DATA PROCESSING EQUIPMENT AND THE LIBRARY
A Review of Available Tools and Their Potential Application

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As it is preferable to discuss data processing equipment in general, using UNIVAC equipment as typical examples of the tools that are presently available; this paper will be concerned with four main topics:

    I. THE TOOLS OF THE TRADE
    II. POTENTIAL AREAS OF APPLICATION
    III. MATCHING THE TOOLS TO THE JOB
    IV. RECENT TECHNOLOGICAL DEVELOPMENTS.

It is hoped that the following comparisons will prove helpful to librarians.

I. THE TOOLS OF THE TRADE

Data processing equipment, on the basis of general characteristics, falls into three general classes or types:

A. Punched Card Equipment
B. High Speed Card Processing Equipment
C. Electronic Data Processing Equipment (Computers).

A. Punched Card Equipment

For purposes of this discussion, punched card equipment is defined as equipment whose input is limited to the punched card, and whose output is limited to a printer and/or a punched card.

There are two types of punched card installations:

1. Complete, "free-standing," installations.
2. Peripheral installations, operated in conjunction with electronic data processing equipment.

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The complete, "free-standing," installation is just what the name implies. It is a complete, independent, operating installation consisting of a number of basic punched card units, capable of creating and processing data in punched card form, and producing usable output.

In most instances the major mission of the peripheral installation is to create input data for an electronic data processing (computer) installation, where the actual processing and output is performed by more sophisticated equipment.

There are two manufacturers of punched card equipment in the United States, IBM and UNIVAC, which market equipment originated by their predecessor company, Remington Rand. The physical specifications of the IBM and UNIVAC punched cards are identical. However, the columnar format and punching code of the two cards are entirely different. Reference to Figure 1 will illustrate that the IBM Card contains 80 vertical columns, each containing 12 punching positions; whereas, the UNIVAC card contains 90 columns, each column containing 6 punching positions.

Generally speaking, the punched card equipment line supplied by both IBM and UNIVAC is almost identical. It includes the following units:

(1) Key Punches and Verifiers.—To create the punched card and verify the accuracy of the punching.

(2) Reproducing Punches.—To transfer punched data from a deck of punched cards to a deck of unpunched or partially punched cards. Or to create a deck of identical punched cards from a single punched card (gang punching).

(3) Interpreters.—To decode and print on the face of the punched card the English language equivalent of the punched code.

(4) Sorters and Collators.—To sort and/or merge decks of punched cards into desired sequences.

(5) Calculators.—To read, calculate, and punched desired results in punched cards.

(6) Printers.—To produce usable printed reports from data contained in punched cards.

(7) Summary Punches.—To simultaneously punch cards containing data included in reports produced by the printer.

Certain pieces of UNIVAC Punched Card Equipment have unique features and characteristics which might justify brief comment at this time.

(1) UNIVAC Key Punches. All punching is withheld until all key depressions for a given card are completed. With the

depression of a single "trip" key, all holes are punched simultaneously. This is in contrast to the "instantaneous" IBM punching principle where the hole or holes are punched as keys are depressed. This punch die-punching technique permits an operator to correct any detected errors prior to the actual punching of the card.

(2) UNIVAC Optical Scanning Punch. The UNIVAC Optical Scan Card can record up to 40 columns of marked data as compared with IBM's 27 columns. The UNIVAC card can be marked with any soft pencil, ball point, or standard pen. Sensitivity control is variable. The Optical Scanning Punch can be programmed to store constants, generate characters, and make logical decisions (see Figure 2).

(3) UNIVAC Collating Reproducer. This machine combines the functions of a collator and a reproducer. Each function is separately operable and permits simultaneous reproducing and collating when desired.

Notwithstanding the speed, capacity, and flexibility of punched card equipment and the economy of its operation when properly applied, this type of equipment has certain basic limitations when compared with other more sophisticated types of data processing equipment. These limitations include the following:

(1) Limited Card Column Capacity. In certain instances 80 or 90 columns are not sufficient to record the data from a single transaction.

