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Electronic Data Processing Feasibility Study Machinery For Commercial Banking Firms

David W. Howell

ELECTRONIC DATA PROCESSING FEASIBILITY STUDY MACHINERY FOR COMMERCIAL BANKING FIRMS

by

David W. Howell

B.S., United States Naval Academy

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This independent study submitted by David W. Howell in partial fulfillment of the requirements for the Degree of Master of Science in the University of North Dakota is hereby approved by the Committee under whom the work has been done.

Chairman

Director, Special Air Force Programs

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ABSTRACT

Electronic Data Processing is one of the most significant developments in recorded history. Many commercial banks have computers installed on their premises or lease computer time from a service company. A significant proportion of the installed systems are underutilized both in the number of applications programmed and total computer run times. This is a result of bank management's ignorance of electronic data processing characteristics and the subsequent poor and incomplete planning.

A commercial banking firm should establish electronic data processing feasibility study machinery on a permanent basis. The creation of a permanent staff of junior bank executives should ensure intelligent planning for future computer system requirements and profitable expansion of existing data processing capacity. An information library, requiring little expense, should be maintained to assist staff members to keep abreast of data processing developments. The staff assignments should be in addition to departmental assignments to ensure a continual, yet inexpensive, welding of banking functions with computer technology on a practical basis.

This staff should evaluate the bank's present system of data processing and then establish a systems analysis approach to evaluating future electronic data processing requirements and systems. Profitability will be determined largely by a commercial bank's establishments and application of such a system's approach.

CHAPTER I

COMMERCIAL BANKING

The function of banking in the world is an enormous money governing device which affects all commerce and industry from international levels down to localized rural areas. The influence of banking over commercial processes in highly industrialized nations such as the United States, Great Britain, and Western Germany is pronounced. Unless this influence is checked and limited, as in the United States, it becomes burdensome and onerous.

"Banking" is a rather ambiguous term. It is necessary for the purpose of continuity in this study to confine the application of electronic data processing feasibility factors to one type of banking institution in the United States. The largest group of banks which operate under the same set of control restrictions are the U. S. Federal Reserve member state and national commercial banks. Approximately 85 per cent of all commercial bank credit was effected by member commercial banks in 1966 and this figure has held fairly steady for the past 30 years.[1] The Federal Deposit Insurance Corporation insures deposits in virtually all commercial

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[1] Federal Reserve Bulletin, Board of Governors of the Federal Reserve System, Washington, D.C., June 1966, p. 850.

banks in the United States (242 state banks excepted in 1963) up to a $15,000 limit, and exercises supervisory authority over insured banks.[1] Since Federal supervision is all pervading, this study can be applied to almost all state chartered commercial banks.

Commercial banks are unique in one important attribute. They are repositories for demand deposits. All checking accounts of commercial concerns and individuals are demand deposits. In effect, commercial banks issue bank notes (the promise of a bank to pay money on demand) to demand depositors in an amount equal to their deposits. Bank notes are really credit instruments but commercial banks may "lend their credit," so to speak, and thus create a large part of the funds utilized by borrowers. Demand deposit "money" creation results from the deposit, loan, redeposit, reloan process repeated ad infinitum.[2] The Federal Reserve limits the percentage of demand deposits which banks may loan by requiring that minimum deposits (reserve) be maintained. Reserves are vault cash (since 1960) and deposit balances held at the respective Federal Reserve Banks (there are twelve). Also, a smaller percentage reserve is maintained for savings or "time" deposits.[3]

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[1]Carter H. Golembe, "The Present Structure of the United States Commercial Banking System," The Bankers' Handbook, ed. William H. Baughn and Charls E. Walker (Homewood, Ill.: Dow Jones-Irwin, Inc., 1966), pp. 1009-1010.

[2]Ibid.

[3]American Institute of Banking, Principles of Bank Operations (New York: American Bankers Assoc., 1956), pp. 339-40.

A bank can raise additional reserve funds (1) by selling securities, (2) by borrowing reserve (Federal) funds from other banks, or (3) by borrowing from a Federal Reserve Bank.[1] Number one is self-explanatory. "Federal funds" denote reserve balances held by banks in excess of requirements. These funds may be drafts drawn on a Federal Reserve Bank and held by a nonbanking institution. The interest rate rarely exceeds the current Federal Reserve District Discount Rate (loan rate to member banks).[2] Traditionally, country banks are more inclined to have excess reserves than are city banks because the latter have easier access to short-time security markets and deal in larger sums which make closer attention to their continual investment more profitable. Federal Reserve banks loan funds to member banks at a discount rate; this source is curtailed or shut off if Reserve banks desire to tighten credit or is made easily available if Reserve banks follow an easy money policy.[3]

Commercial banks do anticipate and analyze money market conditions fairly accurately and are able to formulate effective courses of action. However, improvement is not only possible but probable, and with the aid of electronic data processing techniques a bank should be able to anticipate money market conditions very accurately and to predict reasonable courses of action the district Federal Bank may

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[1] R. Pierce Lumpkin and Aubrey N. Snellings, Readings on Money (Richmond: The Federal Reserve Bank of Richmond, 1965), p. 34.

[2] Ibid., p. 35.

[3] Ibid., pp. 32-33.

take as a result. Based on these reasonable alternatives and on the expected money market conditions, banks could determine optimal total banking response in regard to timing, interest rate, and amount variations in all services performed for individuals and commercial firms. Such a thorough analysis is not possible unless the empirical data needed can be programmed into a computer.

Banking has changed enormously in the twentieth century. Commercial banks did not discover retail banking until Mr. Amadeo P. Giannini started the practice at the turn of the century. "A. P. Giannini was a financial marketing genius. He perfected all the selling principles and concepts we use in banks today to retain and get new business . . ."[1] Marketing financial services, much as industrial firms market both products and services, is a required modus operandi for commercial banks today.

In order to implement a service concept, commercial bank managers have had to concern themselves with how to control costs by altering the planning, organizing, staffing, coordinating, and controlling elements of the banks' operations.[2] Application of modern management techniques has been essential in order to maintain and/or increase profitability. Bank firms must now make fast and coordinated responses to changes, frequently sudden, in their environment;

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[1]Reed Sass, "The Case for Retail Banking," Banking, June 1967, p. 52.

[2]Lamar Lee, Jr. and Donald W. Dobler, Purchasing and Materials Management (New York: McGraw-Hill Book Co., 1965), p. 382.

this is especially critical for banks with many branches. Therefore, a correct balancing of decentralized management with adequate centralized control is just as critical a factor in banking as it is in industrial firms.

In order to cope with the increasing complexity of banking operations, managers have had to eliminate the rule-of-thumb type of decision making and utilize rational problem solving and/or systems analysis techniques to maintain profitability. Cost versus utility analysis is becoming more of a necessity in banking just as it is in industrial firms.

Before discussing the functions and services of banks, it is best to illustrate and briefly discuss a typical member commercial bank's statement of condition or balance sheet (see Table 1, page 6) and statement of operating earnings (see Table 2, page 7). Note that both are quite similar in format to their counterparts for industrial concerns. In fact, both formats are recommended by the Federal Reserve System in its Regulation F. "The 1964 amendments to the Securities Acts required that large corporations whose stock is traded over the counter (as banks are) conform to public disclosure requirements similar to those which apply for listed corporations. The three bank regulatory agencies (FDIC, Comptroller of the Currency, Federal Reserve) were empowered to work out the specific reporting details."[1]

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[1]Augustus R. Southworth, Jr. and F. Lee Jacquette, "Accounting Systems in Banking," The Bankers' Handbook, ed. William H. Baughn and Charls E. Walker (Homewood, Ill.: Dow Jones-Irwin, Inc., 1966), p. 197.

