ADAPTABILITY OF ELECTRONIC PROCEDURES TO BANK DATA PROCESSING

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By

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ABSTRACT

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by Karl M. Skousen

Banking history reveals that a sequence of various instruments and devices have been used to aid in banking's record-keeping functions to meet changing circumstances. With the economic upsurge following World War II, checks and checking accounts increased at an unprecedented rate. The physical magnitude of the volume of checks and accompanying cost increases caused bankers to search for ways to handle them through utilization of electronic data processing equipment. As a consequence, a number of questions arise. Some of these questions are: (1) can electronic equipment be physically adapted or developed to meet the data processing needs of most banks? (2) can banks economically and organizationally make wise use of electronic data processing? and (3) what are the organizational, managerial and human implications of banks' conversion to electronic data processing?

An electronic computer for account updating and figure manipulation is only one component of a functional EDP system. Banks need also a means of converting transaction data to machine language, and a method of expediting the flow of checks through the banking system. The major requirement,

therefore, is for equipment that can "read" original source documents. The development of magnetic ink character recognition (MICR) and electronic sorter-reader-converters has made machine character sensing possible, and has greatly enhanced check transfer.

Electronic computers, sorter-reader-converters and other machines comprising the equipment of an electronic data processing system are costly. This factor has thus far limited EDP systems to relatively few of the country's larger banks. However, new computer systems, specifically designed with banking's special problems in mind, are now being marketed. The availability of these smaller and less costly systems has increased about ten-fold the number of banks which may now find electronic data processing feasible. Furthermore, the benefits and advantages to be derived from electronic computer use is being sought by the smaller banks through computer sharing. Two methods predominate: jointly owned facilities, or the rental of computer services.

When the first method is followed, cooperating banks establish a separate computer center and equitably pro-rate operating costs to the center users. When the second method is followed, computer service bureaus provide data-processing rental services. Such services may be received from: (1) correspondent banks having electronic equipment, (2) computer owners in other business industries, (3) service centers operated by electronic equipment manufacturers, (4) independently owned service bureaus, or (5) service bureaus established and operated in conjunction with an existing bankers' or bank clearing-system organization.

Application of EDP to banking activities has institutional implications as well as human ones. For instance, bank internal organizations will probably be changed as clerical functions are centralized and customary functional lines become blurred. Clerical manpower requirements will be changed, space for processing and storage of data will be reduced, and communication and check transfer methods will likely be altered. Principally, the management areas (and hence institutional and human ones) which will be most affected are: (1) decision-making, (2) planning and operation, (3) human relations, and (4) institutional growth and/or survival (especially for smaller banks).

(1) Decision-making--It seems reasonable to expect that less time will be required for routine decisions, with computers programmed to make many of them. Greater automaticity should result in fewer crises in operations. Hence, the need for middle management will likely decline. Therefore, over time, a probable shrinking of middle management is visualized. Since it is possible to maintain more information in more detail, management will have access to a greater range of factual data, and will need to rely less on intuition.

(2) Planning and operations--Timely and relatively accurate forecasts and projections can be made through

problem and alternative project simulation. Therefore, management will be able to take preventive control action rather than having to rely on corrective action. Individuals, freed from time-consuming routine duties, will have time to think and to plan, rather than merely to react to the environment.

(3) Human relations--Equipment will do more work now being done by clerical employees. Consequently, some personnel displacement will take place, with adjustments and re-training required. However, expanding services and increased demand will require more people. Furthermore, computer centers will have to be staffed with qualified technical personnel. In addition, customer relations will continue high in importance; as new methods are introduced that alter customary practices or make new forms necessary, customer acceptance must be generated.

(4) Institutional growth--Competitive advantage may result from lower per unit costs. Large volume capacity of computer systems may also induce some banks to seek further per unit cost reductions through merger. As a result of these two factors--competition and merger--smaller banks may find survival difficult. Some may be engulfed by larger banks, while others may simply cease to exist.

Internal and independent auditors are likely to encounter new challenges in EDP. Basically, these challenges fall into two categories: internal control and the disappearance of audit trails. In some cases, customary auditing techniques will require modification, or they must be discarded and replaced with newer measures that are suitable to computer systems.

Electronic researchers predict an exciting stream of new technical developments. Some of these developments hold great promise for banking and foretell changing methods of paper handling and data processing. One suggested possibility would see the establishment of a single national records center. Utilizing universal account numbers, the checking accounts of all depositors in all banks would be maintained on giant (capacity, not necessarily size) computers. Through electronic communication and telepicture networks, immediate access could be had from any bank in the nation. Checks would be stored by the bank where presented. A second possibility would see the by-passing of check-writing procedures. After establishing identification, transaction details would be transmitted directly and immediately from point of origination to a record center where accounts would be automatically posted. However, radical changes probably will not be the rule; the banking industry, by its nature, accepts changes only gradually.

Though accompanied by many problems, and initial high costs, more and more banking firms are finding electronic equipment and procedures adaptable to their data processing needs. For the smaller banks, continued use of semi-automatic equipment will prevail until either some form of computer sharing is viewed as advantageous, or until new developments and decreasing costs make individual installations economically feasible.

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information. In most respects, the writer believes the information presented is accurate, but wherever it is not, the responsibility is entirely his. In such a fast-moving field as EDP in banking, it is probably not possible to present a work that is entirely up-to-date.

Finally, grateful acknowledgment is expressed to those who have sacrificed to make this work possible: first and foremost to my wife, and to our children and grandchildren, and to parents and friends--all of whom offered encouragement and had faith in the writer's ability to complete the job.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	ii
LIST OF FIGURES	viii
LIST OF APPENDICES	ix
Chapter	
I. INTRODUCTION	1
Purposes	2
Methodology	3
Scope of the Study	4
Organization of the Study	6
II. SOME CHANGING ASPECTS OF BANKING	11
Background	11
Banking	12
A bank's paper problem	14
The present	17
Data Processing	19
Data processing defined	19
Clerical force growth	21
Repercussions of change	23
Why more efficient data processing? . . .	25
Bank clerical department requirements . .	26
Requirement for system flexibility . . .	28
The Dynamics of Growth	30
Personnel	31
The rising flood of checks	34
Development of check usage	35
Expanded use	36
Bank services and competition	40

Chapter Page

III. BANK DATA PROCESSING AND MECHANIZATION PRIOR TO EDP 50

Early Methods of Bank "Record" Keeping . . 50
Development of Early Bank Bookkeeping Machines 56

IV. THE MAGIC OF MICR 67

Goals, Objectives and Problems 68

The "language" barrier 69

Reasons for MICR 75
Solving the MICR Problems 78

MICR placement on checks 79
Incidence of mutilation 81
Economy in equipment and operation . . . 82

Equipment costs 82
Continuing labor costs 84

Customer acceptance 85
Punch card compatability 86
Check standardization 87
Magnetic ink character shape 91

Steps Involved in a Check Mechanization System 94

V. DATA PROCESSING EQUIPMENT CURRENTLY USED . . 99

Conventional Bookkeeping Machines 101
Window Posting Machines 102
Proof Machines 108
Sorter-Reader-Converters 109
On-Premise Encoding Equipment 111
Electronic Bookkeeping Machines 112
Punched-Card Systems 118
Electronic Computer Systems 120

Early beginning 121
Computer data processing 128

Numbered accounts 130
MICR checks 132
Expensive equipment 135

The machinery 140
A unique computer approach 142

Chapter Page

VI. DATA PROCESSING SYSTEMS AT WORK 147

A Visible Record Computer Installation . . 149

How the system operates 153

EDP With Punched Card Input 157
An English Computer System 164
EDP at Michigan National Bank 168

Customer and public relations 171
Personnel 181
System implementation 185
Operations and procedures 191

Checking accounts 191
Savings accounts 196
Installment loans 199
Mortgage loans 202
Payroll 203

Summary 207

VII. JOINT DATA PROCESSING FACILITIES AND COMPUTER SHARING 209

Methods of Computer Sharing 211

Service bureaus 212
Equipment manufacturer processing centers 213
Prime-user-operated type 214
Regional clearing bureau facilities . . . 216
Joint bank facilities 217

Elements of Feasibility for Computer Sharing 219

Operational feasibility 219
Facility feasibility 220
Economic feasibility 220
Psychological feasibility 221

Procedures for Computer Sharing 221
An Example of Joint Facility Use 223

Some do's and don'ts 227

Other Computer Sharing Aspects 228

Chapter		Page
VIII.	IMPLICATIONS OF PRESENT EDP TECHNOLOGY ADVANCES	231
	Introduction	231
	Operating Personnel	234
	Clerical labor force adjustment	235
	Present adjustments	236
	Possible future adjustments	237
	Computer center personnel	238
	Illustrative EDP center organizations	239
	Management	244
	Cost reduction	245
	The other view on cost reduction	246
	Planning and control	252
	Maximizing profits	254
	Internal organization	257
	Dangers of Implementation	259
	Additional Implications	266
	New services	267
	Increased shift work	269
	Revised communications	269
	Cooperative efforts	270
	Questions of merger	272
	Unionization	275
	Legal implications	278
	IRS requirements	279
	Regulatory agency requirements	281
	Liability for coding error	283
	Legal questions in sharing facilities	283
	Auditing	285
	Internal control	289
	Audit trail	292
	Auditing objectives and problem areas	295
IX.	IMPLICATIONS OF FUTURE DEVELOPMENTS IN BANK DATA PROCESSING TECHNOLOGY	299
X.	SUMMARY AND CONCLUSIONS	311
BIBLIOGRAPHY		319
APPENDIX		333

LIST OF FIGURES

Figure		Page
1.	The Rising Volume of Checks	38
2.	Comparative Increases in Total Net Assets . .	44
3.	Headache Check	90
4.	Equipment on Hand	103
5.	How Each Operation is Handled	104
6.	General Flow of Daily Work--The First National Bank of Miami	154
7.	Statement Preparation and Account Analysis--The First National Bank of Miami	156
8.	Data Processing Center (A Schematic Drawing)--The First National Bank of Boston	160
9.	Processing Sequence Flow--The First National Bank of Boston	161
10.	Sequence Flow--Barclays Bank of London	166
11.	Regular Checking-Account Statement	179
12.	"Bob Tailed" Checking-Account Statement . . .	180
13.	In-Bank and Electronic Processing Center Checking Accounts	194
14.	Exception Reports	197
15.	In-Bank EPC Savings Operation	200
16.	In-Bank and Electronic Processing Center Bank Mortgage Operation	204
17.	Central Office and Electronic Processing Center Service Mortgage Operation	205
18.	Organization Chart--Illustrative Data Processing Center	241
19.	Organization Chart--Illustrative Data Processing Center	242
20.	Revised Communication	271

LIST OF APPENDICES

Appendix | Page

A. Bank Transit Number and Routing Symbols . . . 333

B. Banking's Newest Neighborhood 335

C. Letter to Non-Controlled Account Customers Explaining Plans--Michigan National Bank . 336

D. Electronic Check Handling Survey Questionnaire--Michigan National Bank 337

CHAPTER I

INTRODUCTION

Bankers have long felt the need for mechanical assistance in processing the large number of documents they are required to handle. As a result, a number of document processing and computing machines have been designed and produced specifically for banking; still others have been successfully adapted to banking requirements. As the number of customers and the check volume per customer has increased, so has the need for newer, faster and more adequate equipment.

The present study is prompted by the efforts of banks to meet the continuing expansion of check usage with more efficient means; and by the need to find means and techniques that are sufficiently uniform to promote the efficiency, adequacy and effectiveness of the central banking system. While each bank's situation is unique, because of locality, organization, circumstances, and so forth, there is a thread of similarity which can serve as basis for search for broadly applicable data processing methods.

Purposes

The immediate purpose of this inquiry is to try to find some conclusions about the adaptability of electronic data processing procedures to bank data processing. The need for such an investigation arises because there appears to have been, as yet, no determination as to how banks can best process most efficiently the flood of documents, and because, wisely or not, many banks have sought the answer in EDP (electronic data processing). To accomplish this end, data processing problems associated with modern day banking will be reviewed, previously used data processing methods and systems will be commented upon, and a representative number of currently operating data processing systems will be described and reported.

For purposes of this study, electronic data processing equipment will be limited to those machinery systems employing a "stored program," the distinguishing feature of an electronic computer. However, semi-automatic systems cannot be completely excluded from the discussions that follow, as they play an important role in current data processing practices in many banks. Furthermore, a number of questions, subsidiary to the first, are raised which could not be answered without discussing to some extent the variant machinery methods presently used by banks. This study will also be directed to a few of these. They are:

1. What systems, other than electronic equipment systems, are available to banking firms which will make competitive survival possible?

2. If present data processing systems are inadequate or not adaptable to the needs of all banks, what must be developed to meet their needs?

3. What steps have been taken to advance bank data processing and document handling?

4. What organizational and personnel implications, real or fancied, are there in automating bank activities, and what can be done about them?

Methodology

The source data used for this study included numerous articles which have appeared in various banking magazines, accounting publications, theses prepared by students of The Stonier Graduate School of Banking, bank information and publicity releases, manufacturers' equipment brochures and other publications.

A number of personal interviews were arranged, usually with officers and key personnel of data processing facilities. Operating systems were studied to become familiar with bank data processing practices and procedures, and equipment configurations and their operations.

These various sources of information, all dealing with some phase of bank automation, have been used in this study to arrive at some conclusions regarding the extent to which electronic equipment and procedures are adaptable to the data processing needs of banking, an aspect of bank automation not specifically dealt with heretofore.

Scope of the Study

An original objective of this study was to inquire into the internal management relations and financial aspects of a bank's conversion to electronic data processing. Cost studies were to have been made, extensiveness and appropriateness of feasibility studies reviewed, and other internal management implications explored. For source data, real bank situations were to have been studied. However, a wall of "no comment" was encountered on these issues. Therefore, even though the writer considers such aspects of an EDP installation to be of vital importance, they will not be dealt with at any length.

