs will be deployed within a library, not only for staff use and patron access to the local online catalogue, but also for access to a wide range of information resources both within and outside the library. These resources will encompass both bibliographic records and full-text and image files.

In the past two years, the author has visited more than 20 academic, public, special libraries and cross-section of University Libraries in Maharashtra. An analysis of this base indicates a high degree of interest by library managers in information technology, but a lower level of technology understanding. The needs for information concerning the impact of information technologies on library space requirements both long and short-term were a major catalyst in preparing this thesis.

Of the libraries visited, none library has movable aisle compact shelving; only three have an automated storage and retrieval system. Telefacsimile is available in 80 percent of the libraries, but microform is the most widely used information technology—all libraries visited have some holdings. Fewer than 10 percent of the automated library systems are interfaced with those of other libraries using the Z39.50 standard or other linking techniques. Electronic journals are used by fewer than 15 percent of the libraries, but CD-ROM is
more widely implemented, with at least one product in 80 percent of the libraries visited.

Local Area Networks (LANs) are installed in only 25 percent of all libraries. Backbone networks exist on over 15 percent of the academic campuses. All of the libraries visited participate in inter-library loan with other libraries, and a bibliographic utility or other electronic location/messaging system is available to more than 50 percent of them.

Many libraries are using all of the information technologies described in this report, as well as virtually all of the space saving techniques discussed except movable aisle Compact shelving. However, no institution appears to have implemented a comprehensive programme, which addresses all aspects of technology and space use and planning. (See appendix A)

The structure of this Chapter reflects all of these expectations and observations. Part.1 focuses on technologies for storing and accessing traditional print collections, including movable aisle compact shelving, automated storage and retrieval systems, microform, and digital telefacsimile. Part. 2 addresses space requirements and the implications of automated library systems, service bureau support for library automation, electronic publications, and document imaging. Part. 3 deals with the physical infrastructure required to support electronics in libraries; cabling, local area networks, and interlibrary networks. The final part presents recommendations for space planning and managing information technologies in libraries.

4.1 SPACE CONSERVING TECHNOLOGIES

This part examines technologies which libraries select primarily to conserve the amount of space devoted to the storage of traditional print materials. All of them are in use in libraries today and all have demonstrated utility and cost-efficiency in applications intended to the challenges of accessible storage of printed material. Movable aisle compact shelving and automated storage and retrieval systems combine traditional formats and facilities in non-traditional, high density storage applications; microforms represent an alternative approach, compacting the volume of the material to be stored; facsimile represents a third approach, supporting the substitution of remote access for local storage. In keeping with the mainstream focus of this chapter, this discussion excludes emerging technologies-large scale use of digitized image banks, for instance and storage approaches judged to be beyond the reach of the majority of libraries, such as remote storage facilities.
4.1.1 Technologies for Storing Print Materials

The technologies with the greatest potential to affect library space requirements are those, which can be used to store, print materials. They also have a dramatic impact on the structural requirements of facilities in which they are installed.

4.1.1.1 Conventional Open Stack Shelving

The most common type of storage opens to patrons-conventional open stack shelving-uses stationary cantilever or bracket-style adjustable shelving. While several heights and shelf depths are available, the most widely used is 90-inch high, double-faced shelving with one fixed and six adjustable shelves. The shelving, nominally 10 inches deep, is configured in bays 36 inches wide. It is usually installed in ranges of 21, 24, or 27 feet long. When steel of the correct 18 gauge for shelves and 16 gauges for other components is used, such shelves support fully loaded 36 inch shelves. Cantilever shelving also can be installed without a canopy top, allowing units to be configured with seven shelves per section, extending beyond the 90-inch height of the uprights except when shelves are spaced to accommodate quarto and folio volumes.

The storage capacity of such shelving is usually quoted as 10 volumes per square foot, a figure that assumes that the shelves will be approximately 60 percent filled. When that point is reached, planning should begin for additional shelving. By the time the shelves are 84 percent filled it becomes difficult to accommodate the random addition of newly catalogued material without excessive rearrangement of existing materials. At 90 percent, shelves are considered fully loaded.

The weight-bearing capacity of any structure is described in terms of “dead load” and “live load”. Dead load is the weight of the structure itself, live load the weight of elements that can be moved around within a building. The weight of a fully loaded (90 percent of capacity), double-faced, 36-inch shelving section of seven shelves is 1,120 pounds. Thus, the conventional open stack shelving most widely installed in libraries (seven shelves per section with 32-inch aisles) requires a floor with a live load capacity of 150 pounds per square foot (PSF), a figure which includes a 50 percent safety margin. ADA requirements now set a minimum of 36 inches for aisles in any new construction or major renovation, reducing the live load to approximately 140 PSF.

Conventional open stack shelving is expensive not only because of the shelving cost, but also because of space requirements. Technologies, which make it possible to increase the storage capacity of each square foot, should therefore be considered. Most librarians and architects are familiar with the
construction requirements for conventional open stack shelving, but are less well-versed in the technologies affect lighting and power requirements in addition to floor loading; they are discussed in some detail in the following pages.

One of the most comprehensive and useful discussions of conventional open stack shelving is that by John F. Camp and Carl A. Eckelman entitled “Library Bookstacks: An Overview with Test Reports on Bracket Shelving” in Library Technology Reports, November-December 1990. It is essential background reading for anyone planning to purchase either conventional open stack shelving, or movable aisle compact shelving.

4.1.1.2 Movable Aisle Compact Shelving

Movable aisle compact shelving is installed on carriages that ride on tracks. The ranges move as a unit, relying on mechanical or electrical power, creating an aisle where needed. A single aisle services a series of stacks. If used in an area open to patrons, compact shelving units should be configured with at least one aisle for each ten ranges, and safety devices are required—including both floor and hip level sensors. (See Appendix "B")

The single most important factor when planning for compact shelving is the ability of the floor to bear the weight of stacks and equipment. Movable aisle compact shelving requires floor loading as high as 250 PSF, necessitating either special construction or ground floor installation. However, not all ground floors can accommodate movable aisle compact shelving; because the soil underneath the building may not be firm enough to support the load. Floor loading must be tested before planning the installation of this type of equipment.