(2) Limited Memory and Programming Capacity. The memory and programming capacity of the punched card printer and calculator is inadequate for many sophisticated programs.

(3) Inadequate Speed. The transaction volume of some operations requires more card read, punch, calculating, and printing speeds.

(4) Non-integrated Operation. A punched card system is a series of separate, off-line, independent operations which cannot be integrated into a single automatic operation.

(5) Bulky Storage. Punched cards are bulky and costly to store in comparison with magnetic tape.

B. High Speed Card Processing Equipment

The unique characteristics of this type of equipment permit it to "bridge the gap" between standard punched card equipment and electronic data processing equipment. Input is limited to punched cards and output to high speed printers and punched cards.

The UNIVAC 1004 Card Processor is a fine example of the high speed card processor. (see Figure 3). Listed below are some of the outstanding features of the UNIVAC 1004.

(1) Faster input, output, and printing speeds:

> Card Read   - 400-600 CPM
> Card Punch -   200 CPM
> Print   - 400-600 LPM.

(2) Calculation at electronic speeds:

> Compute   - 400-600 CPM.

(3) Internal memory:

> Core Memory 1000-2000 Characters
> Simultaneous read - calculate - print - punch.

(4) More programming power:

> 62 Program Steps
> Each step performs up to 9 different operations.

(5) Concurrent operations:

> Simultaneous read - calculate - print - punch.

(6) Communications capabilities:

> Can be linked to other types of data processing equipment via standard communications facilities.

(7) Field expandable:

> Additional modules of core memory, program steps, and magnetic tape may be field installed.

(8) Input flexibility:

> Can process 80 and/or 90 column cards.

(9) Economical cost:

> See Figure 3.

The UNIVAC 1004 Card Processor is the only operable high speed card processing system on the market at the present time. Other manufacturers have recently announced new systems which may fall in this category.

C. Electronic Data Processing Equipment (Computers)

Electronic computers are classified on a number of different bases. The most common of these classifications is as follows:

(1) Special Purpose vs. General Purpose

> The characteristics of these two types of computers are obvious. Typical special purpose devices would include computers designed for missile guidance, processing

control, numerical control, etc. General purpose computers, by their characteristics, are multi-use systems which can be applied to any business or general scientific area.

(2) Digital vs. Analog

Digital computers accept input and produce output in digital form. Analog computers measure values and produce output in various forms other than by digital representation. An electric meter is a typical example of an analog device. It measures the flow of current and represents consumption on a readable dial.

Obviously, for library applications, the discussion will be limited to general purpose digital computers.

(3) Batch Processing vs. Random Access

Batch processing computers usually process data in some consistent sequence or arrangement. Data is usually stored in memory in a given sequence, and input is presorted in the same sequence. Random access computers, in contrast, permit the processing of data on a random or nonsequential basis.

(4) Externally vs. Internally Programmed

Externally programmed processors or computers are programmed by means of a wired plugboard. Programs for internally programmed computers are recorded on punched cards, paper tape, or magnetic tape and then stored in internal memory.

All punched card equipment is externally programmed. Likewise the UNIVAC 1004 Card Processor also utilizes this programming technique. Although the UNIVAC 1004 has up to 2000 characters of internal core memory, the program is actually wired on a plugboard. This frees the internal memory for actual working storage. Most modern electronic computers are programmed internally.

1. Basic Components of all Digital Computers

Generally speaking, all digital computers, regardless of type, characteristics, speed, capacity, or cost, contain the same basis components, namely: input devices, main processor, auxiliary mass memory, and output devices. (see Figure 4).

a. Input devices: Every computer configuration must include one or more devices which permit data to be entered into the system.

The more sophisticated the system, the greater will be the variety of input devices. The larger the system, the greater will be the quantity of each particular device. The most common input devices are the following:

(1) Console typewriter
(2) Punched cards
(3) Magnetic tape
(4) Paper tape
(5) Communication devices.

b. Main Processor: Most main processors contain three sub-components, namely: internal memory unit, program control unit, and arithmetic unit.