TABLE 1

HOMETOWN BANK
STATEMENT OF CONDITION
December 31, 1966[a]

Assets	
Cash and due from banks	$ 1,900,000
Investment securities:	
United States government obligations	1,300,000
Obligations of states and political subdivisions	1,360,000
Other securities	20,000
Loans (less reserve of $100,000)	5,140,000
Bank premises and equipment	130,000
Accrued interest and accounts receivable	70,000
Other assets	80,000
Total Assets	$10,000,000
Liabilities and Capital Funds	
Deposits:	
Demand deposits	$ 5,900,000
Savings deposits	2,130,000
Other time deposits	700,000
Liabilities for borrowed money	190,000
Accrued taxes and other expenses	60,000
Dividends payable	25,000
Other liabilities	175,000
Total Liabilities	$ 9,180,000
Capital Funds:	
Capital stock	170,000
Surplus	480,000
Undivided profits	130,000
Reserve for contingencies	40,000
Total Capital Funds	$ 820,000
Total Liabilities and Capital Funds	$10,000,000

[a] Augustus R. Southworth, Jr. and F. Lee Jacquette, "Accounting Systems in Banking," The Bankers' Handbook, ed. William H. Baughn and Charls E. Walker (Homewood, Ill.: Dow Jones-Irwin, Inc., 1966), p. 197.

TABLE 2

HOMETOWN BANK
STATEMENT OF OPERATING EARNINGS
January 1st to December 31st, 1966, Inclusive[a]

Operating Revenue:	
Interest and other fees on loans	$ 270,000
Interest and dividends on securities:	
U.S. government obligations	44,000
Obligations of states and political subdivisions	35,000
Other securities	1,500
Trust department income	15,500
Service charges on deposit accounts	19,200
Other operating revenue	4,800
Total operating revenue	$ 390,000
Operating Expenses:	
Salaries	97,900
Bonuses and profit sharing	10,100
Pension, social security, other employee benefits	12,000
Interest on deposits	96,800
Interest on borrowed money	4,100
Net occupancy expense of bank premises	24,000
Equipment expenses (including depreciation of $1,200)	12,400
Other operating expenses	16,000
Total operating expenses	$ 273,300
Operating earnings before income taxes	$ 116,700
Income taxes applicable to operating earnings	34,700
Net operating earnings	$ 82,000

[a]Augustus R. Southworth, Jr. and F. Lee Jacquette, "Accounting Systems in Banking," The Bankers' Handbook, ed. William H. Baughn and Charls E. Walker (Homewood, Ill.: Dow Jones-Irwin, Inc., 1966), p. 201.

With banks growing larger and the popularity of branch banking increasing, the ownership base for banks today is much less concentrated than what it was just three decades ago. This has been a primary factor in inducing accounting changes.[1] In December 1966, the Accounting Principles Board of the American Institute of Certified Public Accountants made many accounting recommendations to bank firms dealing generally with the accrual basis of accounting and related subjects for the purpose of creating much greater uniformity in reporting procedures. These recommendations were endorsed by the American Banking Association.[2] Stockholders and interested customers will benefit from detailed and uniform statements of condition and operating earnings. Their satisfaction with a bank's operation is most important. Most banks do not now contract to have independent accounting firms perform audits periodically.[3] One may safely assume this will become a requirement as it is for most corporations today.

The institution of more stringent accounting requirements should be anticipated by member banks, and planned for immediately. Bank firms with access to a computer should find that, once computer programmed, the new accounting procedure will add little, if any, operating cost. The programmed accounting framework should facilitate the taking of independent audits thus lowering such costs to the firm. The establishment of a more thorough and accurate control and

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[1]Fred M. Oliver, "New Horizons in Bank Accounting and Reporting," Banking, June 1967, p. 63.

[2]*Ibid.*, pp. 64-65.

[3]*Ibid.*, p. 65.

planning effort (with budgeting) should accrue from the accounting program.

All commercial banks maintain departments for soliciting and servicing loans and discounts, either secured or unsecured.[1] Profit dictates that a bank employ its assets in debt vehicles offering the greatest aggregate rate of return. Safety or liquidity is the other overriding consideration and is inversely proportional to safety and liquidity. Therefore, most commercial bank loans are short-term, self-liquidating paper with maturity usually ranging from thirty days to six months.[2] Scheduling the payments and maturity of all loans so that they are on an orderly staggered basis complements a bank's liquidity capability; a simple computer program could ensure this.

Loan departments should maintain a credit file on actual and potential business customers within its sphere of financial activity. These files should be updated frequently to help preclude losses on uncollectible accounts. With the trend to retail banking and the adoption of marketing concepts, it would behoove banks to establish or have available to them, extensive credit files on farmers and other individuals. Traditionally a community credit file on individuals is maintained by a civic organization (such as the Chamber of Commerce) and all businesses have access to it.

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[1]American Institute of Banking, Principles of Bank Operations (New York: American Bankers Assoc., 1956), pp. 144-151.

[2]*Ibid*., p. 142.

The author feels that it is feasible for one community bank to provide a file service which can be programmed for computer operation. Retrieval time and upgrading data in the files, as necessary, can be accomplished in a few microseconds. This represents a definite cost savings over manual retrieval and data changing. A bank with real-time on-line computer capability could contract to perform this service for a community, directly with all businesses or through an appropriate civic organization. Certainly a bank's credit file on community businesses, as well as credit evaluation techniques, should be programmed into a computer if one is available. Business credit analysis involves checking ratios on liquidity, profitability, and capital structure; trends in the business and comparisons of ratios and trends with the industry are important too.[1] A computer programmed credit file would facilitate this analysis and assist the customers too.

The retail banking trend and emphasis on marketing financial services has introduced great flexibility and variety into lending practices in this century. Retail banking is the provision of banking services to individuals who are considered to be small customers with small demand and savings deposits. These deposits bring little or no profit to banks. However, small customers may be expected to account for a

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[1] Rex J. Morthland, "Credit Analysis--Specific Tools of Analysis," The Bankers' Handbook, ed. William H. Baughn and Charls E. Walker (Homewood, Ill.: Dow Jones-Irwin, Inc., 1966), pp. 290-304.

significant portion of a bank's installment credit which pays the highest interest rates and provides the highest net return of profit in the bank's credit portfolios.[1]

As stated succinctly by Mr. Robert Lindquist, a bank manager:

> Banks should be as much concerned with marketing and with research and development as are the manufacturing industries. Research as to what services related to banking are needed and can be profitably used by business firms and individuals; development of these services within the framework of the bank's equipment and personnel and legal limitations; research on the potential users of these services and how best to reach them; pricing of the services to permit offering them at a profit and to meet competition; packaging of the services to make them attractive and easy to sell; development of advertising and sales programs to bring the services to market. It is this concept of the marketing function, and its application through research and development, that brings to full realization the place of and need for public relations in banking.[2]

Each type of loan involves a tremendous number of variables such as industry interest rate variations, rate variations between types of loan and length of time to maturity, money market conditions prevailing, and credit analyses. A listing of categories is as follows: seasonal lending; lending against accounts receivable; inventory loans; term loans (usually involving capital changes); loans to finance companies; lease financing (a new field); loans against stocks, bonds, and similar collateral; commodity loans; agricultural loans (lately recovering some business from the government);

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[1]Sass, pp. 49-51.

[2]Robert Lindquist, "Goals of Bank Public Relations Programs," The Bankers' Handbook, ed. William H. Baughn and Charls E. Walker (Homewood, Ill.: Dow Jones-Irwin, Inc., 1966), p. 700.

construction loans; real estate loans which include the conventional single family, commercial, industrial properties, FHA insured loans, and Veterans' Administration mortgages; dealer financing; direct installment lending; home improvement loans; small business installment loans; and special types of consumer loans such as the Student Loan Program, Hospital plans, and travel loans.[1] All these loan services are normally impossible for a small or medium-sized bank to provide. However, a bank having access to on-line time-sharing electronic data processing capability is better able to cope with the enormous amounts of research and loan administration involved in a wide marketing loan program than one which does not have this capability.

To help maintain a safe liquidity position, banks invest in government securities, typically U.S. Treasury bills and other Treasury and federal agency securities of short (less than one or two-year) maturities, and short-term high quality municipal obligations with broad market acceptance.[2]

Bankers will shift funds back and forth between loans and investments depending on relative differences in interest rates. If the great number of variables involved in money and investment management could be arranged in a computer

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[1]William H. Baughn and Charls E. Walker (ed.), The Bankers' Handbook (Homewood, Ill.: Dow Jones-Irwin, Inc., 1966), pp. 247-546.