When floor loading permits, movable aisle compact shelving can double the storage capacity of an area to as much as 20 volumes per square foot when shelves are 60 percent full. Open access, perpendicular-sliding movable aisle compact shelving systems are the most widely used because they do not require staff intervention to retrieve materials, and are less expensive, less heavy and more reliable than other types of compact shelving.

Open access, movable aisle compact shelving works best when used to house entire collections of lesser used materials such as rare books, special collections, documents, or backfiles of periodicals. It is costly and confusing to remove individual monographs or varying lengths of periodical runs to movable aisle compact shelving. To avoid confusing patrons, it should be possible to describe in a single paragraph what is housed in a compact shelving area. Ideally, the public services staff responsible for a collection stored on movable aisle compact shelving should be located near that stacks area.
Lighting in areas equipped with movable aisle compact shelving should be placed perpendicular to the ranges to prevent shadows being cast when aisles are moved. While no data cabling is required for the stacks, there should be provision for online patron access catalogue terminals in areas accessible to users. The most common approach is to install one or more such devices just inside the entrance to the area housing the compact shelving.

The best source for more detailed information about movable aisle compact shelving is "Planning for a Movable Compact Shelving System" by Frank Bright (Chicago: American Library Association, 1991).

4.1.2 ISSUES IN SELECTING STORAGE FOR PRINT MATERIALS

There are a number of issues, which must be addressed in evaluating, option for storing print materials. The effects on use, user acceptance, protection of the collection, reliability of retrieval, construction implications, staffing implications, and costs are considered in the following pages.

4.1.2.1 Effect on Use

The method or combination of methods, used to store a library’s collection affects the use of that collection. The effects need to be considered in assessing and selecting space saving methods of storage. Any negative impact on use will mean that the financial investment in a collection will not be fully leveraged, a lack that represents a cost to be acknowledged.

Call Number Sequence: Patrons in open stacks libraries are accustomed to collections arranged in call number order the “unitary” approach to organizing a collection. Most libraries exempt oversized books, periodicals, government documents, special collections and the like from such treatment; nevertheless, the idea is to make it possible for a patron to find an item with little more information then is provided by its call number. When a patron does seek assistance from a library staff member, the ideal is for the staff member to be able to pinpoint the location without having to consult a finding guide or catalogue.

Although conventional wisdom holds that any deviation from a unitary collection in a single call number sequence on standard shelving in open stacks will have a negative effect on use, this is not necessarily the case. Experience at several university libraries indicates that the removal of a well defined collection such as all bound journals from ten years and earlier from call number sequence to movable aisle compact shelving does not have a noticeable negative impact on use on those journals.
Bibliographic Access: The quality of bibliographic access to library materials is always an issue, but it becomes a particular issue if patrons cannot examine materials on the shelves. Even a catalogue, which conforms fully to current cataloguing standards, may not answer all questions, patrons searching the catalogue may have. In an open access environment, patrons unable to meet their needs from the catalogue can go to the stacks to examine materials and browse; in a restricted access environment the catalogue must substitute both for known item look-up and for browsing in the stacks.

Because more and more patrons access online catalogues, periodical indexes and other databases from their offices, homes and dorms, the quality and completeness of bibliographic descriptions have become increasingly important in the past few years. For materials not available locally, users already rely almost entirely on electronic browsing. It is only a matter of and it will be a choice of approach by many seeking materials in their local library.

An online catalogue linked to a high quality bibliographic database can provide access by call number, keyword and up to 30 additional indices. Boolean operators and search limiters further expedite searching by experienced library users. If the bibliographic records include links to the tables-of-contents for monographs, the need for access to open stacks for browsing would be even more substantially reduced.

Fullness of the Shelves: The fullness of the shelves can have a negative impact on use of materials in open stacks or movable aisle compact shelving. At 90 percent full. It is difficult to reshelf items and keeps material on the shelves in order. There are no negatives related to the fullness of an automated storage and retrieval system-even at 100 percent.

Prompting: Any negative effects due to removing materials from the unitary arrangement usual in open stacks can be reduced by inserting well-designed prompt screens in the online catalogue to alert users to the fact that the materials they seek are readily available onsite, in another location, perhaps in a movable aisle compact shelving area or an automated storage and retrieval system.

Selection of Materials for Compact Storage: Careful selection of materials to be taken from conventional open stacks and placed in compact shelving or an automated storage and retrieval system can further minimize negative impact on use. An obvious choice for automated storage and retrieval systems is those materials traditionally accessed through indexes and abstracts rather than by browsing.

User Education: User education sessions and handouts for all potential users increase their awareness, knowledge, skills and confidence in accessing
materials in a library, and keep them up to date with changes in the availability and location of resources.

A major factor in achieving a high availability rate and thus potentially a high success rate, is the direct availability of materials on the shelves. Direct availability can be augmented by patron accessibility to a system that provides access to circulation records which indicate materials that are charged out and an effective mechanism for placing holds against circulating materials and/or issuing recalls for such items.

The success rate of any open access approach is affected by the possibility of materials being unavailable due to mis-shelving. Miss-shelving may be the result of a simple shelving error or intentional misplacement by patrons seeking to restrict access by anyone but themselves. A restricted access storage approach increases the integrity of the collection and the success rate to nearly 100 percent, but at the expense of browsing.

4.1.2.2 User Acceptance

Use of collections, however they are shelved, is affected by user attitude. Convenience is the single most important issue, but one for which the definition may differ for experienced and inexperienced library patrons. Experienced patrons may consider “Browsability” a convenience, while less experienced users may view retrieval by staff as the ultimate inconvenience. Ease of browsing also is affected by the reliability of retrieval if materials are shelved out of order, then browsing is handicapped. Browsability must, therefore, be examined in the light of practical constraints.