(1) Internal memory unit:

The internal memory is usually either magnetic core, drum, or thin film. The amount of internal memory may vary from 4000 characters up.

(2) Program control unit:

This unit reads and interprets the program which has been stored in memory, and conditions the computer so that it will automatically complete the program.

(3) Arithmetic unit:

This unit performs all the arithmetic computations that are required to complete a program. Computations are limited to basic arithmetic functions: add, substract, multiply, and divide.

c. Auxiliary Mass Memory: Most large scale digital computers include auxiliary mass memory devices as optional features. This mass memory is usually housed in separate cabinets but is always under the control of the main processor. This memory may be in the form of magnetic drums or discs, or in some instances, magnetic tape. Mass memory capacity may extend into millions of characters. Access time is usually relatively slow in comparison with internal memory.

d. Output Devices: Every computing system must include one or more devices to accept, transmit, or produce the output from a computer operation. Here again, the larger and the more sophisticated the system, the greater will be the variety and number of output devices. The most common of these devices are:

(1) Console typewriter
(2) Punched cards

(3) Paper tape
(4) Magnetic tape
(5) High speed printer
(6) Special visual display devices
(7) Communication devices.

It is obvious, therefore, that the characteristics, the size, and the price of general purpose digital computers may vary widely, depending upon the particular combination, variety, quantity, and capacity of the individual components included in the system.

2. Types of General Purpose Digital Computers

Figure 5 is a tabulation of the basic characteristics of general purpose digital computing systems presently marketed by UNIVAC. These systems are classified into three general categories based on these characteristics:

a. Business Data Processing Computers—Batch Processing
b. Real Time Computers—Random Access
c. Scientific Computers.

The general characteristics of each of these three types of computing systems follow.

a. Business Data Processing Computers—Batch Processing

Generally speaking, the average business data processing job requires the processing of large masses of input data, relatively simple calculations, and a large volume of output. For example, large payroll, billing, accounts payable, sales analyses, and inventory applications involve the processing of large volumes of individual transactions. However, the required arithmetic calculations are very simple; i.e., hourly rate times hours worked, unit cost times quantity, gross value times a discount factor, etc. As output, the business data processing computer system must produce large numbers of paychecks, vouchers, invoices, etc. Consequently, fast output is required.

In order to meet these demands, the business data processing computer usually has the following characteristics:

(1) Fast input speed
(2) Relatively slow computing speed
(3) Relatively small internal memory
(4) Little or no mass memory
(5) Fast output speed.

It is usually practical and customary to process business data on a batch basis, so there is relatively little demand for random access capability.

b. Real Time Computers—Random Access

The unique characteristics of the real time, random access, computer permit immediate, random access of memory when required. The real time computer is used in situations where the time requirements are particularly stringent. In most real time situations, time will not permit the batching and pre-sequencing of input data. In most instances, input is processed in random sequence, memory is instantaneously searched, and the output is delivered in seconds or fractions of seconds. To meet these requirements, most real time, random access computers have the following general characteristics:

(1) Fast input speed
(2) Fast access and fast computing speed
(3) Moderately large internal memory
(4) Large mass memory
(5) Fast communication devices
(6) Fast output speed.

One of the most common uses of the real time, random access computer is in the general area known as information retrieval. The information retrieval concept requires the ability to interrogate the mass memory of the computer at will, usually on a random access basis. The required information must be delivered in the desired form almost instantaneously, and this accounts for the term "real time."

The interrogation of the computer is, in many instances, accomplished by the use of special communication devices. These special devices may be located at remote points, and they are linked to the computer via teletype or telephone lines. The inquiry units may be special typewriters, paper tape units, or special purpose devices. The inquiry devices may actually be other "satellite" computers or processors, located at remote points. For example, Figure 5 indicates that the UNIVAC 1004 and 1050 systems are capable of functioning as communication input and output devices to larger UNIVAC systems if required. Their use as communication devices in no way interferes with their utility as "free-standing" systems.