This study is not intended as an historical treatise on banking. Yet, previously-used recording devices and instruments are of interest in that they contributed to the development of progressively newer equipment. Therefore, a review of some of these devices will be given.

Two innovations are of special interest because of their contribution to currently used machine systems in banking and will be discussed in greater detail. One of these is the adding machine and the part played in its invention by an ex-banker, while the other is magnetic ink character recognition (MICR). The latter permits checks to become not only negotiable instruments, but also original source documents which can be machine handled and "read." Therefore, its development was of major importance in effectively utilizing electronic data processing in banking.

A portion of the early discussion will relate to banking problems engendered by economic growth and expanded usage of checks. Searching for solutions to these problems, bankers began studying and evaluating different available data processing systems, but especially electronic systems, principally because of their reputed speed and accuracy. Therefore, this study will concentrate on the application of electronic equipment and data processing procedures to the bookkeeping functions of banking operations.[1] However, procedures and equipment of other data processing systems currently in use by banks will also be discussed.

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[1]Principles of Bank Operations (New York: American Institute of Banking, American Bankers Association, 1956), pp. 83-84. "The term 'bookkeeper' has developed a somewhat special meaning in banking circles. The actual bookkeeping operations of a bank, involving asset and liability and income and expense accounts, is usually referred to as the work of the general books or general ledger. In banking, when we say bookkeepers, or bookkeeping, ordinarily we are referring to the personnel or the function of handling the detailed subsidiary records of the deposit liability accounts on the general ledger. For instance, the bank's liability to its depositors must be divided on the general books into two or more parts under such headings as Demand Deposits and Time Deposits. Each class of deposit liability is carried under a single total.

The maintenance of the individual depositor's record that comprise the single totals appearing on the general

Anything as new and radically different as electronic data processing will have far reaching effects. Therefore, some of the implications of electronic data processing, both present and future, will be reviewed and commented on.

Organization of the Study

Since data processing problems of a bank are in some respects unique and peculiar because of the large number of repetitive, routine type transactions involved, a background to data processing problems in the particular context of banking will be presented in Chapter II. Included in the discussion will be an analysis of banking's present paper problems.

A second phase will begin with a definition of data processing and will reflect upon problems associated with clerical force growth, some of the repercussions of change, why more efficient data processing is considered necessary, and clerical department requirements for banks, with special inquiry into the need for data processing flexibility.

A third aspect of this chapter will be concerned with the dynamics of growth. Included herein will be discussions

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books is the bookkeeping function. For example, in the case of the liability account Demand Deposits, the general books are concerned only with the total of deposits made each day and the total of checks paid each day. The bookkeepers, however, must record each individual transaction by posting each individual deposit ticket and each individual check to the proper customer's account. Sometimes this activity is known as keeping the individual ledger, but perhaps bookkeeping is the term most frequently used."

of banking's changing personnel situation, problems engendered by the growing flood of checks, the impact of a profit "squeeze" and the need to hold the line on rising costs, and, in addition to increased commercial bank activities, the rapid expansion of competitive financial institutions.

Chapter III will be largely historical in nature and will be concerned with data processing methods employed by banks prior to the introduction of electronic equipment. First, earlier manual methods will be referred to, with a view to reflecting the development of recording techniques and the progression of systems and "equipment" employed.

Bridging the primitive data processing methods and the widely used conventional bookkeeping machines of today were a number of devices which were utilized to help lighten the load and make easier the bank clerk's job. Among these was the adding machine. Because of its importance to the development of subsequent machines a more detailed description is given of its inception, evolution, and subsequent adaptations leading to the currently used bookkeeping machines.

One of the most significant developments in the advance to feasible data processing of checks and other documents by high speed electronic equipment is that of a common machine language for banking, or MICR (Magnetic Ink Character Recognition). The development required concentrated and concerted effort on the part of many people, groups, and organizations. Its realization and the process which led to it will be detailed in Chapter IV, with a discussion of what is necessary in order to utilize MICR effectively, what it is, some of the problems which have been associated with it, and how it works.

Chapter V describes the data processing equipment in current use and discusses the attributes and characteristics of such devices as conventional bookkeeping machines, proof machines, sorter-reader-converters, electronic bookkeeping machines, and tabulating equipment.

Because of their growing importance in the data processing functions of banking, electronic computers are set forth in greater detail. First, a short review of the introduction and early development is given, with special mention of the first, large-scale computer system placed in operation, the ERMA system of the Bank of America.

Some of the pre-requisites to a bank computer installation are also discussed in Chapter V, attempting to show that part of the requisites of a computer system are also required of a semi-automatic processing system. A final part of the chapter is devoted to a presentation of computer systems machinery and a description of a recently developed computer system for bank data processing.

Chapter VI presents reports of data processing systems at work. Different approaches to bank automation for check handling and bookkeeping operations will be discussed without presenting them in detail. However, enough of a summary will be given to provide an insight into a particular installation's characteristics and methods of operation. Through this means it is hoped that an appreciation of machinery versatility and adaptability, as well as an insight into effective equipment utilization and systems design, may be gained. Four systems in all will be presented. The last, an EDP installation in a Michigan bank will be presented in greater detail. The two main areas will deal with the steps and procedures followed in the conversion process to EDP, and the operations and procedures employed for processing checking accounts, savings accounts, installment loans, mortgage loans and payrolls.

Chapter VII concerns the feasibility, desirability and possibility of computer sharing and joint data processing facilities for smaller banks. Different methods and some of the more important aspects of computer sharing are reviewed. A recommended procedure for investigating the possibility of a joint venture is also given, followed by an example of procedures and installation measures taken by three banks now jointly operating a data processing center.

In Chapter VIII, some of the implications of present EDP technology advances for different groups of people involved are examined. Groups concerned are management, operating personnel, and auditors, both internal and independent. A brief review of implementation dangers are also given, and internal control and audit trail implications of EDP for auditing are discussed briefly.

Chapter IX is concerned with implications of future developments in bank data-processing technology. Presented therein are views of writers, bankers and electronic researchers and what they envision as future possibilities.

Finally, Chapter X will summarize and comment on some of the conclusions and findings of this study. In this final chapter, an attempt is made to assess the over-all effectiveness and adaptability of electronic data processing procedures to cope with the challenges of banking's data processing requirements, both present and future.

CHAPTER II

SOME CHANGING ASPECTS OF BANKING

Background

Long before the incidence of large scale plant and office mechanization, and prior to high speed data processing equipment, the paper work of a business was handled by a small group of people working together who were commonly referred to as "the office." Each office employee was somewhat familiar with all phases of the office operation and the flow of paper work through the entire business. This seemed to hold for all businesses, including banking firms. The office served as the center for communications; it was the nerve center for the enterprise. But, as a rule, businesses were smaller and not nearly so complex fifty or one hundred years ago as they are today. Restrictions, regulations, and the host of reports now required for managements, governmental agencies and ownership groups did not play the role in business existence that they now do. Neither did the amount of paper work required of most businesses impose the tremendous work loads and accompanying expenses that are currently prevalent.

Banking

The banking industry has a long history of development and progress and of increased services to the economic activities of the world. As the economic environment within which we live has progressed from that of the barter economy to that of the supersonic jet age, banking practices and procedures have had to keep pace. In order to do so, an earlier practice of merely acting as a storage place for valuables had to give way to the current banking functions of converting savings into investment and of "creating" credit by giving borrowers current spending power in exchange for a future promise to repay the bank.

With the growth and development which has taken place, there have also evolved new methods of carrying out the financial aspects of a business negotiation. No longer is it necessary to take the risk associated with transporting gold by Wells Fargo from one part of the country to another, nor with carrying huge sums of money personally for business transaction purposes. With these new methods, however, an increasing amount of paper work has been required. Various forms of financial documents--paper--now make former practices unnecessary. To most of us this is represented by the check book and the fact that we may buy for "cash" merely by writing out a check, or buy on credit by signing our name and then paying our account periodically by issuing a check. Consequently, for these and other reasons, the use of checks and other financial documents has served to increase tremendously the amount of paper work which a bank is required to handle.

To a large extent, the reliance which we now place on the banking system as a safe, sure medium for our financial activities stems from (1) the regulation of bank formation and activity, (2) formulation of the Federal Reserve System, and (3) government insurance of bank deposits. Gone are most of the fears which some have associated with the placing of their funds in someone else's hands for safekeeping. The banking industry has developed in size and stature to a paramount place in our modern, interdependent, economic society. The statement attributed to Will Rogers, "there have been three great inventions since the beginning of time: Fire, the Wheel, and Central Banking,"[1] gives evidence to the importance of our modern banking system. But with all the progress, the development, the expanded services and the increased conveniences have come a variety of banking perplexities and problems. Certainly not the least of these has been the tremendous increase in paper work.

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[1]Quoted by Paul A. Samuelson in Economics--An Introductory Analysis (New York: McGraw-Hill Book Company, Inc., 1959), p. 313.

A Bank's Paper Problem

The paper handling task of the banking system is unique in that the voluminous number of checks we write each year must be processed through it. This requires time, effort, physical facilities, and people. In addition, as a banking institution increases its services to its customers and increases the number of customers it serves, it takes more of each of these factors to accomplish the task efficiently. Eventually, a limit is reached as to the amount of time available, or the physical facilities which can be utilized efficiently, or the number of people who can be employed economically. Consequently, banking has been required to search for methods of processing its enormous amount of paper more accurately, with more speed, and if possible, at less cost. A number of machines have been employed to try to cope with the growing problem even though banking is not considered to be a highly mechanized industry. Perhaps the most widely used are the conventional bookkeeping machines. Larger banks have also installed punched card, or "tab," systems and found them to be an improvement. However, there are those who feel that the tab systems can only offer temporary relief, as their capacity and speed are somewhat limited, and the mountains of checks continue to grow.

A few years ago there developed a growing awareness of the inadequacies of the then existing equipment and methods for processing the anticipated volume increases. Bank managements were faced with decisions as to whether to (1) supplement their present equipment, (2) replace it with later and newer equipment of the same general nature, or (3) discard the old equipment and replace it with an entirely new and different type--a type that would require new concepts of data processing, development of new techniques of handling, and industry-wide cooperation never before attempted. The latter was the avenue made possible by the introduction of the electronic computer.

Electronic data processing has developed rapidly within the last few years, from nothing to a most significant place in our economy. Its impact has been felt by the manufacturing industries, transportation concerns, insurance companies, brokerage and investment firms, wholesale and retail establishments, space and missile research groups, and banking and other financial institutions.

The electronic computer has been touted as an electronic "brain," a super machine that could do all manner of things. It could make rapid calculations, store information, recall it at the right time and in the right place, make decisions, and in the minds of some, think. It has been heralded in glowing terms and with high praise for its capabilities; it has been hailed by scientists and business men alike. Business looked upon it as an emancipator of the white collar worker, as a means of more efficiently performing the ever-growing amount of clerical work, and as a means of reducing costs. On the other hand, the worker no doubt felt somewhat uneasy about all this new mechanization and automation. Although assured that progress and innovation would accrue to his benefit in the long run, he had a fear and an uneasiness of being replaced by a machine and of facing unemployment. As John Diebold has said, "when confronted with the potential of automation, people do not think in general terms, or in historical terms. They think in terms of the danger to their individual jobs. . . ."[1]

The potential capacity of electronics and the computer were recognized early. However, due to many reasons, such as inexperience, poor planning and mismanagement, initial high costs of installation and high operating costs, they were at first disappointing.

Bankers were cautious and but few were willing to explore the possibilities of electronic data processing

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[1]John Diebold, "Automation . . . Its Meaning and Impact," an address delivered at the Industrial Relation Session of the 65th Congress of American Industry, sponsored by the National Association of Manufacturers, New York, (December 7, 1960). (Unpublished).

for banking at a very early date. Nevertheless, through the efforts of such groups as the American Bankers Association, some of the most troublesome problems connected with the adoption of electronic data processing for banking have been overcome. The first installations of EDP systems by banking institutions were made in the early 1950's with but little general acceptance until the last few years. Of late there has been a rapid growth of orders for, and installations of, computers and other new equipment developed for the specific data processing requirements of the banking industry.

The Present

Electronic data processing has not yet gained the full confidence of all bankers; many are still questioning its use. To some it has appeared as too costly and has been regarded as being applicable only to the larger banks. This lack of confidence has caused the machine manufacturers and smaller bank managements to look for a different type of solution, an installation to fit the particular needs of the small, lower volume bank. One answer which has been developed is the Post-Tronic or Sensitronic bookkeeping machines, commonly referred to as "tronics." Other solutions that are being discussed widely are the use of service bureaus, cooperatives of one type or another, rental time from larger banks with electronic data processing installations, and so forth.

Where the bank has viewed the computer and its peripheral equipment as merely the substitution of one machine or a group of machines for another, in many cases, the results have been rather disappointing. Too often the equipment was installed without making a thorough investigation of how it could be integrated into a well-developed system. Thus, anticipated savings were not realized.

Where previously installed mechanical systems were not too satisfactory, some bankers looked to electronic data processing for the answer to their data processing problems. Here again, the answer was not always forthcoming. A change of equipment will not necessarily solve problems caused by an improper installation, by mismanagement or a lack of properly trained personnel, or from ineffective operation and control, or by a misdirected, patchwork-constructed system for data processing. The important thing is to develop systems for the situations where their use can be advantageous from an overall business viewpoint, and where the user has the capacity to plan effectively and judiciously for the equipment before it is installed.