Browsability involves looking on the shelves in search of what has already been identified and for related materials. Such serendipitous discovery is important to many patrons, especially in research libraries. On the other hand, university undergraduates often look for a limited number of titles and would like to limit the retrieval time. Interviews conducted by the author at many University libraries confirm that the majority of students want to obtain a few titles quickly; faculties are more interested in browsing.

Browsing is used primarily to locate monographs, not journal articles. Most library patrons use electronic indexes and abstracts to obtain journal citations. Electronic tables-of-contents for monographs are not yet widely available in University Libraries of Maharashtra, but if they were available in automated library systems and linked to bibliographic records so these could be retrieved by a single keystroke, electronic browsing might become a popular alternative to shelf browsing.
In addition to full cataloguing and other enhancements to access, browsing of restricted materials can be facilitated by permitting users to request an unlimited number of items and providing convenient seating for those who need some time and space to peruse them.

4.1.2.3 Protection of the Collection

A Collection must be protected against theft, heat, humidity and seismic activity. Theft protection is the most difficult as it involves overcoming the conscious efforts of individuals; any collection is vulnerable. The insertion of security targets in materials and electronic sensing devices at library exits can reduce the loss rate, but can not eliminate it. Concealment of high-demand materials within a library to assure exclusive access cannot be controlled by other than regular clearing of carrels and reading of shelves. When materials are available to patrons only by library staff retrieval, theft and concealment can be almost eliminated.

4.1.2.4 Construction Implications

Library materials are heavy, requiring buildings with at least twice the floor load capacity of conventional classroom and office spaces. While it is possible to increase the floor load of space not designed for use as book storage, such modifications are costly. Therefore, library space is usually built-to-purpose. The usual floor-loading standard for libraries is 150 PSF, a standard that assumes conventional open stack shelving. The floor load capacity must be increased by as much as 66.7 percent for movable aisle compact shelving and 100 percent for an automated storage and retrieval system. It is rarely cost-effective to increase the floor loading of existing floors beyond 150 PSF. Equipment which requires more than 150 PSF is usually installed in new construction or on the basement / ground floor of an existing building where the additional weight will not be a problem. However, testing is still essential as some soil conditions may make even a concrete slab plain or unstable.

4.1.2.5 Analysis of Storage Options

While the concept of a unitary collection is attractive, it is not wholly realized in any library. Invariably periodicals, documents, oversized items and special collection materials are shelved separately. The practical issue is whether monographs with the same class number will be shelved together or split between two locations based on frequency of use. When they are split, patrons may fail to note the location code unless the online patron access catalogue prompts them to request the material, rather than going to the open stacks. In a split collection, staff presented with only a call number will not be able to determine where the item is located without consulting a computer
terminal. However, a single inquiry will establish not only location but also current availability status.

Ideally, individually classed items would not be moved from conventional open stacks to movable aisle compact shelving or an automated storage and retrieval system; such relocation would be limited to resources normally shelved in blocks. However, this is not realistic in libraries, which do not have thousands of journal titles and extensive document holdings, so it must be assumed that some of the items, moved to high-density storage, will be monographs. User education must emphasize the need to note shelving locations as well as call numbers.

Good bibliographic access, including online catalogue access to tables-of-contents data for monographs, will reduce the need for browsing. This benefits both automated storage and retrieval systems and open access shelving. Good bibliographic access facilitates faster and more meaningful remote browsing from an office, dormitory or home. The author recommends that imaging of the tables-of-contents of monographs be an integral part of any plan to implement an automated storage and retrieval system.

The concern for browsability must be balanced with concern for the success rate of library patrons in finding materials. There is considerable evidence that in open stack facilities with either conventional shelving, or movable aisle compact shelving library patrons locate only about half of the items they find in the catalogue. By contrast, the success rates in finding or accounting for items housed in automated storage and retrieval systems are nearly 100 percent.

The protection of a collection against theft, temperature, humidity, fires and seismic activity should not be ignored. Theft in libraries is increasing and libraries are responding by installing electronic security systems, which have reduced casual theft but hindered the determined thief. What the presence of electronic security systems may do is to prompt would-be thieves to move materials to another place within the library, not out of the door. An automated storage and retrieval system definitely deters both types of behavior.

4.1.3 Microforms

Microforms have been used in libraries for over 60 years. Therefore, the following discussion will be limited, with the emphasis on the most common problems and the probable future of the technology. For a detailed discussion of Microform storage and handling, consult “Stability, Care, and Handling of Microform, Magnetic Media and Optical Disk” by William Saffady in Library Technology Reports for January-February 1991; for facilities planning, consult

Preservation provided the initial impetus for using microform but by the late 1930s space saving especially for backfiles of newspapers was a frequently cited motivation. By the 1950s, there was a widespread realization that microform was useful not only for preservation and space reduction, but also a mean of holding materials no longer in print or readily available.

4.1.3.1 Storing Microform

Special storage cabinets with chemical drawers are a thing of the past now because most buildings are air-conditioned and diazo service copies are widely used. Microfilm is most economically stored in microfilm filing boxes, which can be shelved in conventional open stack shelving or 11-drawer microfilm file cabinets. Each file drawer holds 135 16mm rolls or 80 35mm rolls, for total of 1,485 or 880 reels, respectively. Microfiche is best stored in 9-drawer microfiche cabinets which hold 116,100 4x6 fiches. Each cabinet requires approximately five square feet of floor space and 10 square feet of circulating space. The weight of full cabinets requires a floor with a loading of 150 PSF, same as conventional open stacks.

Microform is a space saving medium but storage economy can be improved further by storing it in movable aisle compact shelving. The relatively low level of use of microform makes it an ideal candidate for such storage.

4.1.3.2 The Future of Microform

It is likely that microform publishing will be replaced 100% by electronic publishing in the next decade or so. (Most of the international organizations and Publishers have stopped producing microform and CD-ROMs and started web- based pages with full text like e.g. International Nuclear Information Systems (INIS); World Health Organization (WHO) etc. The latter is comparable in cost but much more flexible, allowing not only rapid retrieval of specific images but also remote access. The principal advantage of microform-its archival lifespan is gradually being achieved by electronic media. Even if the latter require copying of a new master every 50 years, it can be considered comparable.