In most instances, these special inquiry units are also capable of receiving and recording the information which was requested. Hence, they are actually dual purpose input-output devices.

In order that the real time computer may efficiently fulfill its mission in an information retrieval operation, it must be capable of instantaneously searching mass memory on a random access basis, performing required computations at high speeds and then transmitting the required output data to the remote output devices.

c. Scientific Computers

The scientific computer must be capable of accepting a modest amount of input data and then performing complex arithmetic computations at high speeds. The ultimate output, in most instances, is modest in volume. Since scientific programs are generally quite complex, they require large memory capacity for program and working storage. The characteristics of most scientific computers are as follows:

(1) Fast input
(2) Extremely fast computing speeds
(3) Extremely large internal memory
(4) Modest mass memory
(5) Moderately fast output speed.

Since very few library applications fall into the pure scientific category, for the purposes of this discussion we can dismiss the scientific computer from any further consideration.

I. THE TOOLS OF THE TRADE—SUMMARY AND REVIEW

Before moving on to a discussion of where and how data processing equipment can be used in the library system, the foregoing comments on the characteristics of the various tools that are available can be summarized as follows.

A. Punched Card Equipment

After reviewing the functions of the various component units of a punched card system, it was observed that within the limits of the transaction volume to be processed, punched card equipment could be economically used by many library systems. The basic limitations of punched card equipment as compared with more powerful and sophisticated data processing systems have been outlined.

B. High Speed Card Processors

It has been determined that the high speed card processor "bridged the gap" between the punched card and the electronic computer systems. It had greater input and output speed than punched card equipment and had a reasonable amount of internal memory. It had more powerful programming capabilities and could calculate at electronic speeds. Furthermore, it could concurrently read, calculate, print, and punch data, and in most instances, was quite comparable in cost to punched card equipment.

C. Electronic Data Processing Equipment (Computers)

Eliminated from consideration were the special purpose and the analog computer, and it was agreed that for library purposes

only the general purpose digital computer should be considered. It was observed that general purpose digital computers, by virtue of their basic specifications, fall into three classes; namely, the business data processing computer, the real time computer, and the scientific computer. It was also concluded that there were very few pure scientific applications in the library field; hence, there was no need for further consideration of the scientific computer. In summary, by process of elimination, it appears that further discussion of the available tools of the trade should be limited to four classes of equipment:

1. Punched card equipment
2. High speed card processors
3. Business data processing computers (Batch processing)
4. Real time computers (Random access).

II. POTENTIAL AREAS OF APPLICATION

To facilitate discussion of the potential areas of library application of these four types of equipment, see Figure 6 which lists many of the commonly accepted applications in this area. These applications are broken into five general categories:

A. Financial accounting
B. Book processing
C. Circulation control
D. Information retrieval
E. Research and statistics

This schedule indicates the areas of application and the capabilities of the various types of equipment to handle them. Generally speaking, the major factor in the determination of the proper equipment to be selected and used will be the size of the system and the transaction volume to be processed.

In the areas of financial accounting, circulation control, and research and statistics, all four types of equipment are capable of producing desirable end results. Quite naturally, the business data processing computer can do a more complete job than can the punched card system; but here again, the matter of economics must be considered.

A. Financial Accounting

None of these applications is a newcomer to data processing. There is not an application listed in this category that is not presently being handled by hundreds of government, commercial, industrial, and financial users. You will not open new horizons or chart new courses if and when you add these applications to your equipment, regardless of type. Any manufacturer of data processing equipment can supply proven, workable procedures and

programs for any of these applications. They are the orthodox "bread and butter" applications that have supported punched card and computer installations for years past. They are all proven, economical applications; and, as previously stated, your equipment selection will be determined by your volume.

B. Book Processing

This area of application is, of course, unique to the library field. Generally speaking, punched card equipment cannot acceptably produce catalog cards or catalogs because of its inability to print upper and lower case characters. Upper and lower case characters are available on the UNIVAC 1004 Card Processor and all other UNIVAC high speed printers. Consequently, acceptable catalog cards and catalogs can be produced on any of this equipment. While it is possible to produce continuous form book labels on punched card equipment, here again the availability of upper and lower case characters permits the production of a more acceptable label.