Improvements are continuing to be made on data processing equipment. These innovations are making it possible for a wider use of this equipment, both from the standpoint of wider application to the data processing needs of a particular bank, and the economic feasibility of its use by a much larger number of banks. Thus, no longer is bank automation limited to the few larger banks. EDP is now a reality and must be viewed as a possible tool for data processing by all banks. As someone has said, "there is no longer any doubt about whether the banks will introduce automation; the only point still at issue is 'when' and 'how'."[1]

Data Processing

Data Processing Defined

> Data processing is generally assumed to mean the activity of collecting, sorting, and processing information in order to reach a business objective or a required result. In banker's terms, it is the entire process that occurs every time a transaction takes place--not only in terms of the present action, but in terms of the process from original deposit to final proofs. . . .[2]

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[1]As reported under the heading "Bank Mechanisation," in The Economist (London: January 20, 1962), p. 249. The statement was made by one of the speakers at a two-day exchange between bankers and electronic engineers to clear up some points of detail. The meeting was arranged by the Institution of Electronic Engineers and discussions were still in progress when The Economist went to press.

[2]Peter J. Andre, "A Program of Electronic Data Processing for Savings Banks," (unpublished thesis, The Stonier Graduate School of Banking, conducted by the American Bankers Association at Rutgers - The State University, 1961), p. 9.

Stated differently, data processing

> . . . is the conversion or combination of data, or any other working operation on data, as opposed to merely transferring it from one medium to another. Sorting, merging, and other processes which rearrange but do not change explicit information content are included in the scope of this definition.[1]

The accounting firm of Haskins and Sells defines data processing by listing seven basic functions.[2] They are:

1. Preparation of source documents,
2. Introduction (or input) of data from these documents into the record keeping system,
3. Data manipulation, comprising assembly, sorting, and classification of data; reference to and extraction of related data, previously stored; and computation,
4. Storage of data, including temporary filing of intermediate results and other data in process and the maintenance of files of carry-forward data,
5. Withdrawal (or output) of results from processing,
6. Summarization of results, and
7. Supervisory control.

This expanded definition, or list of basic functions, can be applied to the processing of data by any of the methods or systems presently in use, including that of electronic equipment. As implied, data processing helps to serve the purposes of management by providing a communication network which can be utilized

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[1]Felix Kaufman, Electronic Data Processing and Auditing (New York: Ronald Press Company, 1961), p. 9.

[2]Data Processing by Electronics (New York: Haskins and Sells, 1955), p. 2.

for planning, coordinating, controlling and reporting in order to attain the objectives of the organization group.

Clerical Force Growth

Data processing is an expensive and time consuming process. Most business firms are keenly aware of this and have viewed with concern and some degree of alarm the trend in clerical function requirements. The demand for clerical workers has been steadily increasing. According to the United States Bureau of Census, in 1910 only one out of twenty persons was employed in clerical or related occupations, in 1940 only one in ten, while today we find approximately one out of seven so employed.[1] Especially since the end of World War II, many businesses have been hard pushed to keep up with their clerical requirements and costs. David Rubinfein expressed the situation in these terms: "The problem of providing fast, accurate and economical service in the face of unprecedented growth has harassed clerical departments in every major industry for fifteen years."[2]

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[1]U.S., Bureau of the Census, Statistical Abstract of the United States: 1959 (Eightieth Annual Edition).

[2]David Rubinfein, "Automation of Bank-Check Accounting," Journal of Accountancy, CIII (March, 1957), p. 41.

As general clerical employee requirements have grown, continuous growth in checking account volume has added difficulty to operating and clerical-personnel problems of banks. Using figures for the ten year period 1950 to 1960, the banking industry payroll for insured banks grew from 383,000 men and women in 1950 to 609,800 in 1960, a 59 per cent increase for the period.[1]

Leonard Hein lists the following reasons for clerical force growth:

1. A change from small- to large-scale business.
2. The distance from the activity to be recorded to the manager who needs the information.
3. The demands of government for an increasing number of detailed reports.[2]

Mr. Hein further points out two important facts: first, that the volume of data per unit of working force is increasing, and second, that the productivity per unit of non-clerical working force is increasing at a faster rate than that of the clerical worker.[3] The clerical task is also costly; in dollars and cents "American business spends almost $70 billion annually to process data. This is almost one-sixth of the gross national product."[4]

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[1]Winslow E. Pike, "Why Smaller Banks Too, Should Use MICR," The Office, LV (January, 1962), p. 92.

[2]Leonard W. Hein, An Introduction to Electronic Data Processing (Princeton: D. Van Nostrand Company, Inc., 1961), p. 3.

[3]Ibid., p. 1.

[4]Ibid., p. 5.

It is evident from the foregoing that data processing has become "big business," and that the costs of properly operating and maintaining an informationally adequate system for processing data and for maintaining files and readily accessible records have now become increasingly burdensome to the business enterprise. It is only natural, therefore, that when electronic machines were hailed in glowing terms and praised for their high rate of speed, their accuracy, and almost unbelievable capacities to store and process information, that businesses looked to the electronic computer systems for the solution to their data processing problems. But, whenever radically new innovations appear, usually, there are also a number of repercussions that accompany their introduction.

Repercussions of Change

The introduction of radically new methods and machines, has often induced a conservatism and a reluctance to accept not generally associated with the gradual changes of a normal economic growth. An example of this reluctance is furnished by the story of auditors who initially verified the accuracy of adding machine tapes by manual arithmetic because of their skepticism of the machine. So too, today, many are fearful of the record keeping capabilities of electronic data processing equipment because they fear a possible loss of sufficiently detailed visible records, or, in the case of the auditor, "audit trail." But our approach to problems of this nature is now different than it has been at times in the past. Change has not ceased, only our attitude toward it has shifted somewhat. Today, an attempt is made to soften the harmful effects produced by revolutionary innovations while exploring all possible avenues of advantage to be gained from them. Steps are now taken to alleviate the distress, the discomfort and the economic inequalities which result from introduction of new concepts and radically differing procedures. But we are still afraid of and dread innovations which could produce a rather marked change in our own personal, or national, way of life.

Today, many view such things as the European Common Market and the proposed reduction of tariffs and special economic measures affecting particular groups with misgivings. In a like manner automation has been looked at askance by some labor groups and by others, including congressional committees who inquired into the amount of upheaval and discomfort, the readjustments and retraining, and so forth, that would be necessitated. The purpose has been to determine, if possible, the impact that such innovations as automation, which greatly increases man's ability to use tools, and the electronic computer, which multiplies man's ability to do mental work, will have on our economic society, or some segment of it. That repercussions will be felt is a foregone conclusion; the question is, to what extent, by whom, and what can we do about it? The introduction of electronic equipment and the data processing "revolution" initiated with its coming, especially as it pertains to the banking industry, may offer a glimpse of one possible solution.

Why More Efficient Data Processing?

Generally we have been guilty in the past of doing a poor data processing job. Primarily it has been poor because we were satisfied with concepts which were too narrow and performance which was too low. W. A. Dick, writing in The Australian Accountant, has said:

> . . . [the] stewardship approach to accounting represents mere historical scorekeeping. . . . Our accounting systems are satisfactory scoreboards if all you want to do is keep the score. But if we want to help the players, there is much more to be done.[1]

There are many "players," and it is their insistance for more than just "the score" which has led to some of the current data processing developments. Information is not enough, it must be usable information. A good data processing system is designed to "pay its way" by

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[1]W. A. Dick, "What Should Management Require of Its Data Processing System," The Australian Accountant, XXXII (January, 1962), p. 3.

pinpointing opportunities and facilitating decision-making through faster, more efficient and timelier processing methods. In bank automation, before any real progress could be made, many traditional methods of handling had to be rethought. New principles of data communication had to be instituted. Moreover, the new equipment being assembled into data processing machinery systems not only had to provide a new way of looking at record keeping problems and requirements, but it also had to do so while furthering the basic objectives of the banking system. Indicative of the progress being made is the following.

> Data processing techniques have been so fantastically successful in the past twenty years that they are right now literally remaking the face of American business society in the most exciting social and economic revolution the world has ever seen.[1]

Bank Clerical Department Requirements

Data processing is undoubtedly a big job for any business. For a bank it is doubly so, for each bank has a tremendous task in the mere handling and processing of checks which daily flow through it. This comes about for many reasons. First,

> . . . the problems involved in depositor accounting

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[1]Max Joseph Havlick, "What Does Data Processing Need Most Today," Data Processing, III (November, 1961), p. 101.

> are peculiar unto themselves and require special consideration. . . . Even within the field of depositor accounting there are two major problems which presently require different approaches--those pertaining to income exchanges ("our" checks) and those pertaining to outgoing exchanges ("foreign" checks). It should be noted that the latter group often amounts to 60-70% of the items handled.[1]

Each check will be handled ten to twenty times and will pass through an average of two and one-third banks on its way through the banking system. Besides checks, there are also other documents, but checks are the most numerous.

A second reason for a bank's growing clerical job is the increase in services and facilities which many of them have provided. The facilities change is evident from merely viewing the new physical plant layout of bank buildings with their new modern fronts, expansive lobbies and conveniences for banking customers, and the growth of branch banks and drive-in windows. Such conveniences have increased the customers using bank services, and in addition, the banks have offered many intricate new services such as revolving check credit, check credit plans, Christmas clubs, vacation clubs, and so forth. Too, many banks have shifted into services and activities which require more detailed processing.

Banking has always been a service industry. Nevertheless, new opportunities for service were found as the

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[1]Electronics and Banks (New York: Peat, Marwick, Mitchell & Company, 1956), pp. 7-8.

economy moved from a "cash and carry" basis to one where, in this country, the check is used for 90 per cent of all payments made. In addition, the former practice of concentrating on a few big clients which limited both the financial services and the number of transactions has changed to offering many services to millions of small customers in numberless suburban banks or branches. Thus, expansion of facilities and services to more and more people has greatly increased the data processing requirements of the bank's tellers and clerical departments.

Requirement for System Flexibility

The data processing system of an organization is one of intricate complexity, for it is an intermixture of people, information, machines and formal and informal procedures. It is designed with certain end results or objectives as the prime considerations; it must take into consideration the desired reports, accuracy, speed and promptness, adequate internal control, cost, and a combination of these and other factors to provide a properly balanced and fully coordinated system of procedures. In addition, this system must at all times lead toward the overall goal of an optimum profit. If these objectives of a superior data processing system are to be realized, it soon becomes apparent that any combination of machines, procedures, and people must have a high degree of flexibility.

Since the processing of large volumes of paper work is an inescapable part of banking, the proper use of machinery can help to expedite the process. Machines are considerably faster than manual methods, eliminate some human errors, and can be provided with a system of built-in controls and checks. But, since machines, especially those associated with an electronic computer data processing system, require large capital outlays, it is imperative that machinery systems be so designed that an expandable and adaptable component group of machines is available for differing job requirements relative to business size, location, services performed by the user company, and the degree of centralization or decentralization.

In banking, accuracy is a vital characteristic of the data processing activity. This fact has had a marked influence on the approach that banks have taken toward systems design and automation.[1] When accuracy, therefore, is coupled with the other requirements of a bank data processing system, the need for flexibility becomes even more apparent. Not every bank can utilize the same system as effectively as can another. Each bank must design its own particular data processing system to fit its peculiar needs. This is true also of the equipment which a bank can economically employ, for of the approximately 14,000

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[1]Gordon H. Cowperthwaite, "Bank Automation--A Review," The Canadian Chartered Accountant, LXVIII (June, 1961), p. 543.

commercial banks in the United States, 11,392, or about 85 per cent, have deposits of less than $10 million.[1] This means that currently available electronic equipment for full-scale automation would be economical for only about 1,000 of the country's largest banks.[2] Thus, we may conclude that data processing machinery must be not only versatile, but also expandable or adjustable if it is to meet the demands of the diversified, heterogeneous industry of banking firms. A system must also remain flexible in order to meet the demands of growth, new services and competition.

The Dynamics of Growth

Growth requires change. The change may be directed to but one aspect of an economy, or it may be such as to be all-inclusive with all aspects moving in a forward direction. In banking, where there are so many facets to the operation, there is such an intermingling and interaction of one phase of the operation with another that it is difficult, if not impossible, to isolate a particular area for discussion. Nevertheless, there are certain segments where greater and

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[1]Pike, *op. cit.*, p. 92. The 14,000 figure probably is for insured banks only, as others have quoted total banks at over 15,700. (See page 94.)

[2]*Ibid.*

more pronounced changes may appear. Consequently, an attempt will be made to present the more predominant and dynamic aspects of banking firm growth by discussing them in relation to (1) personnel, (2) the rising flood of checks, and (3) bank services and competition. Since people are the most essential element in banking, or in any business for that matter, the subject of personnel will be discussed first. The importance attached to the role which a person plays in an organization's success is indicated in the following statement by Alan Purdy:

> It seems far more important to stress the role the employee will play in automation rather than the part the equipment will play. Those electronic applications that missed their goal did so not so much because of poor system concept but because people failed to participate as expected.[1]

Personnel

During the 1930's and the early 1940's, when emphasis was on a "steady job" and security, it was considered an honor to be employed as a bank teller or bookkeeper. Good personnel could be kept. Since then, however, the situation has changed and it is now becoming difficult for banks to get good help, and harder to keep them.

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[1]Alan B. Purdy, "Computers and Bank Automation," (unpublished thesis), The Graduate School of Banking (now The Stonier Graduate School of Banking conducted by the American Bankers Association at Rutgers - The State University), 1959, p. 11.

"Today's youth are looking for greener pastures, new horizons, and to some extent, less work."[1]

Banking has not been regarded as a highly mechanized industry. Therefore, when expanded operations were required by the post-war economic growth, banks tried to meet the problem by hiring more people rather than by using better equipment. As a result, commercial bank employment increased 65 per cent from 1946 to early 1960 compared with 20 per cent for total non-agricultural employment.[2] Why, then, cannot future expansion be accomplished in the same way, that is, by hiring more people instead of buying machines? The answer is that clerical help is scarce, and even now banking is having trouble finding enough workers at the prices it is able to pay. Thus, as the demand swelled, the supply has not expanded at the same rate. "If banking employment had continued to grow at the same rate that it has in the last fifteen years, everybody then in the labor force would be working in a bank by the year 2100."[3]

The personnel problem of banking has not been limited to mere employee numbers. As workers have become scarce, labor costs have also risen. For instance, from 1950 to

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[1]Andre, op. cit., p. 9.