[2]George W. McKinney, Jr., "Managing the Bank's Money Position," The Bankers' Handbook, ed. William H. Baughn and Charls E. Walker (Homewood, Ill.: Dow Jones-Irwin, Inc., 1966), p. 581.

programmed linear problem framework, it would be possible to determine optimal profit and liquidity position anytime. Weighting considerations for variables are necessary and these would need to be reviewed periodically.

Banks must rely primarily on differentiating the quantity and quality of services they offer individuals and business firms in order to attract and retain demand and time deposits. The Banking Act of 1935 specifically prohibits paying interest on checking accounts and Regulation Q (Federal Reserve) limits the rate member banks may pay on time deposits.[1] Marketing deposit services is a competitive necessity. Some of these services are: paying certain monthly or quarterly bills for customers; making allocations from depositors' demand accounts to savings accounts; automatically making charges against depositors' accounts to repay loans whether made by the bank or other institutions; providing trust power service and trust management service; providing for deposit by mail; keeping monthly charges for checking accounts to a reasonable level, etc.[2] Deposit services offered to business firms might include: providing a night depository facility; offering special services such as data processing, payroll, locked box, and others; providing one check payroll services by receiving an employer's check and automatically crediting his employees, etc.[3]

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[1]U.S., Congress, House, Committee on Banking and Currency, A Study of Selected Banking Service by Bank Size, Structure, and Location, 88th Cong., 2d Sess., 1964, p. 2.

[2]*Ibid.*, pp. 9-15.

[3]*Ibid.*, pp. 16-18.

Ability to provide these services hinges a great deal on the data processing capability of a bank, its size, and the demand for such services in the community it serves. Bank managers must determine whether these services have enough potential demand to warrant their being provided. Even with electronic data processing capability, the incorporation of services must proceed on a slow, orderly basis since the expense may not be offset by enough increased deposits. Individual check and savings account processing by computer will provide the largest potential savings to banks over any other manual or semiautomatic system. They are the most repetitive yet simple accounting procedures a bank has.

Very imaginative alternatives to the issuance and processing of checks are being considered in the industry at the present time. "Checkless society" operation, in whatever form it is manifested, will certainly require electronic data processing and storage capacity.

The progress made in this century in information handling and processing machinery has allowed the banking industry to keep pace with the demands for increased financial services and management requirements. Electronic data processing has created a revolutionary increase in information and data processing speed and capacity. This fascinating development will continue to create profound changes in man's existence. The banking industry has been and will increasingly be affected by this technology. How may banks determine the electronic data processing configurations they need in the near future and beyond? The answer lies in the establishment of permanent feasibility study machinery.

CHAPTER II

ELECTRONIC DATA PROCESSING CHARACTERISTICS

The Computer

Professor Charles Babbage conceived the idea of a new type of calculator in 1822 which he called the "difference machine." However, this effort and his follow-on efforts with a punch tape analytical machine did not receive the encouragement and support they should have. Analog computers were developed nearly one hundred years later and, in 1939, Dr. Howard Aiken planned a digital computer, forerunner of those today.[1] In reality, digital computer development was impossible in Professor Babbage's time; lack of an electronics technology precluded it. Many writers have expressed this evident truism--technological change and development continues to accelerate almost geometrically every fifteen to twenty-five years. Certainly the mushrooming developments in atomic energy, automation applications, and electronic data processing support this thesis.

Operating speeds of computers have risen from tens of operations per second in the late 1940's to a capability of a million operations per second. Future computation speeds

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[1]Robert G. Van Ness, Principles of Data Processing with Computers (Elmhurst, Ill.: The Business Press, 1966), pp. 1-2.

will approach a billion operations per second.[1] There is no geometric progression here since there is a limit to micro-electronic miniaturization and electronic transmission speed is constant. In business, the need for data processing capacity has increased at seemingly geometric rates in the past thirty years or so. It is to be expected that a reasonable rate of increase in data processing needs will occur in the 1970's. More raw data is being stored, processed, collated, outputed, etc., than ever before and with it is a growing need for effective control of all this recordkeeping. Automatic data processing is capable of quickly providing managers with accurate information for decision-making.

Computers are in such strong demand because they have proven to be economical--even for installations which were insufficiently planned and/or are underutilized. The following four factors are generally present as evidence of the economies involved:

1. Computers provide new time dimensions for the working day and for the human concept.

2. Computers provide efficient and effective controls over human error.

3. Computers provide large capacities to store information and the capability to rapidly access this information.

4. Computers provide automatic organizational, administrative, and management controls.[2]

Computers are error free once the computer program is written and tested unless a malfunction occurs. An elaborate planning

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[1]"Computing Machines," Encyclopedia Britannica, 1964 ed., Vol. VI, p. 247.

[2]Van Ness, p. 6.

and budgeting process is possible for any business because of the ease and speed with which management can be supplied with necessary information. "According to a report published by the American Federation of Information Processing Societies (AFIPS), there were only 10 or 15 computers at work in the U.S. in 1950. Today there are 35,200, and by 1975 there will be 85,000. Investment in computers will rise from $8 billion to more than $30 billion by 1970. Present installations include 2,100 large systems costing about $1 million each; in 1975 there will be 4000 of these."[1] Some member commercial banks have computers and most others will need computer capacity to remain competitive.

The input to virtually all digital computers is numbers expressed in the form of a binary code which has two digits, 0 and 1. Translation of the decimal numbering system into binary is by the powers of two with "bits" counted from right to left. For instance, 0 = 0 in binary, $1 = 2^0$ (zero power) and equals 1 in binary. The number 23 equals $2^4 + 2^2 + 2^1 + 2^0$ in binary and registers as 10111; note that the 0 represents the lack of 2^3.[2] Thus any number can be expressed by computers in binary form. An example of binary processing would be addition by "parallel arithmetic" in which the words, or series of binary bits, are parallel added to another word. A carry over results if 1 is added

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[1] John McCarthy, "Information," Scientific American, September 1966, p. 66.

[2] "Computing Machines," Encyclopedia Britannica, 1964 ed., Vol. VI, pp. 246-47.

to 1; the result shows as a 1 in the next left bit stage. An example of this is the words 000101100111 and 000110000100; their sum = 001011101011. Note that computers typically have 12, 24, 48, or 72 bit capacities.[1] Letters and special characters are binary coded also.

The computer performs four basic operations; (1) input, (2) storage, (3) processing, and (4) output. Figure 1 charts basic computer functions.