C. Circulation Control

Several libraries have for years been effectively handling borrower registration, book charging and returns, overdue notices, and fine accounting on standard punched card equipment. The punched card has proven to be an excellent "turn around document" for this use. For the large library system, the ultimate, most sophisticated approach to this application is to store the entire borrower and book inventory file in mass memory, and automatically determine due dates, prepare overdue notices, compute fines, etc.

D. Information Retrieval

Applications in this area can only be processed on large scale systems with mass storage and real time capabilities. The assumption would be that the entire book inventory would be stored in mass memory. One or more input devices could then be used to interrogate the memory to produce the output required. Requests would refer to information regarding a single title, or if required, extensive listings could be printed out containing complete data in any category.

E. Research and Statistics

Generally speaking, research and statistics are usually developed as a free by-product of other applications. For example, circulation statistics would be developed from the same documents or data used in the book charging and return operation. Likewise, analyses of title and subject usage would originate from the source.

Vendor analysis would be produced from data already developed in the accounts payable application.

III. MATCHING THE TOOLS TO THE JOB

The ratio of the number of library data processing installations to total library systems in the United States indicates that libraries in general are not utilizing modern data processing techniques to the degree that is found in governmental, industrial, and commercial organizations. In my estimation, this is the result of several factors and conditions:

A. Too few libraries and library administrators have sufficient knowledge of the capabilities of data processing equipment to visualize the potential economies of their use.

B. Generally speaking, librarians are ultra-conservative about accepting modern data processing techniques. This is obvious when one observes the hundreds of library systems which are still preparing payrolls, vouchers, purchase orders, etc., by obsolete methods which have been discarded long since by other organizations.

C. The library system, being a quasi-public service organization, finds it difficult to obtain the necessary operating capital funds to finance a modern data processing system.

IV. RECENT TECHNOLOGICAL DEVELOPMENTS

Fortunately, some recent technological developments should make it easier for the librarian to justify the investment in modern data processing equipment. Here are a few of them.

A. The "Intermediate" Equipment

This equipment, of the high speed processor class, permits the library system to start small and build. It gives the inexperienced librarian an opportunity to develop an understanding of basic data processing techniques on equipment that is simple in concept but efficient in its operation.

B. The Inexpensive Remote Input Device

The development of these devices permits the larger library system to install a central computer facility and interrogate it with a series of inexpensive inquiry devices which can be installed at remote points.

C. The "Time Sharing" Concept

In the near future, every manufacturer will offer computer "time sharing" services. This would permit a library to install a modest "free-standing" system on its own premises to handle

its routine housekeeping operations. This same system could then be linked by communication lines to a large, real time, mass memory computer installed in a manufacturer's service center.

In conclusion, modern data processing equipment, systems, and techniques have much to offer the librarian and the library system. Efficient, economical tools are "on the shelf." Many of the major applications have already been developed and programmed. Finally, the equipment manufacturers are ready, willing, and hopefully, able to supply any assistance that may be required.

Figure 1
THE STANDARD PUNCHED CARD

CARD FORMAT AND PUNCHING CODES

The UNIVAC Punched Card: Data appears in this card as round holes in 45 vertical columns, divided horizontally into two fields, for a total of 90 columns. Numbers are represented by a one or two hole code, letters by a two or three hole code.

The IBM Punched Card: Data appears in this card in the form of rectangular holes in 80 vertical columns. Numbers are represented by one hole, letters by two hole code.

Figure 2
UNIVAC OPTICAL SCAN AND IBM MARK SENSE CARDS

UNIVAC Optical Scan Card: Marks may be made with any pencil, ball point, or regular pen. Each card will record up to 40 columns of marked information. The marks are converted to standard holes by the UNIVAC Optical Scanning Punch.

IBM Mark Sense Card: Marks may be made with any soft lead pencil. Each card will record up to 27 columns of marked information. The marks are converted to standard holes by the IBM Mark Sense Reproducer.