[2]"How Banking Tames Its Paper Tiger," Business Review, Federal Reserve Bank of Philadelphia (May, 1960), p. 3.

[3]Ibid., p. 4.

1957, wage and salary costs rose 98 per cent while the after-tax profits of commercial banks remained quite constant at about 8 per cent of total capital accounts.[1] As a result of this type of profit squeeze, if expenses were to continue to rise and profits were to be pinched even more, banking could have trouble in getting future capital, many billions of dollars of which would be needed to keep pace with a growing economy. The alternative would be reduced banking services and a possible stunting of the nation's ability to grow economically.

The personnel problem of banks is not entirely a consequence of the increased clerical demands associated with growth, services and competition. Banking has a high labor turnover rate and jobs open frequently. This can perhaps be traced to the high incidence of women employees for many of the clerical tasks required of a bank, and to the fact that these tasks are of the repetitive, routine type, and are neither stimulating nor self-satisfying. In addition, these tasks are complicated by wide fluctuations in activity, resulting in the necessity of gearing performance accordingly. Indicative of the difficulties in hiring and keeping competent employees to handle these routine clerical jobs is the experience of the Bank of America. Speaking before a congressional subcommittee in 1957, and referring to

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[1]*Ibid.*, p. 4.

clerical employees, Mr. A. R. Zipf, a vice-president of the bank said:

> The people who occupy these positions are, in general, young women employed during the transitory period between graduation from high school and their permanent occupation as housewives and mothers. In the Bank of America, we now have more than 2,300 bookkeepers. Of this number, over 90% are young women. Our staff turnover in this category, for the year 1956, was 78.1%, most of which was caused by marriage and other family reasons.[1]

A further complication for banking is the fact that as the gap between the supply and demand of competent employees widens, the banks are required to pay increasingly higher salaries to expand employment significantly.

The Rising Flood of Checks

In the banking industry, each of the service areas has been characterized by growth, but most particularly in the operations of the check collection system. The check collection system is primarily concerned with the payment and collection of funds for checks. And while these are intrinsically simple functions, their performance is complicated by the large volume involved and the variety of handling methods required. For example, a bank may receive checks for collection in the form of

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[1]A. R. Zipf, "Automation in Banking Other Than Check Processing," a statement before the Subcommittee on Economic Stabilization Hearings on Automation and Recent Trends of the Joint Economic Committee of the Congress of the United States (Washington, D. C., November 15, 1957), p. 10. (Mimeographed.)

deposits through the mail, by messenger, at tellers' windows, as payments for bonds and loans, directly from other banks, from local clearing houses, Federal Reserve Banks, or for cash at tellers' windows.

In June, 1954, the Joint Committee on Check Collection System of the American Bankers Association, The Association of Reserve City Banks, and the Conference of Presidents of the Federal Reserve Banks made a report on the increasing number of checks passing through the banking system. The report states:

> . . . among the many services performed by the nation's banking system, the provision of channels through which money payments go from one point to another ranks high in importance. . . . More than 90 per cent of the dollar amount of such payments in the United States is made by check. . . .[1]

These are "primarily written on the 54 million checking accounts in insured commercial banks."[2]

<u>Development of Check Usage</u>. In the January, 1961, issue of <u>Banking</u> magazine, William R. Kuhns gives an historically oriented presentation of checking account usage and growth. Among other things he says that unless we want to be technical about the meaning of the word, checks have a history that began more than 2,000 years ago. But, check usage took a long time in developing to any large proportions, for it was not until about a hundred years ago

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[1]Rubinfein, <u>op. cit</u>., p. 41.

[2]William R. Kuhns, "Banking's American Story--MICR Spells 'Opportunity'," <u>Banking</u>, LIII (January, 1961), p. 45.

that check money in the United States began to exceed the actual currency in use. Mr. Kuhns includes in his article copies of checks signed by such men as George Washington, Thomas Jefferson, and Abraham Lincoln, showing that the format and style of checks has changed but little since their times. However, these were privileged men, for, as Mr. Kuhns states:

> During our early years the use of checks was very limited. Opening a checking account was a privilege extended by banks to men of position and prestige. The economy did not require the advantages that checks provide and the people were reluctant to accept them.[1]

Mr. Kuhns continues:

> By 1855 the growth of the nation, the expansion of the economy, and improved communication under uniform postal rates combined to make checks more important than bank notes in the settlement of business transactions. They continued to be primarily a business tool until well into the 20th century. Individuals did not generally feel the need for a checking account and banks were not inclined to extend this service.
>
> For one thing, the clearing system couldn't support a heavy volume. . . . It wasn't until the creation of the Federal Reserve System in 1913 that banks were prepared to cope with a sharp growth in check volume.
>
> The next major step occurred in the mid-1930's with the introduction of the special checking account. The number of accounts and the volume of checks rose rapidly as a result of this innovation.[2]

<u>Expanded Use</u>. The check collection and transit function of any bank is a noisy, busy operation. Moreover, each year it seems to get even busier and noisier, as more machines are used to help process the growing tide of checks.

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[1]<u>Ibid</u>., p. 46. [2]<u>Ibid</u>., p. 49.

An indication of the extent of growth can be ascertained from the following figures.

Prior to World War II Americans wrote about 3.5 billion checks annually. By 1952 check volume reached approximately 8 billion, 12 billion by 1959, 13 billion in 1960, 14 billion in 1961, and by 1970 check volume is projected to reach a volume of over 22 billion checks. (See Figure 1.) The 1952 volume amounted to $2 trillion with 4 trillion in check dollars estimated for 1970, a doubling of the check dollar volume in less than 20 years. Today more than 30 million checks are written daily and more than $6.5 billion changes hands each day through checks.[1]

Writers have made calculations and converted these not too understandable figures into something which, if not more meaningful, may give us a keener appreciation of the immensity of the check deluge with which banks are faced.

The 1961 volume of 14 billion checks, if placed end to end, would circle the earth 70 times,[2] and the anticipated volume of 22 billion checks in 1970 would reach to the moon and back six times.[3]

There is another aspect too, which has added to the

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[1] Ibid., p. 50.

[2] Sam M. Fleming, "How Banks are Mechanizing the Handling of Checks," The Office, LV (January, 1962), p. 82.

[3] "Paper Tiger," op. cit., p. 3.

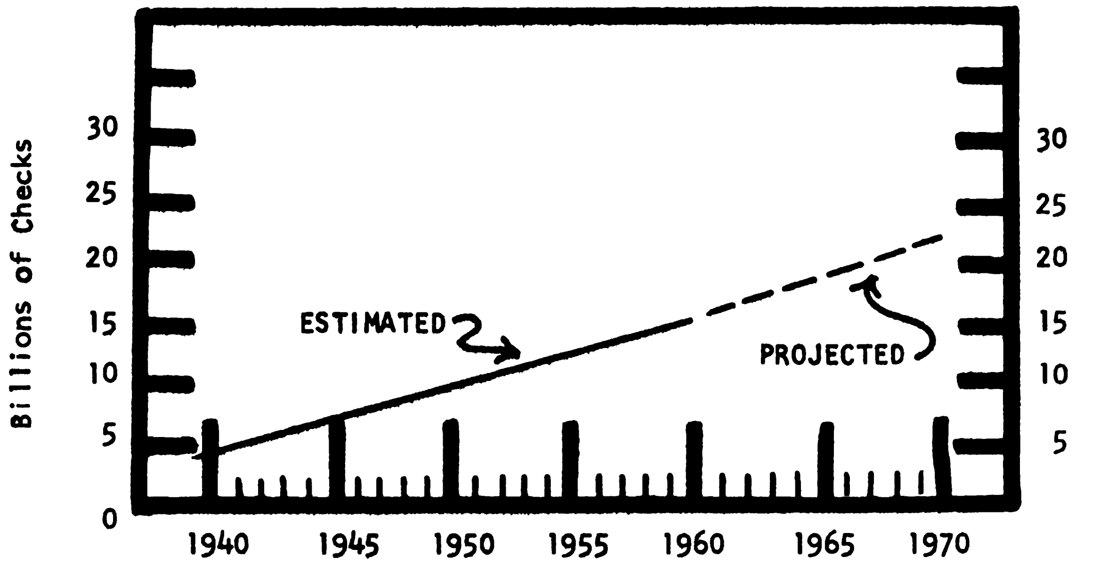

Figure 1.--The Rising Volume of Checks, 1940-1970

Source: Kuhns, William R., "Banking's American Story--MICR Spells 'Opportunity'," Banking, LIII (January, 1961), pp. 45-52.

growing stream of checks. During the past 15 years, the number of checking accounts has more than doubled--to a total of approximately 54 million. In addition, ". . . between May 1959, and May 1960, the velocity of deposit turnover increased 8.7% in New York City, by 8% in the six leading centers outside New York, and 7% in 337 other banking centers."[1]

It can be readily seen that if we were to rely on conventional methods of check handling of the past, facilities would be swamped. It is multiple handling of each check plus the increasing number of checks that has been giving bank operations men their biggest problems.

Regardless of the mounting tide of checks, their increase is not the only reason for the bankers' search for mechanical assistance, as almost all banking operations are growing. To illustrate, from the close of the second World War to the early part of 1960 bank services were expanded somewhat as follows.

In commercial banks during the postwar period, the number of savings accounts increased 33 per cent, commercial loans grew by 113 per cent, checking account activity (debits) increased 163 per cent, mortgages swelled by 290 per cent, and consumer installment credit mushroomed 850 per cent. And there is more to come. During the next decade the population is expected to increase at an average

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[1]Carl A. Bimson, "The Road Ahead," Auditgram, XXXVII (January, 1961), p. 8.

annual rate of 2 per cent and economic activity--per gross national product--is projected to increase 40 to 50 per cent during the 1960's.[1]

According to another writer,

> . . . in the installment loan area, . . . the total number of loans held by commercial banks rose more than ten times between 1941 and 1957. During the same period, the dollar amount of mortgages held by these institutions increased by over 360% while the number of savings accounts increased approximately 61%.[2]

Perhaps an additional factor has been the rapid expansion of branch banking during this same period, thus making available to more customers a wider variety of services, and easier access to them.

Bank Services and Competition

A bank is first and foremost a service organization. In many respects it is a unique business of many facets. It does not exist unto itself alone, but maintains a continuous cooperative relationship with other banks in the banking system. Yet, it is an individual, private, business organization which exists to serve the financial needs of the community of its location, oftentimes in direct competition with other banking firms. Therefore, the degree of success which it achieves largely depends upon its reputation. In turn, a bank's reputation is the result

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[1]"Paper Tiger," op. cit., p. 3.

[2]Purdy, op. cit., p. 7.

of its contribution--in terms of customer services and community welfare and development--to its surrounding area.

As the economic activities of a community become greater, so too must the bank's list of services become broader. When the community becomes large, additional banks will enter and some degree of specialization will start to take place. Likewise, as our economy continues to change, so must the type of services available from our financial institutions change. Hence, services no longer needed will be discontinued while new and appropriate services will be provided.

Many banking innovations have added to the variety of services which a bank can offer. But, as spiraling costs and increasing paper processing problems became a reality, many banks were faced with the possibility of either reducing their services or increasing the charges for those services. Naturally, they were reluctant to do the first for their reputation and their livelihood depended upon the services which they rendered. On the other hand, competition and the customers' recalcitrant reactions to a higher price for services dictated that a third alternative be sought. The invention and production of the electronic computer is now making possible this third alternative. That is, not only can the services which banking institutions have provided in the past remain available to us, but also additional and an even wider variety of services can eventually be ours for a nominal fee. The following remarks of Alan B. Purdy are pertinent in this regard.

> Primarily, bank operations are entering an era of unprecedented expansion, not only in the scope of services to be rendered the banking public, but in the importance attributed to its functions. This expansion will be the result, not only of increasing populations and standards of living, but of changing concepts of what banking services the public desires. The popular check credit plans, no passbook savings and revolving charge accounts are the banking equivalents of the American trend towards ease and convenience in all forms of activity. . . . Furthermore, whether recognized or not, banking is playing an increasing service role in the office operations of its larger depositors. The trend that started with account reconciliation and lock box plans has only begun to gain momentum. Automation will provide the capacity for such added customer service activities, for instance, as payroll calculation and direct credit to major depositors' employee accounts. Banking will become increasingly competitive with greater demands being placed on efficiency, progressiveness and scope of operations. The use of computers and automatic data processing holds the promise of meeting those demands.[1]

The objective of commercial banking, like that of other business enterprises, is to produce a profit. Therefore, the old economic adage--compete, dissolve, or be absorbed--applies with equal force to them.

Although the competition which a bank faces is not as noticeable, perhaps, as that of a retail merchandise establishment, it is just as real nevertheless. Each bank has two-way competition. First, it must compete for the public's funds, then it must compete for the placing of those funds to their best use. Thus, it must not only compete with other commercial banks, but

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[1]Purdy, *ibid*., pp. 88-89.

it must also compete with savings banks, savings and loan associations, insurance companies, Federal and State credit unions, United States Savings Bonds, and the organized stock markets, as well as private placements. Each of these can be aggressive in its own way, and can present a distinct competitive challenge to segments of the commercial banker's operations. That these other financial institutions and outlets have also experienced growth and change is clear when we realize that during the period 1920 to 1960 total deposits in mutual savings banks increased seven times to approximately 36 billion dollars. During the same period, life insurance companies' reserves increased by over 90 billion dollars. The most spectacular growth, however, has been made by savings and loan associations. From 1945 to 1960, investments increased from 7.3 billion to almost 14 billion in 1950, 32.1 billion in 1955 and to approximately 62.2 billion in 1960. In 1920 their total was only about 1.7 billion, so from 1920 to 1960, savings and loan association volumes increased 27 times the original amount.