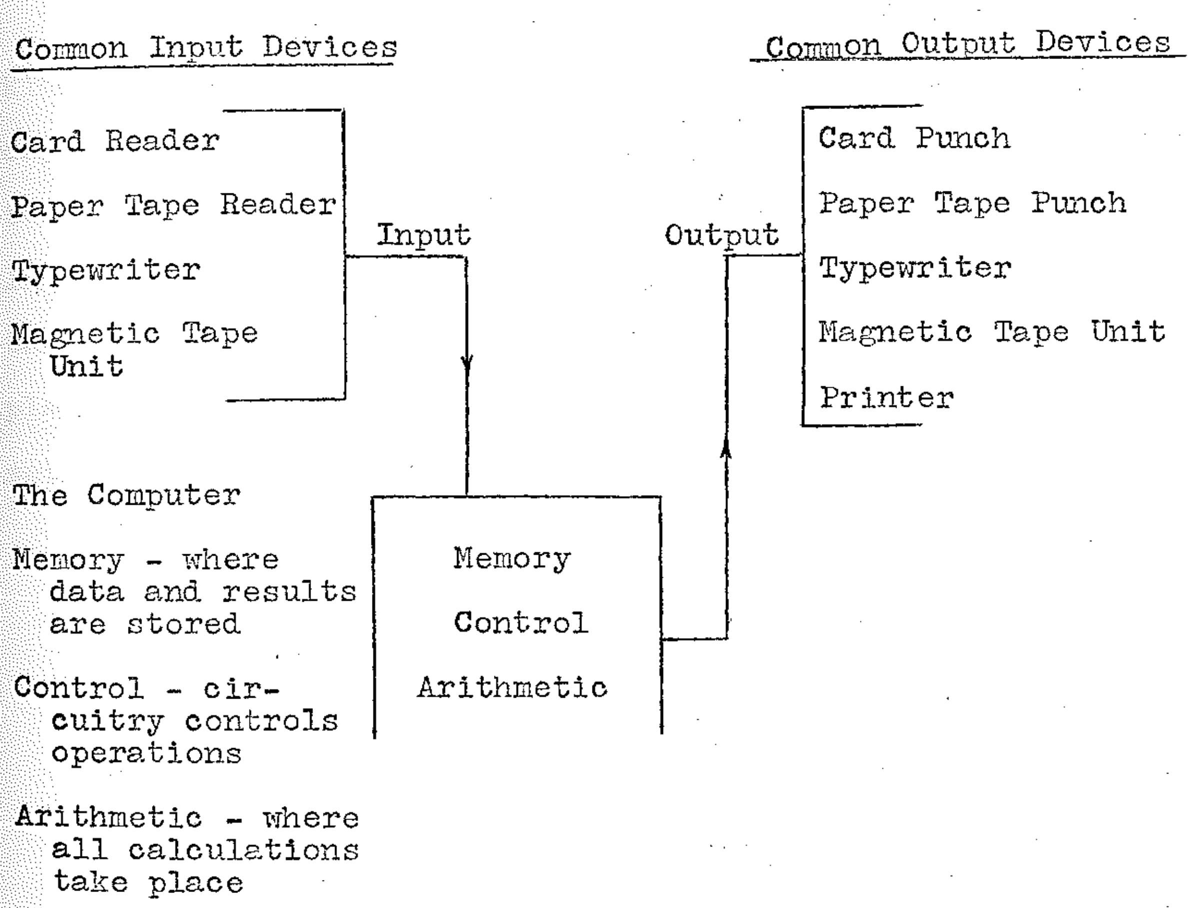

Figure 1--Basic Computer Functions[a]

[a]Robert G. Van Ness, Principles of Data Processing with Computers (Elmhurst, Ill.: The Business Press, 1966), p. 11.

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[1]Van Ness, pp. 13-14.

It is important to understand the characteristics of electronic data processing equipment in order to appreciate the need for a permanent feasibility study group in a banking firm. The following sections present an overview of these characteristics with emphasis placed on third generation or time-sharing systems and their application to banking procedures.

Logic and Memory

Electronic digital computers are made up of two basic kinds of components: logic (or switching) elements and memory elements; the elements, as stated, are binary. These two components must be functionally complete by having the logic circuit capable of performing any logical function synthesized from elements of the set. Some functionally complete circuits are: "and," "or," "not," "nand," and "nor" sets of binary logic elements.[1]

> The circuits that store information in a computer can be divided into two classes: registers and memory circuits. Registers are combined with logic circuits to build up the arithmetic, control, and other information-processing parts of the computer. The information stored in registers represents the instantaneous state of the processing part of the computing system. The term "memory" is commonly reserved for those parts of a computer that make possible the general storage of information, such as the instructions of a program, the information fed into the program, and the results of computations.[2]

The design and cost of memory devices have been limiting factors in computer development. In most high-speed random

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[1]David C. Evans, "Computer Logic and Memory," Scientific American, September 1966, pp. 75-76.

[2]*Ibid.*, p. 75.

access magnetic memory units, tiny cores made of ferrite provide a means of furnishing stored "bits" of information. Microelectronic thin film memory units also are used in random access magnetic memory storage. Another memory technique involves depositing a thin film of magnetic material on a surface such as a plastic tape or card, or a metallic drum or disk.[1] "Magnetic tape about a thousandth of an inch thick, half an inch wide and up to 2,400 feet long per reel has provided the main bulk information store for many years."[2] Microfiche (computer microfilm storage) is an alternate storage technique that is feasible for infrequently accessed information. Each of the above memory devices ordinarily are made to store a million or more "bits" of information. Computers built with integrated components (such as silicone chip), instead of transistors and resistors, are expected to be cheaper than present machines so that information processing costs will decrease further in the near future. "The logic and main memory of a very large modern computer contains nearly half a million transistors and a somewhat larger number of resistors and other electrical components, in addition to 10 million magnetic cores."[3]

Inputs and Outputs

For a computer to be useful, it must be able to communicate with humans. An input/output system must be designed

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[1] Ibid., pp. 79-81. [2] Ibid., p. 81.

[3] Ibid., p. 83.

to accommodate human needs as well as to instruct the computer in its language. After the computer reads and processes the translated input data per instructions, it spews out information through output devices which translate back to a form people can read.

Common forms of input are punched cards and punched paper tapes. Both are prepared by operators who type data on keyboard console units which cause holes to be punched in cards or paper tapes.[1]

> Another method involves the direct reading of source documents; it is becoming increasingly popular because it eliminates translation of source data into machine language. This direct entry method is known as "optical scanning." Another very common method, widely used in banking and financial institutions, is Magnetic Ink Character Recognition (M.I.C.R.).[2]

In 1954, the American Bankers' Association appointed a Technical Sub-committee on Mechanization of Check Handling to study the feasibility and application of the computer. They developed M.I.C.R., one of the most significant accomplishments in bank operations in this century. M.I.C.R. is a common machine language placed along the bottom of all checks (demand deposits). On the bottom left is the transit number field which identifies the Federal Reserve District, the bank, and the particular branch, if any. The code in the middle identifies the customer. The code on the right identifies the amount of the check and is entered by the first

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[1]Van Ness, pp. 22-23.

[2]Ibid., p. 23.

receiving bank. Reader sorters can then process checks at tremendous speeds.[1]

Output is in many forms: printed reports, punched cards, punched tape, magnetic tape, cathode-ray tube pictures, etc.[2] The most common form is the printed report which, obviously, is printed out on a printer after it translates machine language into human language.

Until recently all input/output systems in general use were designed to economize on the computer's time because of the costliness of delaying computation. Recent developments in real-time (real-time denotes recording data as it originates), on-line systems and reductions in the costs of computer use have allowed freedom in designing input/output devices. "Program-interrupt" hardware signals the computer when an input/output unit is ready to transfer data. This signal causes the computer to suspend whatever it was doing and execute this totally independent input/output program. The "program-interrupt" will return the computer to its original activity when it completes the program. Some type of priority has to be established for real-time sharing systems with many input/output stations. A "memory-snatch" is similar to the interrupt hardware; each input or output of data takes only one memory cycle and so computing is interrupted for only very short periods. Some new input/output devices

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[1]Raymond C. Kolb, "Systems for Handling the Paper Work in Banks," The Bankers' Handbook, ed. William H. Baughn and Charls E. Walker (Homewood, Ill.: Dow Jones-Irwin, Inc., 1966), pp. 180-84.

[2]Van Ness, p. 28.

are: Rand Tablet which allows direct input of drawings; light pen with input through a cathode-ray tube; cathode-ray tube display with three dimensional presentations; and chain printers of fantastic speed.[1]

Programming

Programming tasks for computer processing is not easy and sometimes can be quite frustrating. Writing a program or set of instructions on how to perform a particular task is usually approached in two stages.

> The first of these is called system analysis. It involves analyzing the task to decide exactly what needs to be done and adopting an overall plan. The second stage is to write the required operations in a form suitable for the computer.[2]

The second stage, involving many detailed decisions, depends on the particular computer to be used. In the second stage, once the objects are named, definitions of the objects need to be clarified and a representation specified for each of them. Finally, these detailed representations or instructions are written in a particular programming language.

There are many programming languages: FORTRAN, ALGOL, and MAD (scientific use); JOVIAL (military); COBOL; SIMSCRIPT; LISP; PL/I; and CPL.[3] COBOL is defined as COmmon Business Oriented Language and is designed primarily for repetitive file processing. The U.S. Government has specified that

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[1] Ivan E. Sutherland, "Computer Inputs and Outputs," Scientific American, September 1966, pp. 86-96.

[2] Christopher Strachey, "System Analysis and Programming," Scientific American, September 1966, p. 112.