Figure 3
COMPARATIVE SPEEDS, CAPACITIES, AND COSTS
UNIVAC 1004 CARD PROCESSOR VS PUNCHED CARD EQUIPMENT

COMPARISON OF SPEEDS AND CAPACITIES

Operation	UNIVAC 1004 High Speed Card Processor	Standard Punched Card Equipment
Card Read	400-600 CPM	150 CPM
Card Summary Punch	200 CPM	100 CPM
Memory Capacity	2000 Characters	150 Characters
Computing Speeds	400-600 CPM	150 CPM
Printing	400-600 LPM	150 LPM
Magnetic Tape-Read & Write	Yes	No
Paper Tape-Read & Write	Yes	No
Concurrent Read-Compute-Print-Punch	Yes	No

COMPARISON OF COSTS—TYPICAL EQUIPMENT & CONFIGURATIONS

Equipment

IBM 407 Printer	$900	150 CPM Read-Print
IBM 514 Summary Punch	125	100 CPM Punch
IBM 604 Calculator	600	100 CPM Calculate
Total Monthly Rental	$1,625	
UNIVAC 1004 Card Processor	$1,150	400 CPM—Read, Calculate, Print
UNIVAC 1004 Card Punch	300	200 CPM Punch
Total Monthly Rental	$1,450	

Figure 4
BASIC COMPONENTS

GENERAL PURPOSE DIGITAL COMPUTERS


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                        ┌─────────────────────────────┐
                        │   AUXILIARY MASS MEMORY     │
                        │                             │
                        │   Discs - Drums - Tapes     │
                        │   Special Devices           │
                        └─────────────────────────────┘
                                    ▲│
                                    │▼
┌──────────────────┐   ┌─────────────────────────────┐   ┌──────────────────┐
│  INPUT DEVICES   │   │       MAIN PROCESSOR        │   │  OUTPUT DEVICES  │
│                  │   │                             │   │                  │
│  Typewriter      │   │     Internal Memory         │   │  Typewriter      │
│                  │   │                             │   │                  │
│  Punched Cards   │   │  Core - Drum - Thin Film    │   │  Punched Cards   │
│                  │   │                             │   │                  │
│  Paper Tape   ───┼──▶│      Program Control        │──▶│  Paper Tape      │
│                  │   │                             │   │                  │
│  Magnetic Tape   │   │   External - Internal       │   │  Magnetic Tape   │
│                  │   │  ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─  │   │                  │
│  Communication   │   │      Arithmetic Unit        │   │  H. S. Printer   │
│  Devices         │   │                             │   │                  │
│                  │   │      Add - Subtract         │   │  Communication   │
│                  │   │      Multiply - Divide      │   │  Devices         │
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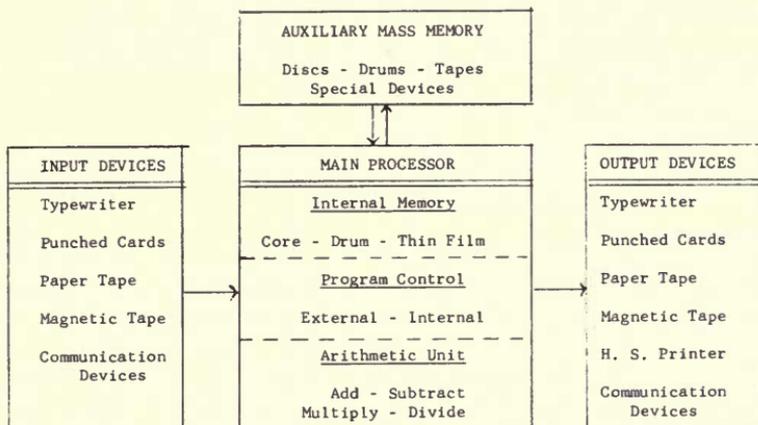
Figure 5
UNIVAC DATA PROCESSING EQUIPMENT