A similar story is told by the total net assets as shown by the data in Figure 2.

At the end of 1945 commercial banks held approximately 70 per cent of the total assets of the four groups listed in Figure 2; at the end of 1961 the percentage of the total had dwindled to near 52 per cent, showing only an approximate increase of 1.7 times compared to that of

Year	Commercial Banks		Mutual Savings Banks		Savings and Loan Associations		Life Insurance Companies		Total	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
1945	$160,312	70	$16,962	7	$ 8,747	4	$ 44,797	19	$230,818	100
1959	244,686	53	38,945	8	63,530	14	113,650	25	460,811	100
1960	257,552	53	40,571	8	71,476	15	119,576	24	489,175	100
1961	274,290	52	42,823	8	82,061	16	126,589	24	525,763	100
Times Increase (45-60)	1.7 times		2.5 times		9.4 times		2.8 times		2.3 times	

Figure 1.--Comparative Increases in Total Net Assets
(in millions of dollars)

Source: U. S. Bureau of the Census, *Statistical Abstract of the United States: 1959*, 80th Annual Edition (Washington, D. C.: U.S. Government Printing Office, 1959).

9.4 times for savings and loan associations. Not shown, but also of significance are the increases shown by the credit unions. Using year-end figures, from 1949 to 1959, Federal and State credit unions increased in number from 5,427 to 19,500, while total assets were increased from $510 million to $4,381 million.[1]

If we consider that banks are prohibited by law to pay interest on demand deposit accounts, and are also limited by the amount of interest payable to their customers on savings accounts, we can see some reasoning for the increased competition from other financial houses. More corporate funds are being put into interest-bearing securities. Too, some of the larger banks in the major money centers have been further affected by the decentralization of large corporations, which has led to a dispersing of checking accounts to smaller banks. Although this should not affect materially the overall bank totals, it does affect the profit of the larger city bank.[2]

Another aspect of the competition between financial institutions is that of personnel. The other areas, such as finance, insurance, and real estate groups, are taking more of the available employees. Since 1919 these groups

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[1]The source of these figures is the Federal Deposit Insurance Corporation as reported by Herbert Bratter, "Banking--1950-1970: The View From Here," Banking, LII (May, 1960), pp. 46-49.

[2]Lee Silberman, "Bank Clients' Boon," The Wall Street Journal (Midwest Edition), April 20, 1962, pp. 1, 15.

have increased their personnel requirements 130 per cent, to 2.3 million workers in 1956. As the demands for qualified, competent personnel continues to increase for all financial institutions the costs for salaries, training, and so forth also climb. The question is, can banks continue to compete? Or, how can the banks impede the encroachments upon their profits?

Bankers have attempted to meet the challenges imposed by competition from other financial institutions for funds, personnel and service customers by adopting enterprising operating measures. To improve services, facilities have been expanded and improved. Some bankers viewed EDP as presenting opportunities for further enhancement of their competitive and profit positions.

Computer systems are extremely fast. Therefore, current data processing requirements could be handled in but a fraction of the time taken previously. The additional capacity could then be utilized in either handling additional work volumes, which could be aggressively solicited, or in providing additional revenue producing services. Thus, by employing EDP, services presently provided could be improved and varied to make them more attractive to a bank's customers. The scope of services could be broadened, the variety expanded, and all could be made available on a convenient, timely basis. In addition, providing banking customers with easier, quicker, suitable and opportune services, the bank employing EDP could increase its share of the total rising bank volume without fear of overburdening its data processing facilities, for EDP seems to thrive on volume.

Needless to say, not all bankers viewed the electronic computer with the same degree of expectation as related above. Some had misgivings concerning the high cost of different equipment units; they doubted the ability of any but the larger banks to utilize them efficiently because of lack of sufficient volumes. Many smaller banks even questioned their ability to maintain their competitive position because of the disadvantages which would seemingly be theirs because of not being able to afford the high priced EDP equipment. Therefore, other avenues for service expansion and improvements needed to be explored by them; some less expensive type of equipment with increased capacities and speed over equipment they had been using needed to be made available.

In an article appearing in the Wall Street Journal recently, a number of other steps which banks are taking to prevent the erosion of their profits were given.[1] Without going into too much detail, they might be summarized as follows:

1. Many large banks increasingly are promoting types of loans that formerly got little attention.

2. Bankers are traveling a good deal to call on

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[1] Ibid.

potential borrowers.

3. Bankers are working on complicated propositions which they would have turned down not long ago.

4. Bankers, though reluctant to admit it, have become increasingly aggressive in taking accounts away from other banks.

5. Most banks are also increasingly on the lookout for suitable companies that an acquisition-minded client may want to buy, with acquisition financing in mind.

6. Banks are pushing harder in such areas as residential mortgage lending where interest rates are higher.

7. Banks are striving to funnel as much of the high-priced savings deposits as they can into consumer loans.

8. In their quest for more consumer loans, permission is being requested to display promotional materials in a concern's office or plant advertising their services to employees.

9. Banks with electronic data processing equipment are offering computer services as an added inducement to their customers. Both the Bank of America and Chase Manhattan Bank, New York, are actively engaged in this field.

Thus, it would appear that as banking institutions encounter obstacles and temporary barriers to their goals, managements become increasingly aggressive in their efforts to do the job entrusted to them. That is, bankers must strive energetically to: provide the conveniences and services expected by their customers, promote the interests and economic well being of the communities, and continue to maintain adequate profits for the bank's owners.

CHAPTER III

BANK DATA PROCESSING AND MECHANIZATION PRIOR TO EDP[1]

Early Methods of Bank "Record" Keeping

Bankers have for centuries been required to maintain records of the transactions occurring between themselves and their clients. Presently, the application of machines to practically every business operation, and especially that of data processing in banks, is one of the outstanding characteristics of modern business. Furthermore, if the word is not too technically defined, machinery has been long and widely used in the record-keeping functions of a bank. The use of equipment dates

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[1]In this section the following sources have been drawn upon heavily for the information carried herein:

"How Banking Tames Its Paper Tiger," Business Review, Federal Reserve Bank of Philadelphia (May, 1960), pp. 2-10.

Leslie Walker, "Equipment--Keystone of Modern Banking," Banking, LIV (October, 1961), pp. 202-206.

Duplicate copies of typewritten publicity drafts from Burroughs Corporation, Detroit. (No indication of publication or dates were included.)

back almost to the beginning of time, for figuring work and accounting problems must have always existed.

It can be easily imagined that prehistoric bookkeeping was crude, but nevertheless, the neolithic man who traded pottery, arrow heads, or other products of his civilization had his "accounting" problems. To record transactions he drew or chiseled symbols on slabs of rocks or on the walls of caves. But, since it took brawn rather than brain, it was strictly a man's job and women were excluded from bookkeeping work.

As the population increased and spread over the earth, systems of trade sprang up. Hence, it became necessary to devise better methods for figuring and recording the trade transactions.

Deciphered tablets and hieroglyphics reveal that the early Babylonians, Egyptians, Hebrews, and Syrians were surprisingly efficient in the handling of figures. It has been stated, in fact, that "the first piece of equipment ever used by a banker was a pointed stick and that banking was born in Babylonia 4,000 years ago . . . [when] the first records were scratched on clay tablets."[1]

About the same time Ahmes, an Egyptian temple scribe, wrote the first known handbook on arithmetic. His papyrus (manuscript) still exists in the British Museum. Centuries later, papyrus scrolls were also used as "ledgers" by the

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[1]"Paper Tiger," op. cit., p. 5.

bankers of Phoenicia as they posted to them with pens made from reeds.

The Chinese evolved the idea of knotted cords, then beads on wire. From the latter, around 600 B.C., came the first calculating machine--the wooden abacus--which is still widely used by Oriental peoples. The Chinese were also the first to use paper.

The ancient Greeks and Romans had a highly-developed banking system. Too, these early civilizations developed an abacus of stone provided with grooves in which pebbles called "calculi" were rolled up and down. From their "calculi" the word "calculate" is derived.

Another early accounting device used by bankers of the time was the quipu, which is still used in some regions of Peru. The Aztecs, at the height of their power, kept track of their treasures by using the quipu. It consists of a twisted cord made of different colored strands from which is hung a fringe of knotted strings. The knots on these strings represent numbers and might be combined to express any required amount, while the colored strands of the main cord represent objects so that different kinds of properties can be distinguished. For example, a red color might indicate gold, a black, cattle, and so on.

Perhaps even earlier than the abacus or the quipu were the sangi or number rods which may still be found in parts of Korea and Japan.

The next major milestone in record-keeping took place during the middle ages when the decimal system and Arabic numerals replaced Roman numerals throughout much of Europe. This greatly simplified calculation. Although it may have seemed easier to the Romans, we would find it rather difficult to figure interest on MMDCCCLXXXVIII denarii at VI per cent per annum.

In England, from the time of William the Conqueror to as late as Charles II, the tally system was in vogue. When a man owed money, he would record the amount by cutting notches in a stick called a tally stock. He would then give the stick to his creditor. Because a dishonest creditor would sometimes cut extra notches before he presented the tally stock for payment the system was changed. After the notches were made the tally was split down the middle. The notches on the creditor's half then had to correspond to the notches on the debtor's half. From this system the term tally was derived, a word still in current usage. It is also interesting to note that some semblance of this system was used by the cattle barons of the early West as they took periodical inventories, or tallies, of their cattle.

Banks kept records of deposits by the tally system. Their depositors held tally stocks corresponding to those in the bank. From this came the modern word "stockholder."

Up to 1543 the British Government also kept records of transactions by the tally system. After the system was discontinued, for nearly two centuries the basement of the House of Commons remained cluttered with vast accumulations of these dry sticks. Finally it was decided to burn them. When the stove became overheated, a fire ensued, burning both the House of Commons and the adjacent House of Lords.

Blaise Pascal, in 1642, built a machine that could add figures. In 1693, Gottfried Leibnitz produced a multiplying device. Subsequently numerous inventors, mathematicians, eccentrics, and others who merely wanted to get rich quick tried to devise machines that would substitute "brass for brains." But during a period of nearly 200 years, few practical machines were developed.

In the early 1800's, however, an English mathematician, Charles Babbage made at least two attempts to construct a machine involving a sequence of operating steps. These machines were to be mechanical in nature and were to incorporate functions similar to those of the present-day computer. Unmastered technical difficulties did not permit completion of these machines, though, and his "Difference Engine" (about 1812) and "Analytical Engine" (about 1833) were temporarily forgotten.

Later, Dr. Herman Hollerith devised a punched-card system for tabulating the 1890 census. He had earlier experimented with punched paper tape but abandoned the idea in favor of cards. Although Dr. Hollerith's equipment was not sequentially programmed, it did utilize punched cards in a manner similar to that used by the Jacquard loom. The Jacquard innovation, providing for operation of a loom through a sequence of operations controlled by means of punched cards, pre-dated Babbage's work. The eventual production of tabulating systems for data processing, as well as the computer, are the outgrowth of these earlier experiments.

As late as 1890 most banking transactions were recorded by hand. Clerks, wearing green eye shades and high button shoes, ". . . and perched on high stools, inked entries in ponderous ledgers. Male secretaries copied letters in 'fine round hands.' Officers scratched interest computations with goose-quill pens."[1] Illustrative of the type of ledgers used is the following.

> In the early days of banking, one ledger record of a depositor's account was made, and the bank kept this record permanently in its possession. Huge bound books, known as Boston ledgers, were used for this purpose. It was not practical to provide the customer with a copy of his account for his own use; instead, he was requested to submit his checking account passbook to the bank periodically for balancing. The bookkeeper would add all the customer's deposits in the passbook, subtract from the deposit total the aggregate of checks paid since the last balancing, bring forward the new balance, and return the passbook, together with the paid checks, to the depositor. Thus, by means of the passbook, each customer was furnished with a record of all deposits made and of all checks paid, and he was given his current balance figure.[2]

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[1]Burroughs Corporation, op. cit.

[2]American Institute of Banking, op. cit., p. 84.

It was not until shortly before the turn of the century that the mechanical revolution started in offices and banks. Once started, however, it set off an almost feverish development and use of office equipment.

First to appear was the writing machine, the typewriter. Then came the adding machine, followed by a host of different equipment.

> By 1914 a book on office management found the following among the machinery in general use: cash registers, punched-card tabulators, addressing machines, billing machines, duplicating machines, photo copiers, automatic typewriters, check-signing equipment, and folding machines.[1]

The production of a practical adding machine aided materially the record-keeping activities of the banker and provided the basis for the subsequently developed bookkeeping and accounting machines. Its importance ranks high in the mechanization progress of banking.

Development of Early Bank Bookkeeping Machines

The inventor of the Burroughs adding machine, William Seward Burroughs, was born in Rochester, New York, on January 28, 1857. His father, who was a mechanic, decided that his son should have a "gentleman's job," and not follow in his footsteps. Young William exhibited early tendencies toward things mechanical, however, and after the family had moved to Auburn, New York, and when

[1]"Paper Tiger," op. cit., p. 6.

he was fourteen years of age, he attended a lecture on "mathematical short cuts." This lecture fired his imagination and was the impetus for his conception of the adding machine. The youth spent many hours making sketches of his "adding machine," and he even promised to build one when he grew older.

After completing two years of high school, Burroughs received employment as a postal clerk. He next decided to enter banking and obtained a position as a bank clerk. He soon discovered that his "gentleman's job" had many drawbacks. The hours were extremely long, the work very confining and fatiguing, and always there haunted him the specter of error that meant hours of extra work and ceaseless worry.

It was not long after he had entered the bank that Burroughs developed a feeling that something was wrong with the system of keeping the figure data. He found that half his time was spent in taking precautionary measures to avoid error and that half of his remaining time was used in finding and correcting errors that had crept in despite his caution. Only about one-fourth of his time was devoted to actual productive work. It was painstaking, tedious work, and required a great deal of "overtime." Gradually there began shaping in his mind the conviction that the human brain is, at best, an imperfect tool, never infallible, and incapable of sustained effort without error. The answer, as he viewed it, was "something mechanical."