The demise of microform publishing will not mean the disappearance of microform from libraries. Most libraries have so much invested in microform that it would be impractical to replace materials already held in that format. Rather than reformatting existing resources, libraries will likely choose to spend their funds on acquiring new materials regardless of format.
Furthermore, the basic equipment necessary to view microforms will always be available.

4.1.4 Digital Telefacsimile

It will be some years before a substantial percentage of the information libraries seek to collect is in machine-readable form. A scenario more plausible is that of a paperless, virtual library is one in which a library has a combination of hard-copy and electronic resources. An adequately funded library’s collection typically grows at a rate of 5 percent per year. Were an organization to commit half of its acquisitions budget to information in electronic form (an unlikely scenario), three-quarters of its collection would still be in hard-copy format two decades after implementing a “50 percent electronic” acquisition policy. For the next 20 years at least, libraries will have to be designed with room for books, journals and microform readers as well as accommodation for computer rooms, terminals and a number of other electronic devices.

Because of the continued existence of hard-copy information, libraries will need to implement systems to support the electronic transfer of information not in machine-readable form. While the digital Tele-facsimile machine is the principal tool, digitizing scanners, which can transmit a higher quality image cost effectively over the Internet, are being adopted by hundreds of institutions. The most popular device is Ariel, developed by the Research Libraries Group.

No inter-library loan unit should be planned without provision for a digital fax machine or its equivalent. In libraries that handle more than 10,000 inter-library loans for serials, there should be provision for at least two machines. Since most fax machines handle single sheets rather than bound volumes, the area should also be equipped with a photocopier.

The library administrative office should also be planned to accommodate digital telefacsimile equipment. In a small office, the fax function might be combined with photocopying, or with a PC configured with a fax board, scanner and printer.

Summary

If conserving space is important to a library, the technologies which are most effective are movable aisle compact shelving, automated storage and retrieval, microform and digital telefacsimile. While not as exciting as electronic publishing and access to remote databases, they should form the foundation of any systematic facilities plan.
4.2 Electronic Information Technologies

Until 1980 most automated library system installations were single function systems using brief bibliographic records and supporting only circulation control or acquisitions. The increasing power of computers supported broader functionality and by 1990 most vendors were offering acquisitions, serials control, cataloguing, circulation and online patron access catalogue modules. Among the other modules available or in development in 1995, were inventory, information and referral, media booking and interlibrary loan. Each added capability affects memory and disk storage requirements.

Since 1980 most libraries have entered full bibliographic information in machine-readable form into their automated library systems. Increasingly, such systems are being used to provide access not only to records for monographs but also to journal citations previously accessible only through printed periodical indexes and remote database services. A patron can now undertake a search by author and/or subject and retrieve both monographs and journal articles. A link from the journal citation file to the serials control module provides information as to whether a citation can be filled from local holdings. Adding journal files to the local automated library system significantly increases disk storage requirements and increases the number of terminals needed to support patrons.

More recently libraries have begun to augment bibliographic files with full-text files for reference publications such as directories, dictionaries and encyclopedias, requiring substantial additional disk capacity.

Libraries also are beginning to electronically store and access images of printed publications and other formats unavailable in the ASCII format-images of print text, manuscripts, photographs, slides and even motion videos. The impact of this development is not limited to disk storage; images significantly increase the demand for remote peripherals and more extensive and capacious telecommunications links.

4.2.1 Integrated Systems Approach

The integrated or total systems approach to library automation uses a single bibliographic file to support all functions (acquisitions, serial control, circulation, online patron access catalogue, etc.). While this approach was accepted as a goal 20 years ago, it only became a reality in the past decade. As recently as 1985, few patrons were able to enter a search and obtain holdings information and availability data about materials on order, in process, on the shelf, in circulation, or at the bindery. Since up to half of what a patron requests may not be on the shelf, the addition of availability information was a significant advance.

4.2.2 Building Local Databases

As library staff and patrons increasingly come to regard terminals or PCs as gateways to a wide variety of information sources, there will be increasing interest in converting the many manual files and indices in libraries to machine-readable form. While it has proved cost-effective to build local bibliographic databases by extracting records for published materials from resource files, no such sources are available for highly specialized local files and indices. What is needed is a fast, low-cost method of electronically converting printed or typewritten text into machine-readable form. Despite progress in optical character recognition (OCR) technology, it is not possible yet to satisfactorily scan catalogue cards or similar records in Maharashtra Libraries.

There is no doubt that OCR equipment performs well on simple monographs or typescript-like materials, especially if the text has been prepared according to a set of formatting standards. Because considerable human intervention and oversight by those knowledgeable about the material are scanned is required when library records are scanned, it is a good idea to do the work within the library. A report on OCR software “Optical Character Recognition Software for IBM-Compatible Microcomputers: Library Applications and Test Reports” by William Saffady was published in Library Technology Reports for September-October 1991.

When OCR equipment becomes more flexible, libraries will need to be able to accommodate the equipment in the library. The best approach would be to combine OCR, microfilming and imaging in a single reproduction room.

4.2.3 Client / Server Architecture

Client/Server architecture has become a hot topic in the past year, with almost every automated library system vendor claiming to be implementing this approach. Client/Server is a computer architecture which divides functions into client (requestor) and server (provider) sub-systems, and uses standard communication protocols such as TCP/IP and Z39.50 to facilitate the sharing of information between clients and servers. The November-December 1994 issue of Library Technology Reports contains “Client/Server Technology for Library with a Survey of Vendor Offerings” by Richard W. Boss.

Among the significant characteristics of client/server architecture are:
- The client and server perform different tasks
- The client and server usually operate on different computer platforms
- Either the client or the server may be upgraded without affecting the other
- Clients may connect to one or more servers; servers may connect to multiple concurrent clients
- Clients always initiate dialogue by requesting a service.