COMPARATIVE SPEEDS, CAPACITIES AND OTHER CHARACTERISTICS

	BUSINESS DATA PROCESSING EQUIPMENT (Batch Processing)					REAL TIME COMPUTERS (Random Access)		SCIENTIFIC COMPUTER
	Punched Card Equipment	1004 II Processor	1004 III Processor	1050 IV Computer	UNIVAC III Computer	418 Computer	490 Computer	1108 Computer
Typical Monthly Rental		$1575	$2375	$7250	$22,500	$10,000	$25,500	$45,000
Input Devices								
Card Read- Cards per minute	150	600	600	900	700	600	600	900
Paper Tape Read - Characters per Second	---	400	400	1000	500	400	400	400
Magnetic Tape - Characters per second	---	---	34M	133M	133M	120M	125M	120M
Internal Memory								
Maximum Capacity - words	150	2M	2M	65M	33M	65M	33M	131M
Word Size - Bits	1	1	1	1	6	18	30	36
Total Bits - (approx.)	150	2M	2M	65M	198M	1170M	990M	4716M
Auxiliary Mass Memory - Drums								
Capacity per Drum - Million characters	---	---	132	132	132	132	132	132
Maximum Number of Units per Controller	---	---	8	8	8	8	8	8
Average Access Time - Milliseconds	---	---	92	92	92	92	92	92
Processing Speed								
Add Time - Microseconds	400	91	91	35	8	4	5	3/4
Cycle Time - Microseconds	---	7	7	2	4	2	5	3/4
Output Devices								
Card Punch - Cards per Minute	100	200	200	300	300	200	150	300
Paper Tape Punch - Characters per Second	---	110	110	110	110	110	110	110
Magnetic Tape Write - " " "	---	---	34M	133M	133M	120M	125M	120M
High Speed Printer - Lines per Minute	150	600	600	922	922	600	922	922
Communications Equipment								
Via Data Line Terminal to:		1004 1050 U 111 418 490 1108	1004 1050 U 111 418 490 1108	1004	1004	1004 1050	1004 1050	1004 1050 418

Figure 6
ELECTRONIC DATA PROCESSING EQUIPMENT

PARTIAL LIST OF REPRESENTATIVE LIBRARY APPLICATIONS

	Punched Card Equipment	High Speed Card Processors	Business Data Processing Computers	Real Time Computers
A. Financial Accounting Applications				
1. Revenue Accounting	x	x	x	x
2. Inventories: supplies-equipment-visual aids	x	x	x	x
3. Inventories-Books: owned and available	x	x	x	x
location-shelf lists	x	x	x	x
4. Budgetary Accounting: fund accounting	x	x	x	x
5. Purchasing: requisitions-purchase orders	x	x	x	x
6. Accounts Payable: vendor remittances-vouchers registers	x	x	x	x
7. Billing: accounts receivable-statements-trial balancing	x	x	x	x
8. Payroll: paychecks-registers-labor costs-personnel	x	x	x	x
B. Book Processing Applications				
1. Catalog Cards		x	x	x
2. Catalogs: union catalogs-book catalogs		x	x	x
3. Serial Lists:-union lists		x	x	x
4. Book Labels		x	x	x
C. Circulation Control				
1. Borrower Registration	x	x	x	x
2. Book Charging: file maintenance-book returns	x	x	x	x
3. Overdue Notices	x	x	x	x
4. Fine Accounting	x	x	x	x
5. Inter-Library Loans	x	x	x	x
D. Information Retrieval				
1. Subject Listings				x
2. Author and Title Listings				x
3. Book Location Lists: departmental, etc.				x
4. Aged Title Lists				x
E. Research and Statistics				
1. Circulation Statistics	x	x	x	x
2. Title and Subject Usage	x	x	x	x
3. Borrower Analysis	x	x	x	x
4. Vendor Analysis	x	x	x	x
5. Reference Analysis	x	x	x	x
F. Other Applications				
1. Mailing Labels	x	x	x	x
2. Mailing Lists	x	x	x	x