Five years after entering the bank, a combination of factors--a not too robust health, the long hours required by his work, the constant worry over errors, plus the thought and study devoted to his idea--required him to leave his work, go to a different climate, and take up something less confining. Therefore, in 1882 he went to St. Louis, where he had relatives, and found work as a mechanic in a machine shop.

The idea of an adding machine now became stronger and stronger. As a result, Burroughs persuaded one of the city's leading merchants to advance him $300 with which to develop his idea. Upon receipt of the loan, he quit the shop to devote his entire time to his machine. He soon found working space in a shop owned by Joseph Boyer, a man who gave him much friendly encouragement and help. (Boyer later became chairman of the Board of Directors of Burroughs Adding Machine Company and for twenty years was its president.) Burroughs soon found, however, that it was one thing to have an idea and another to develop it into a practical machine. The $300 was soon used up and $400 more was advanced. After that was spent, he was forced to turn promoter and raise more funds. Eventually, after many struggles and six more years of work, he completed the first model. He called it a "Registering Accountant."

This first practical model required ten years effort and an estimated cost of $300,000.

As news of his work became public, business men invested money to assist Burroughs in the development of his adding machine. Finally, four of his backers formally organized and incorporated, in 1886, as the American Arithmometer Company. (In October, 1904, the company moved to a new plant in Detroit, Michigan, and a few months later became the Burroughs Adding Machine Company. The name was changed to the Burroughs Corporation in 1953.) In 1888, the first U. S. patents were granted, and in 1889 the Boyer Machine Company--where Burroughs had conducted his work--was given a contract to make fifty of the new machines.

The first sales brought bad reports. The machine operators could not make them add correctly; they could not get the same answer twice. Customers, new to the machines, pumped or yanked or caressed the handle and did not control the operating speed as did Burroughs who could make it work accurately every time. The previous admiration for Burroughs and his invention soon began to give way to disbelief, ridicule, and derision. He was even called a hoax, or a mathematical magician, and many belittled him for trying to "put brains in a box." Dismayed, Burroughs locked himself in his working quarters for 72 straight hours, emerging tired and haggard but with the sketch for an oil-filled dashpot, a device similar to that which ensures the steady closing of a door. After retooling and modifications, Burroughs's "Registering Accountant," the world's first practical key-driven and printing adding machine, was a successful reality.

The first machine was limited to simple adding, although it gave a printed record of what it added and the result. Its reality, nevertheless, gave Burroughs and his backers reason to visualize a maximum sale of only 8,000 machines. This would provide one machine for each bank in the United States and Canada, and then the company could be liquidated. Little did they dream that in just forty years, by 1926, the company would have produced a million machines, and that it would eventually bring into use millions more.

Success was finally won. The first really mechanical piece of equipment produced specifically for banking operations was soon adopted by many business organizations. But, due to ill health, Burroughs resigned from the company in 1897 and on September 14, 1898, at the age of 41, he died. His life was relatively short, but his contribution to other bank clerks and bookkeepers and business men in general will last forever.

The first users of the simple adding machines were banks--principally smaller banks. But banks in general did not at first rush to buy this innovation. They were reluctant and unwilling to accept that this "newfangled contraption" would actually total a column of figures correctly, or that there was a need for banks to have it. Nevertheless, improvements were made in the machines, newer developments were added, and acceptance became widespread. Eventually, the original machine evolved into six basic lines of mechanical equipment: adding-subtracting machines, cash-registering machines, calculating machines, numerical accounting machines, typewriting accounting machines, and statistical accounting machines. Over 2500 special and catalog models have been produced by Burroughs in the seventy-five years of the company's existence.

Shortly after the adding machine was developed, the calculating machine was produced. Other innovations were also introduced. Among the more noteworthy improvements of the time were adding attachments for typewriters--coupled with typewriters that could write in bound books--and, shortly after 1900, the attachment of electric motors which greatly furthered the development of rapid, skillful addition. About the same time machine subtraction was made possible, with the result that totals and balances could then be computed.

At first, deposits, checks, and daily balances were printed vertically in one or more columns. Then it was realized that separate columns for each class of entry would make the statement look more like a ledger and much easier to follow for account reconcilement. Thus, around 1910 or 1912, the idea of posting ledgers by machine was conceived. As usual, though, the further development and more widespread use of posting machines was retarded for a time because of an almost universal suspicion of the loose-leaf ledger as a safe record for accounting purposes. Nevertheless, the first bookkeeping machine was a marvel in its day because it would add, subtract, print the date, and print the balance. Its appearance helped to reveal the many disadvantages of the old Boston ledger and provided the means for speedier and more accurate record keeping. This, in turn, helped to improve banking services at a time when there was an unprecedented increase in the number of depositors.

Initially, mechanical posting brought about a decided change so far as the customer's record was concerned, and also provided an element of internal control and check. The speed and accuracy of the new bookkeeping machines made it practical for a bank to go through the entire posting process twice (dual posting). One bookkeeper would post to the customer's ledger while a second would post the identical data to the customer's statement. Subsequently, methods were devised whereby the bank's record and the customer's record were simultaneously prepared.

When the original income tax law was passed in 1913, requiring the reporting of a business's affairs in a systematic manner, modern record keeping really began. With this as an incentive, and with the war, the period of 1910-1916 saw a reduction in the number of skilled bookkeepers. As a consequence, some acceptance of posting machines was given by the accounting profession--principally, however, in the preparation of customers' statements. Later the reduction of clerical costs became the paramount motive. Hence, once given the opportunity to prove its value in the field of accounting, office posting machinery came into its own.

A motor-returned carriage mechanism released early in 1920 did much to lighten further the load of bank bookkeeping. In 1926 a bookkeeping machine was released that would "remember" totals. This machine carried a separate total for the checks charged, the deposits credited, and a total of the balances extended. Thus, proof was established that checks had been posted as checks, deposits as deposits, and if the total carried in the machine agreed with predetermined totals, the items had been entered correctly and entries had been made to the correct account. This, then, was the forerunner to the bankers' modern, conventional bookkeeping machine.

Another important innovation in banking was made possible by machine developments. This was the numerical transit system, a bank numbering system devised to facilitate the routing and transfer of checks.[1] The use of numbers, together with the speed of machines, could be used to simplify the task of writing complete transit letters and save the laborious process of listing the checks in one operation and writing the name of the bank upon which the check was drawn, plus the name of the endorser, in another operation.

During the 1920's, a large increase in the volume of loans of various types emphasized the need for efficient loan accounting systems. To cope with this expansion, typewriter accounting machines were developed that produced in a single operation the note register, the liability ledger, a note advice, maturity tickler, and officer's memorandum. The development of this machine made possible the use of mechanization for one, all, or any combination of the following records: Loan and Discount, F.H.A. Mortgage Loans, Regular Mortgage Loans, Real Estate, Securities, Transit Letters, General Ledger and Daily Statement.

The 1930's saw many changes in banking and bank operations. The depression and shrinkage of bank income from normal sources created problems that placed new emphasis on efficiency. To save time and reduce costs, newly improved machines and systems were devised to speed the proving of items and the creation of analysis information. One of the

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[1]An explanation of bank numbers and transit routing symbols is given in Appendix A.

new machines was the first commercial teller's machine.

The first exhibit for equipment of manufacturers was displayed at the 64th Annual Convention of the American Bankers Association held in Houston, Texas, in 1938. Primarily the exhibits dealt with conveniences for bank people, but one manufacturer announced that an automatic punched-card accounting system was available for the various bank record keeping purposes. Thus was introduced the popular tabulating--"tab"--systems which many banks have employed with satisfaction.

Another machine exhibited was "a proof machine that endorsed, sorted, listed, and proved checks, more or less automatically, but under the careful manipulation of an attractive lady."[1] With modifications, this machine is used extensively today and is an essential piece of equipment for nearly every bank, since proof of deposits is the basis for all deposit accounting. Presently, the New York Federal Reserve Bank uses about 250 modern proof machines, in three shifts, to process nearly 600 million checks a year.[2]

Improvements have continued to be made in both bank machines and in bank accounting systems and procedures. Indicating the bankers' interest in a coordinated control system of men and machines is the check list of modern

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[1]Walker, _op. cit._, p. 202.

[2]Kuhns, _op. cit._, p. 46.

banking rules prepared by them at their 1951 Annual Convention. A set of criteria against which each new service and piece of equipment could be measured was agreed upon. The following is illustrative.

New Services and equipment are to:

1. Increase customer services,
2. Reduce operating expenses,
3. Cut down on clerical errors,
4. Decrease manual operations,
5. Reduce employee fatigue,
6. Appeal to operating personnel,
7. Increase general efficiency,
8. Improve customer relations, and
9. Produce more accurate records.[1]

Bankers were looking toward new horizons. The advent of the 1950's was viewed with renewed optimism and promise of a new age--a new era--in banking. For it was in the 1940's that developments led to the production of a newer method of data processing--that by electronics--and this new medium gave promise of being able to meet the record-keeping challenge of the post-war, economic explosion. The conventional bookkeeping machine, the wonder of its day, and still the most widely used bank accounting machine, must eventually make way for the newer equipment. But first, a common machine language, universally usable by all banks, had to be developed.

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[1]Walker, _op. cit_., p. 202.

CHAPTER IV

THE MAGIC OF MICR

Within the last decade a new system of check processing has been developed for the use of our nation's banks. In some respects this processing system is fantastic, but it really is not magic. Rather, it is magnetic; and it is known as MICR--Magnetic Ink Character Recognition. There are two basic components to the system--first, machines that can "read" and process checks, and second, checks that can be processed mechanically. To make it possible, it was first necessary to invent a universally acceptable "language;" then manufacturers could proceed to develop processing machines capable of "reading" the common machine language.

According to John A. Kley, the MICR program had its inception in 1953 when Edward T. Shipley, comptroller and auditor of the Wachovia Bank and Trust Company, Winston-Salem, North Carolina, prepared a memorandum suggesting a study of mechanization for check handling and possible use of computers for bank data processing. Mr. Shipley's memo was presented to the American Bankers Association's

Dr. Harold Stonier by Robert M. Hanes, president of the Wachovia Bank and Trust Company. After study of the proposal, the Bank Management Commission of the ABA appointed a Technical Committee on Mechanization of Check Handling and named Mr. Kley, a New York banker, as chairman. The date was April 5, 1954.[1]

Goals, Objectives and Problems

From the start the Technical Committee worked very closely with the interested industry delegates and liaison representatives from the Federal Reserve System. Joint participation was necessary if an effective system agreeable to all was to be forthcoming. The individual efforts of committee members had to be directed toward a common goal that would eliminate differences in machinery processing concepts and techniques, and standardize checks and certain check printing requirements.

The specialized problems associated with banking complicated the committee's task. The major problems might be summarized somewhat as follows:

1. To determine the medium most suitable as a common language for the imprinting of checks and other documents to be mechanically processed.

2. To determine the actual location of the common

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[1]Thomas R. Bitterly "Magnetic Ink Character Developments," Federal Accountant, VIII (March, 1959), p. 18.

language on checks.

3. To coordinate the location and arrangement of the characters within the designated area on the checks.

4. To establish a magnetic ink free band within the specified check area--other than the magnetic ink character coding--for uniform machine sensing of encoded checks.

5. To determine the character shape of the magnetic ink printing.

6. To develop check format standards which would make possible a more universal application of machinery methods to check handling and thus reap greater over-all benefits from the MICR program.

The "Language" Barrier

Language has been a barrier to international communications and the free flow of information between different nationalities for ages. But the language barrier between nations has not been insurmountable. Neither was the "language" barrier to effective high speed check processing insurmountable. Nevertheless, it took time and study to achieve the desired objective of a common machine language--a language for check impression that was acceptable to all industries involved, as well as to the manifold purposes of the banking system.

From the standpoint of time, the MICR program is the result of over six years of cooperative study and research initiated and directed by the Bank Management Commission of the American Bankers Association.

From the standpoint of study, it is only natural to assume that the Technical Committee on Mechanization of Check Handling developed a series of ideal standards and established these as the desired objectives for a mechanized check handling system. The search for essential traits and qualities that would measure up to the high standards needed must have required not only a great deal of time but also a great deal of concentrated effort and study to search out the one best system, size, material, placement, or method. In its searching, it is also reasonable to assume that the committee gave long and deliberate consideration to such factors as accuracy, control, speed and cost. Certainly a machine system would not be recommended if it did not provide accuracy at least in excess of human accuracy; nor would a system receive approval if it would not provide for safeguards that could meet government and regulatory agency audit requirements; neither would it be reasonable for the committee to suggest a system that would be unable to cope with the anticipated paper handling problems of the future. Similarly, a machine system would not be recommended if it did not provide a sound, economically-feasible solution to banking's data processing problem. In this respect the Technical Committee's job was further complicated by the disparities in banks' sizes and characteristics, for what might be "economically feasible" for one bank would certainly not be so for every other bank in the country. Nevertheless, since each bank is a link in the chain of banks comprising the banking system, maximum benefits cannot be realized without participation by all.

The separate members of the committee had to subordinate a number of individual preferences and strive diligently to reach acceptable agreements that would concurrently further the committee's objectives and the ultimate goal of a common machine language. That such a task was difficult is evident from the fact that the American Bankers Association's Technical Committee was representing all banks and bankers of the country, regardless of size, geographical location, service specialties, present degree of mechanization, age of mechanical equipment employed, and so forth. Similarly, various electronic machinery manufacturers had independent bank equipment research and development programs underway. Some of these projects were quite advanced and had entailed a considerable expenditure of time and money. It seems quite natural, therefore, that a company would argue loud and long for a method employing the procedures and system it had already partly perfected. For example, a company which had developed a highly satisfactory machine-sensible fluorescent coding for paper documents could hardly be expected to advocate the use of magnetic ink. Nor could the reverse be very logical. Thus, the final decision which resulted in the recommended adoption and use of magnetic ink and the other requisites of a MICR program could only be reached after a considerable amount of study, research, and negotiation. But, if the early prospects which were visualized for MICR and a bank EDP system were to be realized in full, then uniform, accurate, dependable, and trouble-free input information from document to computer had to be assured.