Client/Server architecture is most readily differentiated from hierarchical processing which uses a host and slave configuration by the PC functions within a system. In a client/server structure, the PC-based client communicates with the server as a computer; in hierarchical processing the PC emulates a "dumb" terminal to communicate with the host. In a client/server relationship, the client controls part of the activity; in hierarchical processing, the host controls all activity. In a client/server environment, a client PC is almost and always responsible for screen handling, menu or command interpretation, data entry, help processing and error recovery.

A Client usually is configured on a PC (and a server on a Pentium, super micro, mini or mainframe), a single machine that can act as both client and server on a network. For example, two automated library systems in different libraries which are linked for resource sharing function as clients when requesting information and as servers when providing it.

A single client may communicate with several different servers as, for example, when a PC-based client can access not only a local library system, but also a CD-ROM server, a remote local library system and a remote database service.

Typically, a library staff member or patron formulates a request in the query language of his or her PC (the client); this is translated into an information request in standard format such as Z39.50 or a proprietary format understood by the information source (the server). The link between the client and the server may be a LAN (Local Area Network) within the building, an organization-wide LAN or a WAN (Wide Area Network) which links several LANs together using telephone company circuits. Upon receiving the standardized request, the information source (server) retrieves the appropriate data, packages it in a standard form, and ships it back to the PC (client). The server does not need to know the query language of the client to respond to the request. That is why a client can be used to access many different servers.

There are two major applications for client/server configurations in a library environment: (1) as the architecture for an automated library system and (2) as an approach to linking heterogeneous systems. In the first application, a
vendor designs a system using client/server architecture to facilitate use of that system to access multiple servers in an organizational environment in which clients are already in use, to facilitate bringing together multiple product lines and to improve staff/patron productivity. In the second application, a vendor designs a client to facilitate transparent access to systems of other vendors, and a server to facilitate transparent access to its system from others. While the underlying principles are the same, the vendor has considerable latitude in the design of its own client/server system, but must conform strictly to standards when using the client/server to link its system with those of other libraries.

Client/Server architecture affects cabling and electrical power requirements in libraries. Cabling for client/server applications almost and always involves a LAN, which is shared with other applications and PCs are more sensitive to electrical circuit disturbance than are terminals. Cabling and LANs are discussed in the next part. As to electrical requirements, it is essential that each PC be on a circuit free of motors of any kind; this means either a conditioned circuit or a regular circuit with a power conditioner at the point where the PC connects to the circuit.

4.2.4 User Interfaces

Offering a user access to multiple resources from a single terminal is a major step forward in user service, but full exploitation of this capability requires that access to the system(s) be easier than it is now. An information retrieval system will tend not to be used whenever it is more troublesome for a patron to obtain the information that not to obtain it. To most users, the terminal is the computer. Resistance to the terminal means resistance to the system.

Therefore, increasing emphasis will be on the development of user-friendly terminals. The use of a terminal is perceived as either pleasant or unpleasant depending on the confidence felt by the user. The more special the command language to be learned is, the greater the chance of making a mistake. The greater the chance of making a mistake, the greater the discomfort of the user, and the greater the resistance to the technology. This problem will increase as libraries install more patron use terminals.

So-called “dumb” terminals-devices without memory or storage-which are the most common today, are gradually being displaced by PCs. The development of user friendly interfaces for remote peripherals with memory and the dramatic decreases in the cost of PCs have led many vendors to begin the development of Graphical User Interfaces (GUIs).

GUIs interface with users through icons and other graphics rather than text and menus. They make the system easier for novices to use and are
equally valuable for the expert because they can support multiple concurrent sessions, with multiple windows available for displaying information. While many people associate GUIs with client/server architecture, it is possible to use GUIs on a hierarchical system. PCs supporting GUIs in a hierarchical system have the same power requirements as PCs in client/server systems. GUIs, which are now available from only a few vendors, will be generally available within two to three years. Some libraries have preceded with their own development efforts. Their PC-based workstations provide access not only to the automated library system but also to CD-ROM drives on a LAN and the Internet.

4.2.5 Impact on Space Planning

Now that it is realistic for most libraries to consider the implementation of automated library systems, they must anticipate the impact of such a system on space in their facilities. Many aspects of space planning for automated library system are the same as those for accommodating electronic publications. In fact, interfaces are increasingly being established between automated library systems and electronic publications. The discussion of space has, therefore, been brought together in the last section of this chapter.

4.2.6 Database Services

The terminals of automated library systems can be used to search files other than the databases of other libraries. While most organizations now have one or more separate terminals for searching the remote databases offered by various databases services, the trend is to specify that terminal on the automated library system also be capable of accessing remote databases, usually through a "gateway" in the automated library system. It is probable that dedicated terminals on automated library systems will give way to universal devices which can be used to access the local system, remote library systems, a bibliographic utility, and the remote databases offered by database services or other organizations. If such devices are configured on PCs, the same "device" can also be used to support office functions such as word processing and statistical analysis, as well as subsequently accessing disk-based databases.

As of 2002 (59) publicly available computerized databases numbered over 14,000. Over 4,000 of these were available through only one online service. Only one online service-DIALOG-offered access to more than 900 databases. The number of full text databases is increasing faster than the number of bibliographic databases.

4.2.7 The Internet

Libraries are increasingly using the Internet to access other library systems and remote databases. The Internet relies on a complex set of communication protocols known as TCP/IP. The extensive international network is extremely cost-effective.

Access to databases on the Internet is supported by “telnet”, the transfer of files from the Internet to a local computer is facilitated by a protocol known as FTP; and electronic communication with others who have addresses on the Internet is called e-mail. An Internet server and appropriate software are required for all. Currently, most libraries contract for Internet services rather than install equipment locally but it is a good idea to plan a computer room that can accommodate an Internet server at some time in the future.

4.2.8 Electronic Publishing

An electronic publication is any publication in image or full-text format, which can be accessed electronically, directly or over a network. In this section, the emphasis is on electronic publications, which actually are in the library, as opposed to being accessed remotely through a service bureau. While there are several publication media for electronic publications, including CD-ROM, WORM disks, magnetic tape, and floppy disks, the emphasis here is on CD-ROM, the medium currently used for over 95 percent of all electronic publications purchased by libraries.