[3] Ibid., p. 118.

computers it contracts for must be able to utilize a COBOL program.[1] The Federal Reserve System uses COBOL in its operations. COBOL is best suited for most, if not all, operations a bank firm may wish to computerize or already have computerized. All computer languages developed and implemented in the past few years use a symbolic form--a collection of mnemonic (memory assisting) codes that blend with man's language. For instance, "R" may mean "Read a card" and "WRP" may mean "Write, read, and punch" in symbolic language; numbers represent these instructions in machine language.[2]

Translation of the symbolic language (source program) into a machine language program (object program) is done with a "processor"; this is a program in machine language that does the converting. Of the two types of processors, compilers are decidedly more useful and versatile than assemblers. As assembler translates one machine language instruction for each symbolic instruction written by the programmer; the compiler is capable of generating numerous machine language instructions from one source program. Compilers are more complex and thus require that programs written in compiler language be translated on computers with magnetic tapes or disks.[3] Naturally the trend is toward compilers since they fit in with other hard and soft ware developments in

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[1]Robert H. Gregory and Richard L. Van Horn, Automatic Data Processing Systems (Belmont, Calif.: Wadsworth Publishing Co., Inc., 1965), pp. 294-95.

[2]Van Ness, p. 64.

[3]Ibid., pp. 64-68.

computer use. On-line, real-time computer system capability communications with other computers, efficiency of large computers over small ones, and remote input and output capability are developments which offer business in general, and banking in particular, versatility and data processing efficiency. Compiler capability meshes nicely with these. Compilers are a step in the direction toward the ultimate objective of a systems concept.

Some programs are very simple, such as a large series of totals, and do not need a lot of instructions; the programmer need only specify the format of input/output documents. The data cards are placed directly behind the processor containing specification cards and a report is produced; the processor becomes the processor deck in this "load and go" program. An example of this is the program FARGO used on the IBM 1401 computer which may process a payroll Bank Reconciliation Report.[1] In as much as this is problem oriented, it is akin to a system's concept. It is restricted in use to simple procedures.

Testing is very important in programming. The programmer makes dummy programs wherein every possible job condition is simulated. If errors are found, the program is "debugged" (common term for checking and correcting). To preclude reassembling programs for small errors found in testing, "patching" (the insertion of an unconditional branch to the next unused core location) is sometimes used.[2] Testing aids of

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[1] _Ibid._, pp. 72-75.

[2] _Ibid._, p. 78.

various sorts may be used by programmers to track down programming errors.

> After the source program has been written, assembled into machine language, and tested, it is ready to be used with live data. A condensor is a program that will process a machine language program and punch out a condensed deck with several machine language instructions in each card.[1]

This saves time in loading and reduces volume. Any change in the object deck requires a new condensed deck; in banking operations such as demand deposit processing, the object deck should not need to be changed unless the service is altered.

A "monitor" is a program that will control the loading of programs in a directed sequence. Advantages include reduction in programming time, better control, and multiprogramming in more sophisticated systems.[2] The monitor provides the "interrupt" routine discussed earlier, used in the real-time system. Data collection programming involves the use of several devices that relay data to a computer. Monitors perform other types of multiprogramming and perform other supervisory tasks of a wide variety. Monitor programs of all sorts may be expected to be used in a commercial bank's computer operation.

In any expected transmission tie-in with the Federal Reserve System, on-line, real-time computer capability, programmed for COBOL, will provide banks with the most compatibility and flexibility.

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[1] _Ibid_., p. 82.

[2] _Ibid_., pp. 84-85.

System's Characteristics and Time-Sharing

Basically, an on-line system will obtain data as it is occurring, process it, and furnish results almost immediately. The large airline companies have on-line reservation systems wherein flight space inquiries are sent to a central computer, perhaps a thousand miles away, and the computer processes them immediately. The reservation information answers from the computer are returned to the originating desk-set display units. If an on-line system is fully automatic, such as in highly automated chemical process plants, it is called a "closed-loop" system. Most businesses use less elaborate systems called "open-loop" which employ people to gather data and/or implement control.[1]

The off-line system is one in which there is reduced need for direct connection between operations and the data processing unit. Batch processing is a feature of this type of system wherein master record files are updated only occasionally. Commercial banks have handled checking accounts by off-line batch processing techniques. Depositors' accounts have been updated once per day in conjunction with the receipt of checks through a bank's clearing house once per day; the checks are posted to the accounts after batches of checks are sorted.[2] The introduction of on-line techniques for window tellers' reference and the introduction of bank credit card or "checkless society" service will have an important

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[1] Gregory and Van Horn, pp. 16-18.

[2] *Ibid.*, pp. 19-21.

impact on the design and operation of the whole system. It is important to recognize that off-line, in reference to input equipment, means that while an operator is typing in data at a console unit, that data is being inserted on magnetic or paper tape or cards and the computer is not held idle. The tape or cards feed the data in at a fast rate when the operator signals the computer to receive it. Off-line equipment then is essential for other than time-sharing systems and can be part of a time-shared computer system.

> Time-shared systems consist of a large, central facility designed and programmed to work on a number of different problems simultaneously. The users are connected on-line directly to the computer which provides them with real-time service.[1]

Time-sharing concepts go beyond other real-time on-line systems which are limited to fixed tasks. Christopher Strachey first proposed a time-sharing system in 1959.

> By segregating the central processing operations from the time-consuming interactions with the human programmers, the computer could in effect work on a number of programs simultaneously. Giving only a few seconds or often less than a second at a time to each program or task, the machine could deal with many users at once, as if each had the machine to himself.[2]

The system involves multiple direct connections to a large computer from many locations, nearby or many miles away. Random access storage devices are inherent features of real-time processing. The first such system was established at Massachusetts Institute of Technology (MIT) using an

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[1] Isaac L. Auerbach, "Information Technology in the United States," Computer Yearbook and Directory (Detroit: American Data Processing, Inc., 1966), p. 54.

[2] R. M. Fano and F. J. Corbató, "Time Sharing on Computers," Scientific American, September 1966, p. 129.

International Business Machine (IBM) 709 computer; two years later the system was operating on two IBM 7094 computers. The system contains a large store of supervisory and utility programs, language translating facilities, a library of subroutines, etc.--about one million computer words. Besides some one hundred basic programs, which are called into play by a specific command, the system contains a great variety of special programs.[1]

There is nothing to preclude the use of almost any type of input/output equipment. As mentioned, an off-line unit, where it is customary for an operator to feed in large amounts of data at a time, should fit into a time-shared system. It is to be expected that time-shared systems will be programmed to operate on programs which must process many million of "bits" of data and these will be interrupted by other input stations. For example, a large bank with branches may have a time-shared system which is currently processing to determine the amount of interest for all savings accounts and adding the applicable amounts to each account. While processing this program, the computer might be interrupted several dozen times to supply information to specific questions from many operators of input/output consoles at that bank's home office and branches. Such instantaneous (simultaneous) service for a bank's customers should be most impressive and efficient; queuing at tellers' windows will greatly decrease with the faster teller service.

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[1] *Ibid.*, pp. 129-31.

While time-sharing holds enormous promise, economically feasible time-sharing systems will have to impose some limitation on response time to the subscribers, on the number of subscribers who may have simultaneous access, on the ability of subscribers to modify and develop their own programming, the number of basic and supervisory programs, etc. Costs are expected to be quite high, especially for the storage, peripheral equipment, and programming requirements. The economies inherent for large computers over small ones may not exist if the time-sharing system integrates several small computers.[1]

Service bureaus are coming into existence throughout the country. Some are computer manufacturer managed; some are semi-independent; and some are completely independent. While most of them do not have time-shared capability, there should be a scramble to obtain this capability in the next two or three years. The first general purpose business information utility using time-sharing is the Key-Data Corporation in Cambridge, Massachusetts. It has more than two hundred subscribers, mostly small business, who may simultaneously use its Univac 491 computer. As in the MIT system, this computer accumulates data as it is fed in by a subscriber, processes it, and sends information back in a fraction of a second. By the time this first subscriber has completed typing another item of information, the computer has gone the rounds

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[1]Eric N. Grubinger, "A Practical Look at On-Line Time Sharing," Business Automation, February 1967, p. 48.

of all the terminals and is ready to receive again.[1] The economics of service bureaus using time-sharing large-scale computers is obvious and makes computer processing economically feasible for medium and small businesses. Bank firms may either provide this type of service to other businesses or may be a recipient of such service.

With time-sharing, computer users are sending an increasing volume of digital data over the nation's electrical communication network; this trend will continue.