For more than two years the committee, under the chairmanship of John Kley, studied the various phases of the check mechanization problem. During this period, the group studied a wide range of common-language media available to it. These included carrier and non-carrier systems and a wide variety of coding techniques. Among those reviewed were binary or bar codes, miniature bar codes, and large bar codes; reverse side of check printing and face printing; the use of invisible fluorescent ink and the use of visible magnetic ink; and Arabic character systems using both conventional ink and magnetic ink. The final decision for the use of magnetic ink introduced a number of problems for bank stationers. Where check printing previously had only to please the human eye, magnetic ink printing for machine processing had to meet rigid specifications. This meant that tolerance allowances were much more restrictive, and that new, highly magnified, microscopic proof-reading measures had to be adopted. For example, where there were seventeen possible misadventures in check printing prior to MICR, it has been estimated that 277 things can go wrong with magnetic ink imprinting.[1]

With such an increase in the possibility of error, new equipment often became a necessity. Early in the program, however, some of the printers were not ready to make large expenditures for new press equipment. Instead, they were satisfied with merely trying to "get by." Gordon H. Schneider has characterized some of these as:

1. Old Scrooge--a frugal printer using old worn out lead slugs.
2. The Gambler--the one who says, "I'll take a chance." One of these said that he would take double for those which the sorter could read, and nothing for the rest.
3. Old Punchy--thinks the machine reads by Braille and "creates" new characters.
4. Squeezy Sam--wants to be sure and allows too much ink. Ink control is vital. This "squeeze out," or halo effect, can upset the desired electrical wave shapes of the characters faster than anything else.
5. The Untouchables--allows uneven ink distribution. This is frequently caused by the ink not adhering to new metal type, which must have a run-in period.[2]

With the introduction of MICR check preprinting, printers had to consider twelve factors in evaluating

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[1]Thomas W. Miles, "The ABC's (Aims, Benefits and Characteristics) of MICR," Banking, LIII (September, 1960), p. 221.

[2]Gordon H. Schneider, "MICR Comes of Age," Auditgram, XXXVIII (February, 1962), p. 21.

their check imprinting workmanship. These were, format, spacing, skew, alignment, character dimension, embossment, signal level, uniformity of ink, character edge regularity, voids, and extraneous ink on front or back.[1] It is no wonder, therefore, that new tolerance measurement methods were made necessary. Schneider even suggested that a bank planning to process checks by MICR take steps to evaluate the quality of printing being received. If it did not, it faced the possibility of finding itself with a million dollars worth of useless computer equipment.[2] He further states, ". . . the day may not be far off when quality control of magnetic ink encoding will no longer be necessary. But the industry has not yet reached that point."[3]

In July, 1956, following the Technical Committee's first report, the American Bankers Association announced the recommendation of Arabic magnetic ink characters as the common language for check mechanization. In arriving at its decision, the Technical Committee had relied on information gathered from many sources. Experience was somewhat lacking, but even in this regard the Bank of America had progressed to the point where a large-scale general-purpose computer system was placed in operation

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[1]"NABAC's Idea Round-Up on Bank Operations," _Burroughs Clearing House_, XLIV (October, 1959), p. 45.

[2]Schneider, _op. cit._, p. 21.

[3]_Ibid._, p. 27.

in October of 1955. In addition, results of the computer processing research and experimentation conducted by the Stanford Research Institute for the Bank of America were available. Also, a number of the individual equipment producers had conducted extensive research in computer data processing for banking.

Reasons for MICR

There were many reasons given for the selection of magnetic ink as the common machine language. One writer lists them as follows:

1. It provided the greatest accuracy.
2. It had the least stringent printing tolerance requirements.
3. It was the most acceptable language from a customer viewpoint.
4. It provided positive verification procedures during internal proving operations.
5. It resulted in the lowest over-all costs.
6. The ordinary handling and exposure which checks might be expected to receive produced the least mutilation and obliteration.[1]

Mr. Bitterly also stated that the readability factor was one of magnetic ink's most advantageous qualities. The element of customer acceptance was viewed by others with some concern as is indicated by the following statement.

> Never before has the future of bank operations depended to such a degree on customer cooperation. Unless our customers will use checks with magnetic ink, and unless they will treat them as input documents rather than as just negotiable instruments, the mechanization of check handling will be

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[1]Bitterly, op. cit., p. 19.

less profitable than bankers expected.[1]

To the average customer, the addition of magnetic ink encoding on the bottom of checks has made little difference. He has accepted his assigned account number as an additional means of identification and as another restraint against errors in his checking account. The coding of deposit tickets has been of little or no concern to the average depositor because an ample supply of deposit tickets, already preprinted with his own particular identifying number, has been made available to him. If, however, for some reason or another, a pre-encoded deposit slip was not available, bank-supplied forms could be filled in without any undue inconvenience to the depositor. The same has been true with checks, although the failure to use preprinted documents causes some additional work and inconvenience to the bank.

The story has been told that early in the adoption of MICR encoding an ingenious, and rather dishonest, individual hit upon a get-rich-quick-at-the-expense-of-others idea. Taking a goodly supply of blank deposit slips from the lobby of a large bank, he had them pre-encoded with the account number for his account--one that he had opened with the bank for his nefarious scheme. Placing these in the lobby once again, and timing his actions to coincide with the bank's practices, he took

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[1]"NABAC's Idea Round-Up on Bank Operations," <u>op. cit</u>., p. 46.

advantage of all deposits made to this "special" account during a one day period. He closed out the account just after it had been updated for that one day.

Whether the story is true or not, it does point up a weakness of complete reliance upon preprinted account numbers for charging or crediting customers' accounts. Recognizing this, banks have usually retained a competent "check-paying" staff who laboriously verify the propriety of an account charge by signature examination. Furthermore, true or not, such stories have helped to indoctrinate bank depositors to a more complete and careful use of the documents provided for them by the bank.

The MICR program also provided some conveniences. With punch card checks, because of requirements for machine processing, limitations against using staples, folding, perforating, or mutilating in any way had developed. The use of paper checks and magnetic ink processing, or merely the processing of punch card checks by MICR equipment, eliminated most of these restrictions.

Conversion of commercial accounts to the MICR program probably provided one of the biggest cooperative challenges. Check redesign was often necessary; check advertising in some instances had to be redesigned, relocated on the check, or perhaps even eliminated. Some firms with punch card equipment were reluctant to change check format or card punching routines; with others, a large supply of uncoded or non-standard checks posed a cost problem. Thus, inconvenience, duplicated costs, loss of check information, and aversion to change presented possible deterrents to customer cooperation. But energetic and early action on the part of most bankers was successful in resolving the different issues and in obtaining the cooperative support of their many customers.

Solving the MICR Problems

Following the American Bankers Association's recommendation, all of the major machine manufacturers involved, representatives of the printing industry, and agents of the Federal Reserve System indicated their concurrence. Ordinarily there is keen and spirited competition between many of the firms involved, and that they should be in accord with the committee's recommendation seems unusual. In commenting on this, Chairman Kley says that getting so many different competitors working together to solve the problem at hand was not easy.[1]

> It took time and education and trial. These people had spent a lot of money in other directions. But once they came to the realization that it was better for everybody concerned to have one way of handling mechanization instead of five, we went places. That was the big problem--the manufacturers had five different systems they favored and use of more than one of them would have negated the effectiveness of the entire program. . . .

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[1]Arnold E. Keller, "Major Breakthrough in Paper Processing," a reprint taken from Management and Business Automation (March, 1959), p. 8.

Burrough Corporation's venture into fluorescent coding furnishes a good example of an individual company's efforts toward complete check handling mechanization. In cooperation with the Central Pennsylvania National Bank of Philadelphia, equipment was installed which began encoding checks and deposit tickets with invisible fluorescent symbols in October, 1955. In May, 1956, preparations were started for the installation of fluorescent sorting equipment. Sorting operations were started in January, 1957.[1]

MICR Placement on Checks

After reaching full agreement on the magnetic ink concept, it was thought that the most difficult problem had been solved. However, the next problem, that of determining the actual location of the common language on the check proved to be almost as troublesome. This task was initially assigned to the Business Equipment Manufacturers Committee,[2] thus making it possible for the machine companies to decide on a location best suited to their needs.

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[1]*Ibid.*, p. 8.

[2]This committee was formed to work with the American Bankers Association Technical Committee and was composed of representatives from Addressograph-Multigraph Corporation, Burroughs Corporation, General Electric Company, the Lithographers National Association (representing the check printing industry), Moore Business Forms, National Cash Register Company, Pitney-Bowes, Inc., Sperry Rand Corporation, Standard Register Company, and the Todd Division of Burroughs. A year later the Type Design Committee

A few months later, after the manufacturers group was unable to reach an agreement because of "some basic and unreconcilable differences of opinion," the problem was returned to the Technical Committee. The point of dispute was over whether to encode the magnetic ink characters on the top or the bottom of the check. While most of the manufacturers favored encoding on the bottom edge of checks, one company strongly favored top-edge encoding because of the difficulty of adapting bottom-edge encoding to punch card checks.

When the problem of "placement for the common machine language on checks" was returned to the ABA Technical Committee by the Business Equipment Manufacturers Committee, the manufacturers favoring bottom-edge encoding advanced three basic reasons for their recommendation. These reasons were: (1) fewer mutilations, (2) economy in equipment and operation, and (3) greater customer acceptance. Accepting these as principal factors, the Technical Committee instituted studies designed to determine the validity of these reasons and to weigh the advantages and disadvantages of bottom-edge encoding against the existing

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was also established. This committee included all of the same members except the Lithographers Association. Still later, the Machine Manufacturers Committee was formed to make an appraisal of the engineering reliability of magnetic characters. Included in this group were Burroughs, International Business Machines, General Electric, National Cash Register, and Sperry Rand. The same group also formed a Type Font Committee to co-ordinate the manufacturers' requirements relative to type font shapes suggested by the larger Type Design Committee.

fact of bottom-edge punched cards and the possible interference of card punches with magnetic ink coding. The findings of the committee were as follows:[1]

Incidence of Mutilation

Mutilation of paper checks do occur, and although standardizing checks and educating check users may reduce the mutilation problem, it will never be eliminated. Recognizing this, three independent studies were made, each in a different city--Chicago, Philadelphia, and San Francisco. Representative proportions of all types of checks were included and evaluation was made of mutilations encountered in pertinent areas designated as top or bottom. The study findings showed the following percentage of total mutilations to number of checks examined:

	San Francisco Study	Philadelphia Study	Chicago Study	Total Three Studies
Top Mutilations	6.2%	7.7%	8.3%	6.6%
Bottom Mutilations	1.5%	1.5%	1.0%	1.5%

The three-study average may be influenced by the greater number of checks examined in the San Francisco study. However,

[1]The American Bankers Association's Bank Management Commission reports on the studies and findings of the Technical Committee in its Bank Management Publication #141, Placement for the Common Machine Language on Checks (April, 1957). Information in this section draws heavily from this publication.

the committee findings showed a consistency among the three studies which indicated a high reliability of the samples. Also, a relatively equal mutilation rate among the different checks banks handle (clearings, transit, and "on us") indicated uniformity in the data. It should be noted too, that the mutilations of most concern to the committee were those that would become "reading rejects" of the processing equipment.

Economy in Equipment and Operation

The question of cost is usually of importance in most decisions requiring funds. In regard to which edge of a check to reserve for magnetic ink encoding, the problem of cost was even more significant because of the large number of small banks. As yet, many of the smaller banks will not install EDP systems. Still, small bank participation in the check encoding program is considered essential for a highly efficient automatic check handling system. The committee, keenly aware of this, considered cost from two principal aspects, first, that of equipment costs, and second, that of continuing labor costs.

Equipment costs. Recognizing the many facets of the equipment cost problem, and considering the extreme variations in bank sizes, volumes of operation, banking services offered, area served, and so forth, the committee studied the problem thoroughly. Its findings may be summarized somewhat as follows:

1. Cost of equipment to be used in the bookkeeping function, particularly for larger banks with electronic computer installations, will be little affected by the choice of top or bottom encoding.

2. The cost of required post-printing devices used to encode amounts and transaction codes, and those items not pre-encoded, may be affected substantially by the location of the code.

The above conclusion is based in part on the fact that checks vary in width and the reference point for magnetic ink imprinting must therefore coincide with top or bottom code location. Two reasons for the decision were predominant. First was the desirability of a machine operator having an unobstructed view of the face of the check during any encoding operation. A reduction of errors would result, and machines, such as modified typewriters, could be used for encoding without the body of the check being hidden. No such simple and inexpensive device could be visualized for top encoding.

The second reason was that many business machines employ the principle of rising type bars or print wheels for imprinting. Thus, proof machines, using the bottom edge as a reference point, and leaving the face of the check visible to the operator, could readily be adapted to bottom-edge encoding. If rising type were used with top-edge encoding, inversion and relocation of the type would be necessary while the face of the check would still be hidden from the operator. Redesign or special machine construction would probably increase prices. It was the opinion of the committee, therefore, that the principles involved in the construction of existing conventional machines could be effectively utilized in either constructing new devices or converting present equipment into acceptable bottom-edge post-printing machines. The cost of such devices would then tend to be less than for machines employing unknown and unproven techniques of machine and component design.

Continuing labor costs. The ABA Technical Committee did not feel qualified to evaluate the necessary facets of the human element in continuing labor costs and employed an independent consulting firm to assist in this phase of its cost study. The consulting firm then studied two manual clerical operations anticipated with a magnetically processed document system. They were: (1) The initial sort, proof, and encoding operations when the check is first received; and (2) the filing operations subsequent to the automatic bookkeeping process.