Electronic publications on CD-ROM have been widely available since 1986. At that time, most were periodical indexes and abstracts previously available in print or online and some were full-text databases. The emphasis of electronic publishers has been on the production of CD-ROM which stores information in standard ASCII code (a machine-searchable format), a form of encoding that requires one-sixteenth the storage space as digitized images of the same material. ASCII coding permits full-text searching. Other publication media are being investigated but CD-ROM technology is expected to be preferred through the 2010.

4.2.9 CD-ROM Technology

CD-ROM (Compact Disk Read-Only Memory) works the same way as an audio compact disc. A CD-ROM disk (in the computer environment, it is common to use the spelling “disk”) is the same size as an audio disc (11.9cm/4.72 inch). It is replicated from a master in the same way, the data is permanently encoded and no additional information can be written to it, and information is read from the disk using a laser. The only difference from an audio disc is that CD-ROM incorporates a logical file structure to facilitate
locating data, plus an extra layer of error detection/correction. Data is encoded as pits on the reflective surface of the disk. When the disk is read, the pattern of pits is decoded as binary representations of 0 or 1. Approximately 550 to 650MB of data can be recorded on a single disk—the equivalent of up to 250,000 pages of printed text or 1,500 floppy disks.

CD-ROM disk drives are distinguished from magnetic disk drives in that head crashes are not possible, information cannot be written to a CD, and the access time for CDs is slower than for magnetic disks.

While a CD-ROM disk is read from a CD-ROM disk drive interfaced with a PC, CD-ROM is not a true computer storage medium because it can not record data from the local system. Instead, CD-ROM is considered a publishing medium as the coded disks can be replicated in quantity and distributed widely to a large number of users. The development of MS-DOS, CD-ROM extensions by Microsoft Corporation allows any MS-DOS computer to read CD-ROM disks as though it were a form of floppy diskette.

The read/write function on a magnetic disk is performed by a mechanical head which can “crash” against the disk platter, gouging the platter’s surface and possibly causing loss of data; the laser beam used in the optical CD-ROM technology can have no such effect. Information on a CD-ROM is laid out in a single track all the way around the disk, as opposed to the concentric tracks found on a magnetic disk. The head moves at the same speed over each track of the disk, resulting in access times as long as half a second. Recently, however, CD-ROM drives with access times faster than 300 milliseconds have introduced. This improvement makes data retrieval slightly faster than in floppy disks, which have an approximate access time of 400 milliseconds, but CD-ROM is still substantially slower than the 18 to 28 milliseconds of most magnetic disks.

4.2.10 CD-ROM Networks (CD-NET)

CD-ROM was conceived as a single-user technology, but it is expensive to dedicate a PC, drive and CD-ROM disk to each user. Therefore, CD-ROM LAN configurations were developed. Designers planning a CD-LAN should first develop a basic understanding of LAN technology. A library also should study existing and planned enterprise or organization wide and departmental LANs before embarking on a CD-LAN implementation.

4.2.11 Journal Citation Modules

A library should also consider mounting files on the local library system in addition to, or in lieu of, creating a CD-LAN. Not only does the mounting of “journal citation files”, as they are commonly called, support a larger
number of concurrent users than a CD-LAN, but the data in the files can be linked directly to holdings and availability information in the local system, facilitating service to patrons and maximizing use of the local library resources.

While most CD-ROM drives now retrieve information in less than 300 milliseconds, the magnetic disks on a local library system typically have access times of fewer than 10 milliseconds. When 10, 20 or even more concurrent users are accessing an electronic publication, it may be more cost and service-effective to subscribe to tapes and load them into the local library system than to mount multiple copies of a CD-ROM on a CD-LAN. By interfacing the journal citation file, circulation and serials control modules, it is possible to reflect recent serials check-in and circulation activity in the display.

4.2.12 Imaging

Imaging—and related terms such as electronic imaging, digital imaging and imaging technology describes a group of technologies which, in combination, capture, store, manipulate, and transmit electronic facsimiles of images. The images may be pages of printed materials, photographs, slides, motion video, or other original material.

Most libraries’ experience with imaging has been with electronic publications on CD-ROM, which uses the image format rather than full-text. Considerable interest now is developing in the imaging of archival and other information in the library. This section focuses on that application. (As the number of service bureaus experienced in digitizing materials of interest to libraries is very limited, it is assumed that most libraries will initially undertake local imaging projects in-house. {see also Appendix “D” for e-solutions space}

Within libraries, Electronic imaging is used for the conservation and preservation of vulnerable documents (decentralizing access to such materials) and the provision of access to backfiles of journals and other publications in a medium more efficient than microform. The cost of scanning a document for imaging is only slightly more than the cost of microfilming. A number of large libraries and consortia are currently pursuing major imaging projects involving the electronic capture, storage and transmission of document images, including the National Archives of Canada, National Archives of the United States, National Agricultural Library, National Library of Medicine, Research Libraries Information Network (RLIN) and many libraries all around India.

4.2.12.1 Advantages

Imaging systems have several advantages over traditional paper, microfilm, and microfiche systems, the most important being storage capacity,
receptivity to image enhancement to improve readability, and speed of retrieval. For example, a single optical disk jukebox can store the images of at least 2 million and up to 50 million standard-size pages, depending on the material and equipment size and capability. Such capabilities not only depend upon developments in physical storage technologies, but also on sophisticated compression techniques that essentially reduce the size of digitized images. Compression is achieved by removing extraneous information and condensing redundant patterns of pixels in kind of coded electronic shorthand. In this way, images can be compressed 20 to 30 times, an important factor because images require significantly more memory than regular text files. For instance, without compression, the image of a large engineering drawing could require up to 8-MB storage; with compression, the storage requirement drops from 8MB to 300 KB.

Equally important is the ability to manipulate process and reprocess images. Electronic imaged documents can be enhanced to repair damage, remove stains and clarify hard-to-read areas. And like other computerized information, images can be retrieved, updated, organized and readily shared throughout an organization. Finally in library applications one of the most important benefits-stored images can be accessed by several simultaneous users, some of whom may be at remote locations (provided the remote users are linked to the host location via a transmission medium with the capacity to handle the data load of digitized images).