> Transmission channels most often used are either wire, microwave, or coaxial cable. Channels and converters usually are supplied by common carriers such as American Telephone and Telegraph and Western Union.[2]

Present commercial facilities for digital data information transmission are limited to large urban complexes and short distances from these complexes; service is programmed to expand along with expected demand.

Digital Transmission

The transistor has made digital transmission practical and microelectronics should lower costs even further.

> Using today's technology, we could construct apparatus that would economically:
>
> 1. Transmit pulses over a single pair of wires at rates up to six million bits per second.
>
> 2. Transmit pulses through a coaxial channel at rates up to 300 million bits per second (a total capacity of three billion bits per second each way through a 20-unit coaxial cable).

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[1]Lou Friedberg, "How to Ease into a Management Information System," Business Management, November 1966, pp. 53-54.

[2]Edward J. Menkhaus, "The Ways and Means of Moving Data," Business Automation, March 1967, p. 32.

3. Transmit six billion bits per second each way through a two-inch wave guide by means of radio waves whose wavelength is measured in millimeters.

4. Transmit a total of six billion bits per second between various pairs of telephone offices by means of a single hovering artificial satellite.[1]

To those accustomed to using telephone lines for talking (certainly an inefficient use of them now), these figures are startling!

An example of data transmission via a telephone-message network is the Bank of Delaware's personal credit operation in Wilmington. At near-by Strom's Department Stores, sales clerks dial the number of the bank on push button "Touch-Tone" telephones, enter customer identification codes, and then enter the amount of the purchases. Other banks pioneering in this checkless area are Mercantile Trust Company N.A. of St. Louis, the Wells Fargo Bank of San Francisco, the Manufacturers Bank of Detroit, and the Bank of America.[2] Other banking firms will be instituting similar services as digital data transmission becomes available to them at reasonable rates. This remote input idea is a natural adjunct to a time-sharing computer system.

Last year the American Standard Association adopted a new national standard communications code for data transmission. Now the International Organization for Standards has drafted a proposal for a similar international code for information interchange among computers, business machines, and communications equipment.[3]

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[1]John R. Pierce, "The Transmission of Computer Data," Scientific American, September 1966, pp. 148-49.

[2]*Ibid.*, p. 147.

[3]"Code for Information Interchange Among Machines Drafted by International Organization for Standards," Management Services, July-August 1964, p. 10.

These two standards will greatly facilitate "talking" between computers and will hasten the development of feasible substitutes for check processing in the commercial bank demand deposit system.

CHAPTER III

ELECTRONIC DATA PROCESSING FEASIBILITY STUDY MACHINERY FOR COMMERCIAL BANKS

General Requirements

When computers were first being installed commercially, it was thought that only very large, diversified, and complex organizations would ever use them. This assumption has proved wrong. Technological advances have dramatically lowered the cost, increased the versatility, and increased the speed of calculation of computers. Along with these advances, there has been a great expansion of computer applications. Now, pessimists are parroting this early view on computers by stating that real, on-line time-sharing systems can only be economically utilized by the very largest and most complex of organizations. Mass production of new computer equipment, such as microminiaturized components, is not yet fully exploited. Substantial cost reductions will occur. The Diebold Research Group has predicted that data transmission costs per item will decrease by about 85 per cent between 1965 and 1973.[1] With microminiaturization, it will be feasible to establish time-shared computer complexes

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[1] "Technology Now Affects Way in Which Business Does Things; Will Next Affect What Business Aims to Do," *Management Services*, July-August 1965, pp. 6-7.

serving thousands of input/output stations; data "bits" will be processed in a billionth of a second (nanosecond) instead of millionths of seconds (microseconds). The future for time-sharing looks very promising.

Six years ago banks were concerned about the general feasibility of instituting computers into highly repetitive operations. Only the largest banks were able to justify the huge expense of doing so. Commercial banking firms are now buying computers because of their proven capability to lower operating costs and improve customer services. A 1964 survey conducted by the American Bankers Association indicated that 38 per cent of banks under $10 million in assets will be using on or off premise computer servicing by 1975.[1] These banks are the small firms of the banking industry. With new developments and cost reductions, many more of these small firms will decide to utilize electronic data processing by 1975. Needless to say, virtually all large and most medium-sized banks have already instituted computer data processing to some degree.

The feasibility study machinery should not be a one-time process; it should be a continuous activity devoted to investigating the advisability of utilizing new computer developments for processing a commercial bank firm's data. Only by continuous effort may a bank's management be able to gauge the most feasible time in which to (1) switch to

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[1]Dale L. Reistad, "Technological Revolution in Banking," Computer Yearbook and Directory (Detroit: American Data Processing, Inc., 1966), p. 207.

computer systems, (2) switch from one computer system to another more advanced, (3) add on peripheral equipment in conjunction with adding services for consumers and business customers, (4) know if and when to utilize a computer service organization for data processing needs, (5) determine the probable success of efforts to market electronic data processing services, and/or (6) engage in other activities.

Top management involvement in feasibility study machinery is paramount. Top banking managers must realize that a proper configuration of electronic data processing capability will be as large a determinant of success as is a proper mixture of banking services to consumers and business customers. With a continuing systems approach to determining electronic data processing configuration and capacity, meaningful comparisons of costs and benefits will be more correctly applied. Mistakes and true costs of feasibility determinations certainly should diminish as experience is gained.

The author thinks some basic guidelines should be established for gauging the general suitability of any proposed computer application.

1. Will the end result enhance managerial control of the commercial bank firm's operations and increase decision making accuracy?

2. Will the proposal extend the application of computer techniques to routine banking clerical and low-level judgment jobs and determinations on a practical and timely basis?

3. Will there be a worthwhile reduction of overall operating expense for the banking firm after the proposed application is operational?

4. Will the proposed application allow the bank firm to expand present services and/or allow it to develop new peripheral financial services to the commercial and consumer community it serves?

Organization and Information Requirements

The logical starting point is determining the organization of a feasibility study team. The study team should be a staff organization, the head of which reports to the president or the vice president of the bank. The team chief should be the Data Processing Manager; virtually all banks have conventional punched card equipment or computer equipment for batch processing and M.I.C.R. check reading so there will be a Data Processing Manager.[1] He should have an assistant or assistants as may be necessary from his own department. The Credit, Trust, Accounting, Personnel, and other departments of the bank should be represented on the team, preferably by an assistant to the manager of each. Personnel assigned to the team should have normal assignments with the feasibility team activity assigned as an additional duty; however, depending on the firm's size, one or two assistants in the Data Processing Department should be assigned feasibility study duties full or part-time. Allowance should be made within the departments for all people on the team to be able to work short or long hours on feasibility team activities. Once or twice a week meetings should be a minimum "on call" requirement.

The Data Processing Department personnel should maintain a current library file on electronic data processing

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[1]Van Ness, p. 122.

equipment which will allow meaningful cost, speed, flexibility, adaptability, and capacity comparisons to be made. One very complete service available is provided by Auerbach Information, Incorporated of Philadelphia, which publishes Auerbach Standard EDP reports.[1] These reports are very detailed and somewhat high in cost; thus, the service should be utilized sparingly. Another excellent source area is published data from electronic data processing equipment manufacturers. An example is the Honeywell Series 200 Summary Description.[2] This summary description is an excellent combination of both general descriptions and specific characteristics of different 200 Series configurations available in processors, input/output devices, programming and instruction repertoire, and time-sharing equipment devices. It also explains that it has Demand Deposit Accounting System and Teller Unit Monitoring application packages specifically for banking. Other manufacturers who have computer equipment adaptable to banking functions have and will mail out brochures on their products. Periodicals such as Business Automation, Computers and Automation, and Banking are useful publications for the feasibility team members. Some electronic data processing periodicals will publish comparison data tables on computer equipment on a yearly or other periodic basis. Providing an adequate team library should be an easy and inexpensive task.

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[1]John R. Hillegass, "The Burroughs B2500 and B3500," Data Processing Magazine, April 1967, pp. 62-63.

[2]Honeywell Series 200 Summary Description, Booklet (Wellesley Hills, Mass.: Honeywell Electronic Data Processing Information Services, 1966), pp. 1-54.