Imaging is not a panacea, but its ability to store, transmit and retrieve large amounts of information (and in multimedia applications, to combine text, numeric and pictorial data) make it applicable to a wide range of uses.

4.2.12.2 Imaging Devices

The first requirement for imaging applications is to create or capture the images, which usually accomplished with a scanner. Available units range from inexpensive desktop, monochrome models, which scan a page in about 30 seconds to expensive, production-oriented machines, which scan 100 or more pages per minute. Scanner resolution ranges from 200 dots per inch (dpi) to 1,200 or more. The desktop model is comparable to a facsimile machine; the production-oriented machine is equivalent to a top-quality photocopier. Digitizing cameras, which output data in digital form, provide production-oriented scanners.

Because images require such large amounts storage compared to other forms of digital data, the high data capacity of optical storage devices makes them the storage medium of choice for many imaging applications. Write-once-read-many (WORM) optical disks are used most often, with small systems using 5.25-inch disks while larger systems use one or more 12-inch
disks. To support the necessary capacity, jukebox arrangements of multiple optical disk platters are common.

Images are most often displayed on high-resolution, large screen monitors with resolutions of 300 dpi. Printing options vary from desktop laser printers for monochrome with 300 to 600 dpi to the more expensive gray-scale and color laser printers.

As with data storage, image transmission can challenge the capabilities of current networks. Images are now being transmitted over experimentally, the Z39.50 computer-to-computer protocol. In all cases, the networks must provide large bandwidths with very high-speed connections, such as coaxial or fiber optic cable. Transferring a single megabyte of image data over a 56 KB line-a line with six times the transmission speed supported by most local automated library systems—would require up to 18 minutes. Few users would be prepared to wait for a multi-image file transmitted at that rate.

A typical imaging system configuration for library applications would consist of: An image server or host: A PC, super micro, mini or mainframe to support the storage and retrieval of images. One or more disk drives or jukeboxes would be attached as would scanner(s), printers, facsimiles(s), and other in/out devices. There also may be specialized hardware for image compression and decompression.

An image workstation: A stand alone PC upgraded to support image processing or a special purpose workstation, which allows for image decompression and manipulation. Depending on the images being displayed, the workstation might be configured with a large screen, high-resolution monitor. A printer also may be attached.

A network or circuit: A high-speed local area network such as Ethernet to link multiple workstations and servers or direct connection of image workstations to the host (see Figure 2) as used by most of today's local library systems.

There are many specialized imaging systems on the market, including turnkey products for banks, insurance companies and hospitals, but fewer general imaging systems. Library packages are manufactured by Horizon and Sirsi Corporation systems.

Figure 1
4.3 Space Requirements for Electronic Information Technologies

A number of space requirements should be taken into consideration when planning facilities to accommodate electronic information technologies.

4.3.1 General Requirements

The type of space, rather than the amount, is the big issue in planning for the use of electronic information technologies. The following general requirements apply regardless of the electronic information technology:

The emphasis in planning lighting should be on the quality of light, rather than the level of light. Any screen is easy to read in a lighted room if there is no glare. Special lighting for areas with electronic equipment should, therefore, be avoided. Attention should be paid to minimizing glare. Ideally, all lighting throughout the facility should be indirect, recessed, or parabolic so that glare on screens whether computer, video or microform-will not be a problem. Sensors should be installed in all computer and communication rooms to detect heat, smoke and water, with an alarm that sounds not only within the building but also at a staffed remote facility when the library is closed. There should be heat/smoke detectors throughout the library. Sprinklers systems should be avoided, but if required, zoned dry-pipe sprinkling systems should be used to minimize water damage.

4.3.2 Computer Room Requirements

Most computer manufacturers represent that their equipment is designed to operate in normal office environment, but if a library seeks reliability guarantees, it is essential to accommodate the equipment in a controlled atmosphere of temperature, static electricity, humidity and airborne contaminants.

**Space Requirements**: A Computer system must be located in an area with a minimum of three feet of clear space at the rear and four feet at the front, to permit servicing from behind and operating from the front and assure ample airflow around the equipment. Racks or cabinets should be placed with at least one foot between them. If the initial system consists of two cabinets or racks, a system printer and a system console’s provision should be made for at least two additional cabinets or racks to be installed at some future time.
4.3.3 Reproduction Room

Microfilming, OCR scanning and imaging have very similar space requirements. All require a large, flat work surface, clean electrical power, antistatic flooring, and good air filtration to remove dust from the air, the same as those for the computer room described in the preceding paragraphs.

A room, which is to be used for all types of reproduction, should be sized to accommodate a minimum of three workstations, one of each type. The microfilming workstation typically consists of a planetary camera mounted above a large worktable; the OCR scanner typically consists of a computer desk with a PC and an associated scanner; and the imaging device consists of a computer desk with a scanner, there may be multiple imaging scanners if photographs, slides, videos and films are to be scanned as well as printed matter. Each workstation should have access to a large worktable for preparation of materials. If the planned volume is high enough to require more than one staff member working at a time, there should be a preparation tables for each of the three reproduction workstations.

4.3.4 Communications Rooms

Most buildings have communications closets for telephone service. Now that automated library systems use terminal servers, rather than wiring each terminal or other remote peripheral directly back to the central processing unit, it is desirable to expand these closets into small communications rooms (40-60 square feet is usually sufficient) to accommodate not only telephone equipment but also terminal servers. There should be one such closet on each floor of a multi-floor library and two or more per floor when floors exceed 10,000 square feet in area.

The same temperature, humidity, electrostatic discharge, and air quality requirements necessary for a computer room should be applied to the communications room(s). But rather than installing special air conditioning and humidity equipment, a thermostat will suffice.

4.3.5 Remote Peripherals

PCs, terminals, and printers are the most common remote peripherals in the majority of libraries. They can be anywhere in a building; inside entrances, open reading areas, carrels, group study areas, offices or workrooms. All require electrical power, static control, data cabling, low glare and ample work surfaces.