The team should always have information on electronic data processing and information system requirements it will need in the near and intermediate future. There should be a detailed cost analysis made on presently utilized processing equipment and methods. The analysis of present operations will facilitate comparisons with other replacement systems, methods, and/or equipment. As an example of operating considerations, personnel costs involve salary, pension and other benefits, payroll tax, hiring, orientation and training, and others.[1] The likelihood of percentage cost increases per year in operations must be considered. All data processing equipment depreciation charges must be realistic and new equipment depreciation should be determined on the same formula(s). All other assignable direct and indirect costs need to be determined and applied to present data processing methods. The bank firm's accounting and budgeting department (may be combined with data processing department) should be able to provide these cost figures. The feasibility study team should review and upgrade methods cost considerations and review requirements for the future.

Documented systems analyses of the present methods of bank data processing should be made if they are not already available. If the banking firm has instituted electronic data processing of some of its functions, this documentation should be available. "It consists of detailed fact-finding about information flows: data inputs, processing actions,

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[1]Van Ness, p. 122.

outputs, control points, quantities, file identification, frequencies of transfer, and special time requirements."[1] Data collection forms adapted for banking operations may be used by analysts. Station and network load summary analyses should be made from the data collection forms and formats should be arranged to fit the needs of the individual commercial bank. A flow listing analysis of data processes illustrates the fact that an event creates a document or action at a particular station and focuses analysis on the chain of related events.[2] Input and output format requirements, along with document counts of input data, facilitates determining present data processing capacity. These analyses should be made by the E.D.P. Feasibility Study Team members. These documents form the basis for any further studies either for improved operations of the existing data processing system or for analysis and comparison with proposed system changes.

Procedures for System Changes

Minor feasibility efforts should be conducted on a continuing basis. The data processing manager and his department assistants on the team should study computer industry and banking publication sources to determine areas in which the team may apply more intensive analyses. These areas may be in new peripheral equipment, new bank service applications possible with the existing system; new programming equipment

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[1] Gregory and Van Horn, p. 178.

[2] *Ibid.*, pp. 181-85.

and methods; additional service for commercial customers, such as payroll accounting; and others. In a limited way, most, if not all, requirements and considerations for a major electronic data processing feasibility study will be utilized in minor studies. Therefore, major system change study procedures are formulated in this presentation.

Most of the following procedures and techniques will be centered around an average-sized commercial bank firm--one whose data processing is accomplished by a medium-sized computer with relatively slow process speeds (ten or so "bits" per thousandth of a second). The input/output consists of M.I.C.R. check reading, card processing, and printout devices. Programming is by COBOL for demand deposits, time or savings accounts, and recurring accounting functions, such as payroll.

If the study group is to explore the feasibility of a major data system change, it must consider the reasonable alternatives to maintaining the present system, the basis for comparison, and an alternative itself. Possible alternatives are (1) contract to buy or rent a faster and more flexible on-site tape and disk system with more memory and computational capacity with time-sharing capability; (2) contract to buy or rent a system like the first alternative but without time-sharing capability; and (3) contract to rent all or a portion of present and desired computer processing needs from a computer service organization.

For the typical medium-sized bank, memory storage and processing capacity for the tasks mentioned would have been made and kept. If a small bank firm was considering the use of computer processing for the first time, capacity would have to be formulated from the documented analyses and other mentioned sources. For the large firm with many branch banking units, justification for a large, time-shared and fast processing computer is almost a foregone conclusion; timing of the acquisition, the working cash and cash flow level, are the main limiting considerations.

In addition to considering the basic equipment alternatives, it is necessary to consider to what extent computerized banking services will be increased. Customer services to consider starting or augmenting are (1) investment analysis for trust accounts and the bank's assets; (2) payroll and other accounting service for customer business firms; (3) a flexible demand deposit charge system based on amounts left in the account; (4) time-shared teller input/output console service to speed up and expand teller servicing; (5) multiple analyses for determining optimal credit policy for individual businesses; (6) loan servicing for special circumstances; (7) paying customers' bills; (8) credit card operation; etc. Besides customer service, data processing should be considered for bank marketing analyses, local and national trend analyses to determine best reactions to actual and expected money market events, simulation studies for future bank operating systems, more sophisticated budgeting and auditing, community credit files, etc. Also, the bank's departments requiring frequent data processing access may justify input/output stations outside the computer room.

Input/output stations at a bank's branches are imperative in any comprehensive electronic data processing system.

The bank's marketing manager should be able to establish some quantitative estimates on the demand for customer services at average industry rates. The study team should devise activity, flow listing, and other documents to assist in estimating storage and computational requirements per month or quarter for each of the services considered. From this, estimates of cost can be made. The feasibility study team should then make preliminary estimates on the utility value of the services. Cost versus utility analysis is absolutely essential. Next, the different departments of the bank should be asked by the respective department study team members to review these estimates to check for overlooked factors and to see if cost and utility determinations need refining.

Total computer memory storage and computational capacity will depend on the extent of service the bank decides to eventually try and provide to customers within the expected life cycle of possible computer systems. Some services may be economically unfeasible. The feasibility study group should eliminate specific programs where it is expected that utility may be insufficient to cover costs. As pointed out earlier, services implementation must be slow and deliberate to allow for orderly checking of them and training of personnel.

Cost-utility analysis techniques should be used to determine the number and depth of management assistance programs to incorporate into the desired electronic data processing system. As in the services determination, the bank's departments should assist in the evaluation of these applications. Again, documents are needed to estimate computer capacities.

Once a bank has incorporated a comprehensive electronic data processing capability, the marketing manager and other department managers should be able to devise feasible computer programs for estimating community demand for new or augmented services and for determining value of additional management programs.

An alternative to having the study group estimate desired additional computer capacity is to hire an outside consultant or seek computer industry assistance. However, the feasibility study group, by remaining a permanent staff organization, should be sufficiently oriented and capable of making its own analyses without costly and/or biased outside help.

At this point, the study group should review all proposed activity and flow process documents to check for possible improvements and eliminate areas of duplicated processing. Flow integration is desirable in a sophisticated system handling many task programs.[1] A cross referenced integrated computer system will use less storage capacity than one that is not. Memory storage capacity should be the most critical need costwise.

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[1]Van Ness, pp. 130-31.

The feasibility study group should be able to determine its approximate configuration of peripheral equipment requirements in order to properly handle the desired data processing system. The number and general type of input/output stations should be determined. For instance, how many teller computer access units should be installed to support that type of instantaneous service? The study group should coordinate with department heads in this task.

When the desired capacity and peripheral equipment requirements have been estimated, the next step is to appraise the total costs in relation to total benefits associated with the alternative system solutions.[1] The alternatives to the present system should be expected to improve outputs, produce more information to the bank's management and facilitate profitable management improvement, provide more service to the bank's customers, and reduce personnel and other operating costs.

> The processes of systems analysis, design, development, implementation, and operation for all applications are closely related, and many costs are common to several applications--joint costs--so that calculations of costs for individual applications is difficult, if not impossible.[2]

The recommended procedure is to estimate the cost and utility of individual applications to determine system capacity and configuration requirements but eliminate this degree of breakdown when comparisons between alternative systems are

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[1]Gregory and Van Horn, pp. 192-93.

[2]*Ibid*., p. 193.

to be made. It is more reasonable and desirable to make cost comparisons and benefit comparisons of categories of the total system.

A suggested list of costs and benefits for appraising alternative systems can be found in Figure 2, page 48. The first two alternatives will require that several computer manufacturers submit proposals for each alternative. The preliminary work conducted by the study group should eliminate any padding of capacity or peripheral equipment the manufacturers may otherwise try to sell. The feasibility study group should plan to keep the computer "busy" on night and weekend shifts and should so specify in the requirements or specifications. The manufacturers' representatives will likely respect the obvious effort the study group has made and its knowledge of what it seeks for the bank. Bids and proposed system designs should closely fit the designed system specifications for the bank and all proposals should be closely comparable for each of the first two alternatives.

The third alternative requires flexibility and comparisons of different amounts of electronic data processing to be leased. First, a computer service organization may not be available in the community. If not, a time-sharing configured service organization is the only logical candidate to submit a proposal for all, or a specified portion of, the bank's proposed processing needs. If a computer service organization is present in the community, it would not be necessary for it to have a time-sharing configuration; this ability would likely be a favorable factor to evaluate, however.