Concentrations of remote peripherals will occur in reference, technical services and at service desks but it should be possible to install one anywhere
within a library. Therefore, the general design requirements set forth at the beginning of this section should be used throughout the library.

There should be dedicated electrical circuits for remote peripherals in reference, technical services and at service desks as a minimum. Wiring in the reference area should extend to at least half the carrels. Each circuit should be conditioned with protection against surges, spikes, brownouts and blackouts. Remote peripherals installed elsewhere in the library should have individual surge protectors installed between the plug and the outlet.

Data cabling should be planned to a point inside the entrance of a library, the entry of each floor and the entry to each department so that one or more patron access catalogue terminals can be installed. There should also be data cabling to each service desk, workroom and group study room. At least half the carrels in the reference area should have data cabling extended to them and it should be possible to extend future cabling to all other carrels by pulling it through the plenum between floors.

Today's carrels need to be larger than the traditional 36x24 inches and staff desks larger than the traditional 60x30 inches to accommodate screens, keyboards, printers and other information technology components. Ideally, carrels should be 48x30 inches and desks 72x30 inches with a return suitable for electronic equipment.

4.4 Cabling, LANs and Networks

Cabling, a relatively simple proposition is now one of the most rapidly changing areas of information technology. In the 1970s, it was sufficient for cabling to support bandwidths of 300 baud or bits per second and in the 1980s, 1200-baud capability was considered adequate. In the early 1990s applications demanded cabling capable of handling 2400 to 9600 bits per second; in the mid-1990s higher speed connections are necessary for many applications. Cabling can have a significant impact on physical facilities.

4.4.1 Cabling for Automated Library Systems

Automated system and other information technology installations often include more than one type of cabling. There is a distinction between backbone and work-area cabling.

Backbone cabling provides the connections between different parts of a building or between buildings. Within a building it is installed vertically in a riser or elevator shaft and horizontally in cable tracks or conduit. This cabling represents a long-term investment and should have the highest bandwidth capacity: 100 to 155 Mbps. It should be run in such a way as to avoid
electromagnetic interference and extreme dampness. When installed in airspace between floors, special plenum-rated cabling should be used to resist heat.

4.4.2 Local Area Networks

Libraries are rapidly moving away from cabling that connects remote peripherals directly to an automated library system. Since the emphasis of libraries now is to offer staff and patrons a variety of information sources, including the automated library system, CD-ROM servers, access to an organization-wide network, and a gateway to the Internet, cabling has become part of a network. TCP/IP is currently the most popular internet working protocol.

4.4.3 CD-ROM Access from an Enterprise LAN

It is possible to add CD-ROM drives directly to an enterprise LAN, but this is rarely done because a single CD-ROM drive supports only one user. More common is mounting the CD-ROM on a separate CD-LAN and providing a router or gateway to connect the enterprise LAN to the CD-LAN. A gateway is the more often used solution.

A library also may implement a LAN to support access to a CD-ROM drive and the local library system and even a third host supporting other applications. All PCs would be on a single LAN with a multiple hosts and servers, including the automated library system, CD-ROM servers, Internet server, etc. Users would select the desired system connection form a menu. But it is necessary that there be direct access to the local library system, rather than having an intermediate LAN server, if good response time is to be retained.

4.4.4 Inter-library Networking

A simple connection through a telephone company or other common carrier can support a link between two automated library systems. If the systems use the same operating system and application software, the user will experience no difficulty searching; but if they are “heterogeneous” (different) systems, there will be a “common language barrier”: the search commands to which the user is accustomed will not work on the target system. While it is not unreasonable to expect a staff member to master the requirements of one or two remote systems in addition to those of the local system, there is clearly limit to the number of systems about which any one individual can be knowledgeable. What is needed is a way to “translate” the command language of one system to the requirements of another. This type of “transparent” linkage is key to “end-user” access.
Libraries are increasingly using the Internet to access other library systems and remote databases. The extensive international network is extremely cost-effective, costing as little per user. The Internet’s best use is for occasional access to other organizations’ resources and should not be the sole connecting link to one’s own central site.

4.5 Planning for Technology and Space

A number of recommendations have been developed for consideration by all sizes and types of libraries in planning for technology and space. Although numbered consecutively, for further clarity they have been arranged into four broad groupings; contextual recommendations; making more effective use of existing space; planning new facilities; and developing and expanding the potential or resource sharing-something which may have an impact on space planning over the long term.

Contextual Issues

These should form the foundation for planning for at least the next decade:

1. Base space planning on a realistic, balanced picture of the library of the future, assuming no major impact from electronic publishing on the amount of space needed for approximately twenty to twenty five years.
2. Seek revisions in applicable space formulas so that they reflect changes in legislation and library use.
3. Plan new facilities to accommodate emerging information technologies.
4. Avoid construction of remote storage facilities; instead, consider automated storage and retrieval.
5. Stress resource sharing
6. Implement an automated library system and link it with other using Z39.50 and related standards.
7. Undertake cooperative programmes for state-of-the-art information technology projects.
8. Develop networking capabilities to facilitate access to library resources.

CONCLUSION

All new construction, whether a building addition or replacement, should contain a substantial quantity of movable aisle compact shelving and recommends the use of two-level carrels. The combined impact of reconfiguring existing space (possibly reducing requirements in existing facilities by 5 to 10 percent), movable aisle compact shelving (10 percent or more), and the elimination of duplication of material between print and non-print formats (up to 2 percent), may take it possible for libraries to reduce the need for new construction by as much as 30 percent.
Reconfiguration, movable aisle compact shelving and other modifications will cost money, but generally half or less than that required for new construction. It is also possible that the implementation of a recommendation in any one particular institution may be unreasonably costly due to structural limitations, building layout, ceiling heights or other specific, local conditions.

In the following Chapter 5.9 Evaluation of Space Planning and layout in University Libraries of Maharashtra based on analyzed and interpreted data sought through the questionnaire and interviews and fetch information regarding the aspects of libraries (see Appendix A) is discussed.