Proposed System Costs

Hardware

Basic processor
Storage and input/output
Communications
Facilities
Equipment maintenance

Operating Expenses

Programmers to maintain the system
Equipment operators
Key punchers and media preparers
Data collectors
Data control and correction
Electricity, heating, and air conditioning
Cards, paper, and/or tapes
Communications rental for time-sharing

Development Costs

Hiring and training programmers and analysts
Salaries of programmers and analysts
Salaries of additional developmental personnel
Disruption of normal operations
Retraining of displaced personnel
Establishment of new files

Proposed System Developments

Decreased Operating Costs

Fewer people employed
More effective management of the bank
Reduced time for accounts and file maintenance
Fewer mistakes in individual accounts and other files
Better operating cost control

Increased Revenue

Ability to handle more customers with existing facilities
More customers by faster and more dependable services
Higher fees or more customers from better quality of services
New revenues from new bank services

Figure 2--Major Areas of Costs and Benefits to Consider[a]

[a]Data compiled from Robert H. Gregory and Richard L. Van Horn, Automated Data Processing Systems (Belmont, Calif.: Wadsworth Publishing Co., Inc., 1965), p. 194.

Before the service organization submits a proposal, it would be best to receive bids on small computer systems from interested manufacturers to efficiently cover part of the bank's proposed needs. The computer service organization would then be asked to bid on the desired total data programs. Also, the organization would be asked to bid on specific programs which would not be processed by the small computers. In the case of a mixture, the two systems would be added to form one system for comparison. Another alternative is to have the computer service organization bid on the extra desired programs thus providing a feasible basis upon which the bank's present electronic data processing system may be compared with the other alternative designs. The feasibility study group must then evaluate and augment the bids submitted for all proposals.

The facilities requirements are quite extensive in most cases and the manufacturer's figures must be matched with reality. The most significant items to consider are (1) building construction or alterations which may be needed; (2) humidity control requirements and tolerances (equipment must be kept fairly dry); (3) the amount of air conditioning required and the amount of temperature range tolerance of the equipment; (4) electrical wiring which must be strung out of the way; and (5) false flooring to accommodate the wiring.[1] Generally speaking, new computer equipment's cooling, humidity, and space requirements are no more stringent,

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[1]Van Ness, p. 133.

or are less stringent, than those for older computer systems. Therefore, the medium-sized bank with a computer installation would not need to spend any extra on installations except for the "moving-in" expenses. Small banks considering computer installations for the first time will have a disproportionately high installation cost in relation to expected benefits. Thus their computer data processing needs may be most economically met by leasing space from a computer service organization. For a large bank operation, Bank of America's experiences are classic. That organization took years in planning, preparation, installation, and start-up of their ERMA (General Electric) and IBM complex--a $40 million program![1] Presently, the organization is replacing old data processing equipment; the installation costs will be much less than the initial efforts and probably have little effect in determining the optimal data processing configuration for Bank of America.

Other features of the hardware costs for each bid should be carefully scrutinized. In fact, the only hardware item of special significance to leased computer service is communications; the team should ensure that the bid charge for computer communications is the same as the charge that is actually made by the carrier, American Telephone and Telegraph or Western Union. There are communications charges for installed time-sharing systems for banks with branch

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[1]Donald Young, "Meet Mr. ERMA," Business Automation, August 1965, p. 17.

installations, too. Equipment maintenance and future systems assistance is significant because of the disruption caused by a computer breakdown. If a manufacturer cannot guarantee fast replacement and maintenance for installed systems, downtime cost possibilities could make the significant difference in comparison studies.

Determining operating expenses for each alternative considered is tedious work. Manufacturer's assistance in determining these is essential and is normal practice. Again, the feasibility study group should evaluate each of the operating expense items and then compare the alternative choices.

Development costs for the typical medium-sized bank with an existing small computer system and a trained cadre of personnel will be much less than development costs for bank firms considering initial computer installation. Obviously, one of the advantages in having a feasibility study group in existence is the trained leadership the members will provide for their departments in overcoming development difficulties. Another advantage the feasibility team provides is the records kept on development costs for the present computer system. Areas of development difficulty should have been noted and ways of alleviating these difficulties should be planned for. There should be little difference in development costs between bids of the first alternative and between bids for the second alternative.

The third alternative should be easy to evaluate for a complete leasing arrangement. Its total cost is compared with total costs of the other two alternatives' proposals.

The mix of installation and leasing to provide desired data processing capacity would require the same systematic checking and compilation of costs, which the study group conducted for the first two alternatives. Also, the present computer installation costs should be added to computer service organization charges for the desired additional bank services. As mentioned, this is the most feasible way in which to compare total costs of the existing system with the new alternatives.

Other Considerations

Throughout the effort to study the feasibility of redesigning and/or augmenting the bank's electronic data processing system, it is necessary to estimate and re-estimate utility value of additional programming for community and customer services and improved management methods and techniques. Therefore, the task of quantifying benefits and determining increased revenues is largely accomplished. Another review of them in light of all the specifics of the system's designs for all reasonable alternatives should uncover any overlooked benefits and revenues.

This study process has stressed the need to maintain an independent and unbiased stance with regard to assistance from computer equipment manufacturers. This legitimate posture must not create an atmosphere of reluctance to utilize information manufacturers are very willing to make available. A feasibility study team should always seek data and information assistance that will help it determine the optimal electronic data processing for its firm.

Another factor the study team has to consider is the best time to order, prepare for, and install a system other than the one presently utilized. Top management will have to decide this since financing a major change such as this will also have to be carefully planned for. The Data Processing Manager should inform top management of its progress in the feasibility study efforts with many progress reports. The study may be expected to last several months. Therefore, top management will have time to plan financial strategy. Top management may decide to postpone ordering the system until it can be paid for since leasing a computer system versus buying it usually costs more in the long run. This may be easily determined by using the present value method of comparing these two investment alternatives.[1] As stressed earlier, top management involvement is a necessity.

Overall system preparation and installation procedures may take up to one and a half years.[2] The feasibility study group will be well prepared to handle the enormous tasks involved by its thorough preparation in conducting a proper feasibility and comparison analysis.

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[1]Elwood S. Buffa, Models for Production and Operations Management (New York: John Wiley and Sons, Inc., 1963), pp. 379-82.

[2]Van Ness, p. 170.

CHAPTER IV

CONCLUSION

Electronic data processing has created a revolution in the extension of man's ability to produce goods, to invent new products and create new uses for existing products, to manage systems effectively, and to offer more service at reasonable cost. The time-sharing ability of third generation computer systems will extend the use of computers, eventually to the household level. While it is difficult to determine the utility value of acquiring time-shared computer capacity, a bank firm's feasibility study team must endeavor to do so. Competition to extend computer service will become intense, as well as lucrative, to firms which are able to offer small businesses and individuals excellent and convenient data processing service at reasonable rates. It would seem that commercial banks are in a most favorable economic position to offer these services since data processing would be just a convenient extension of services they already provide. Checkless demand deposit service, when it comes, will best be handled by time-sharing systems.

Feasibility efforts must be a continuous and, yet, inexpensive undertaking. The organization and functioning of a feasibility study group outlined in this presentation meets these two requirements. The results of an ill-timed and/or badly formulated computer acquisition could bankrupt or very adversely affect the profitability of a bank firm for many years. This must be prevented. The personnel selected for membership will undergo a stimulating process of education and they will realize personal satisfaction in helping to guide the management policies of their banking firm. The banking firm, in turn, is realizing side benefits in manager development. Other side benefits would be realized in cost reductions brought about through the improvements in programming, data handling procedures, etc., in the existing data processing system the study group would make.

Many thousands of small commercial banks are, and will continue to be, struggling to survive. The feasibility study concept presented here is adaptable to their abilities to support the effort. The alternatives open to them are more limited as is the number of processes which they may profitably run by electronic data equipment. Very likely their problem will be solved through leasing computer time from a service organization. Aggressive policy arbitrarily suggests that they market computer service themselves. A proper feasibility preparation and study process will guide them to correct decisions at less expense than medium banking firms would need for the same effort.

Large banking firms are able to spend millions of dollars in feasibility and preparation efforts. Those millions of dollars are well spent if the effort results in an optimal or near optimal system configuration. The continuous study effort should help to ensure this.

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