The results of these studies indicated that filing operations are relatively unaffected by the coding position, but that a 12 per cent manual proofing, sorting and amount encoding cost saving would be realized with bottom-edge encoding. The saving stems primarily from vertical drop positioning for bottom encoded checks as compared to a horizontal position movement for those top encoded.

Customer Acceptance

Through the years banking's customers have become inclined to identify themselves more closely with their checks. Business firms not only identify by company name and address, but frequently by product identification and advertising. In a like manner, individuals tend to prefer a more personalized check. These trends have resulted in an endeavor on the part of check printers to design their checks from both a utilitarian and an aesthetic standpoint. The committee agreed fully with the trend to improved check appearance and ascertained from its studies that less serious changes in check format would result by leaving the area at the top of the check for individualized imprinting and reserving certain areas at the bottom of the check for magnetic ink code imprinting.

The subsequent transition to checks with the redesigned formats has given credence to the committee's decision. Customers have readily accepted the style and appearance of their new checks and the conversion process has been relatively trouble free.

Punch Card Compatability

Since one equipment manufacturer favored top-edge encoding for checks, the committee felt it advisable to study more thoroughly the compatability of punch cards and bottom-edge encoding. Information available seemed to indicate that about 14 per cent of all checks issued in this country were in punch card form. About one-half of these are drawn on the Treasurer of the United States. It was recognized, however, that in some areas of the country punch card checks would represent a larger proportion. For example, one bank's "on us" checks ran as high as 36 per cent punched cards and the New York City Clearinghouse banks averaged 27 per cent.

The next item explored by the committee was concerned with the extent of card punching in the area reserved for MICR encoding. It was determined that the Treasury Department normally punches in only twenty-two columns. Other surveys indicated varying, but not full, lower-edge use of card columns for card punching. The conclusions were that the majority of punch card checks do not contain more than twenty-two columns of punching, and that a large volume of checks was concentrated in relatively few accounts. Therefore, it appeared possible to confine MICR coding to one area of punch card checks and lower-edge card punching to another, thus eliminating the problem of overpunching. This, of course, presented some problems associated with specific punch card fields; but the advantages of intermingling paper checks and card checks for high speed handling outweighed the disadvantages. As a result of their findings, therefore, the Technical Committee recommended that magnetic ink preprinting on punch card checks appear below the 9's position in the first fifty columns of the check, and that, starting with the fifty-first column, the post-printing information start one-fourth inch from the bottom edge of the check and be recorded in the next one-fourth inch extending upward. Thus, preprinted characters will appear at the very bottom of the punch card checks while the post-printed characters will appear in the same relative position as they do on paper checks.

The committee's final conclusion was that for all checks--with slight modification for punch card checks--bottom-edge encoding would provide basic advantages relative to incidence of mutilation and resultant reading reliability, equipment and labor economies, and customer acceptability.

Check Standardization

The first major benefit to be envisaged from the MICR program was high speed electronic sorting of paper checks. Due to the variations in data processing methods and the variety of check forms and sizes encountered in differing manual and mechanical systems, even these benefits could not be fully realized until some element of check standardization was introduced. For this reason, and others, such as the need to consider modification of existing equipment designs, the combined efforts of all participants were required in solving most of the remaining major issues.

Without standardization, check processing automation is impossible. Uniformity in the physical size and general design of checks is essential. In addition, machines cannot operate successfully unless the "magic" magnetic characters are placed in a strictly controlled location. The area chosen for checks extends across the bottom of the check within a horizontal band five-eighths of an inch high. Located within this area is a one-fourth inch wide strip reserved for magnetic ink encoding. The printing to be machine read is recorded in this strip, and no magnetic printing is to appear within the five-eighths inch area unless it is a part of the encoded information. The coded information includes the Federal Reserve routing number, the American Bankers Association number, the account number and transaction code field, and the amount field. Where a check is longer than the minimum six inches, it is also possible for a bank to have a serial number or auxiliary "on us" field.[1]

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[1]Included in the appendices is an article prepared by Burroughs Corporation which shows the relationship of the

The American Bankers Association has recognized the need for check standardization for many years, and issued its first publication on the subject in 1926. It was called "A Plan for Simplified Checks." In 1960, another publication, "Check Standards--Under the Common Machine Language," was also issued. In the first instance standardized checks were a desirable goal; in the second, an absolute necessity. Checks had to be standardized so they could be processed by the machines. So-called "headache checks," such as those illustrated in Figure 3, had to be eliminated in order to make full mechanization possible. Perhaps the greatest source of non-standard, or headache checks, results from checks being designed specifically for the machinery systems of individual business firms' office equipment.

To eliminate such headache checks and to standardize the shape and size of checks in use, the ABA recommended format standards, but expressed them in terms of principles. The principles were then supplemented by certain more definitive standards. The more important aspects of these principles and definitive standards are listed here.[1] (Following each principle as stated here, recommended positions were also given.)

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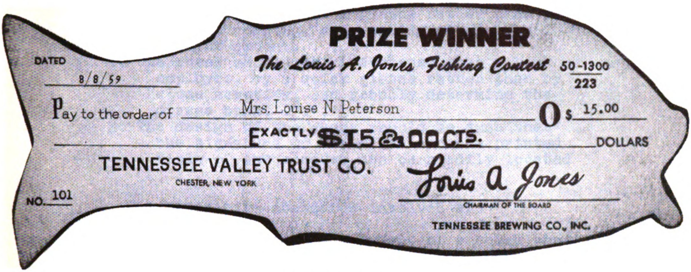
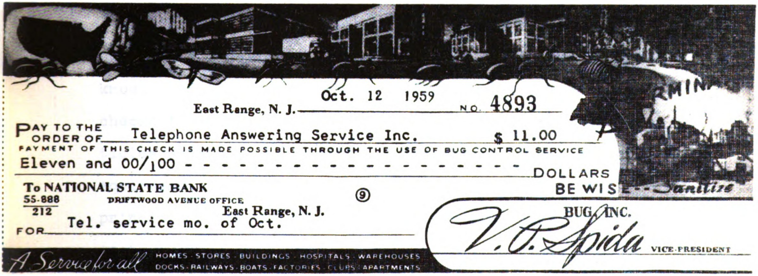
regularly encoded data of a MICR program check. It is entitled, "Banking's Newest Neighborhood--MICR Encoding Locations." The auxiliary field is not shown.

[1]Bank Management Commission, American Bankers Association, Check Standards--Under The Common Machine Language, Bank Management Publication 150 (New York: The American Bankers Association, 1960), pp. 10-11.



Headache Check



Headache Check

Figure 3

1. The check should be so designed that a bank employee, by a quick glance rather than by careful reading, can readily obtain the correct amount. . . .
2. The check should be so designed that a bank employee, by a quick glance rather than by close scrutiny, can readily determine the drawee bank. . . .
3. The design of the check should be such that the signature of the maker and the printed title of the account can be readily located . . . .

The definitive standards involved are:

1. The maximum length and height of a check are 8 3/4" x 3 2/3"; and the minimum length and height are 6" x 2 3/4". . . .
2. The magnetic ink characters along the bottom of the check should be in accordance with prescribed specifications. . . .
3. The fractional ABA routing number (or ABA number in the case of nonpar banks) will continue to be printed in gothic type in the top right area despite the fact essentially the same information is also to be encoded in magnetic ink characters along the bottom of the check.

<u>Magnetic Ink Character Shape</u>

In late 1958 the selection of a common language for checks was finalized. Using a strange-looking type font known as E-13B, numbers and characters are printed on checks in magnetic ink, an ink containing iron oxide particles which can be magnetized and read by the electronic equipment. The reading is based on somewhat the same principle as is our own reading. Our eyes pick out dark spots (words) on a page. These sensory impulses are then swiftly transmitted to the brain where they are instantly matched with patterns that we have stored in memory. The characters consist of nine digits, 0 through 9, and four symbols which act as "punctuation" for the machine, telling it when to start reading and when to stop. They are called the amount symbol, the on-us symbol, the transit number symbol, and the dash symbol.

The common machine language did not become a reality until selection of the character shape was agreed upon. The decision to use E-13B type font was made only after constant revision, testing and retesting, and finally, a thorough evaluation by some fifty printers and an independent research organization. It was essential that approval of all major machine manufacturers involved be obtained; an agreement was reached on December 16, 1958. Previously, though, there had been many imposing obstacles to overcome and some important decisions to be made.

The American Bankers Association, however, through its committees, had pressed forward from the solution of one major problem to another. As progress was made, reports were issued so that the entire banking industry could be apprised of what had been accomplished.[1] Comments written

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[1]Progress reports were issued in a series of Bank Management Publication booklets. They are as follows:

No. 138 <u>Magnetic Ink Character Recognition</u> (July, 1956).

No. 141 <u>Placement for the Common Machine Language on Checks</u> (April, 1957).

No. 142 <u>Location and Arrangement of Magnetic Ink Characters for the Common Machine Language on Checks</u> (January, 1958).

No. 144 <u>Account Numbering and Check Imprinting for</u>

about the advancements were enthusiastic and optimistic. For example, William R. Kuhns wrote, ". . . the magnetic ink code along the bottom indicates our greatest step toward speed, safety, and accuracy."[1] Another publication introduced its article by saying:

> Banking is on the edge of an exciting new age, the electronic age. Devices that actually read, machines that sort checks faster than the eye can see, computers that analyze loan applications. . . .
>
> . . . .
>
> It's what these miracle machines will do for the industry that is exciting most bankers. They will help stabilize rising costs which have been pinching profits. By doing this, they will make it easier for banking to raise the extra capital it must have in the 1960's.
>
> Electronic machines will lessen the personnel problems that plague many banks. "We just can't find all the people we need," is a common lament. And the new equipment may help banish the old bugaboo, handling checks.[2]

Before concluding the present discussion on the development of the MICR program, it may be appropriate to summarize the procedures to be followed in a check mechanization system and to explain briefly how the system works.

Mechanized Check Handling (June, 1958).

No. 146 Progress Report--Mechanization of Check Handling (July, 1958).

No. 147 The Common Machine Language for Mechanized Check Handling (April, 1959).

No. 149 A Progress Report--Mechanization of Check Handling--Supplement to Part III of Bank Management Publication No. 147 (1959).

No. 150 Check Standards Under the Common Machine Language (1960).

[1]Kuhns, op. cit., p. 45.

[2]"Paper Tiger," op. cit., p. 2.

Steps Involved in a Check Mechanization System

In brief, the check mechanization system involves three steps: (1) The transit number-routing symbol and customer account number are placed on each check in magnetic ink at the time the checks are printed. This is called preprinting. (2) The first bank to receive a check for deposit, if it has the necessary equipment, is to encode on the magnetic ink strip the dollar amount of the check as made out by the drawer. (3) Once the check is encoded as indicated in (1) and (2), machines can perform all the usual transit operations of proving, sorting, and listing checks and then go on to post checks to the deposit accounts of bank customers and prepare bank records and customer statements.

To date much progress has been made in accomplishing the first step, that of check preprinting. For example, according to the second semi-annual survey by the Federal Reserve Banks, August, 1961, 36.1 per cent of the checks flowing through the twelve Federal Reserve Banks and their twenty-four branches were coded with magnetic ink characters. The percentage had doubled in six months. A survey of 15,732 banks and branches, also made in August, showed that 80.3 per cent of the banks had begun redesigning and coding checks.[1]

In two states of the Seventh Federal Reserve District, as of February, 1962, 99.4 per cent of the Illinois banks

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[1]Fleming, op. cit., p. 83.

had begun preprinting their transit number-routing symbol on their checks and 57.7 per cent of the items entering the Federal Reserve Bank of Chicago were preprinted in the approved manner. In the state of Michigan the figures were 98.3 per cent for banks preprinting and 62.9 per cent for items preprinted.[1]

Complete cooperation between all banks, par and nonpar,[2] will have to be achieved before maximum results can be realized. In some respects progress has been phenomenal, but complete mechanization will not be achieved without adjustments being made. It will take much longer for the entire system to become fully operative. Some bankers estimate that it will take at least eighteen months to two years before their "pipelines" can become full enough to make the system operative. In this regard the American Bankers Association, through its publication issued in April, 1959, has said:

The Common Machine Language concept for checks will,

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[1]From information received in a personal letter from Harry S. Schultz, Vice President, Federal Reserve Bank of Chicago, March 30, 1962.

[2]Par banks make settlement for checks sent to them for the full face amount of each check. Nonpar banks levy an exchange charge and deduct it from the face amount. Items from which the charge is deducted are termed nonpar items and the banks on which they are drawn are termed nonpar banks or nonpar points. (The Federal Reserve System requires all checks handled through its facilities to be settled at par. Hence, deposit volume of nonpar banks is a small percentage of the total.)

> undoubtedly, have a profound and beneficial effect on the banking industry of the country. This is not going to happen overnight, and it may be some time before this evolutionary change is fully effective. The potential is here now, however, and it is up to the individual banks all over the country as to how soon this potential will be realized. Banks are not expected to, nor should they, move into this magnetic ink program without full consideration of all factors involved. They should, however, consider not only the benefits that they themselves will obtain, but also the benefits provided the whole check collection system. The industry, to some extent, is unique in that close cooperation between individual competitive units is essential to its proper functioning. Banks have an opportunity now to demonstrate this cooperation in the endeavor to mechanize the check collection system.[1]

Many banks have taken steps to further the check mechanization effort as is indicated by the figures from the Federal Reserve Bank surveys presented earlier. However, even though all bankers agree that check automation will require the combined efforts of all banks, they do not all agree as to the benefits to be derived for their own particular bank. For example, Denton A. Fuller, an official of a relatively small New York bank has said:

> I think full automation is in the cards for the smaller banks only over a long period of time. Automation must be a gradual process, perhaps starting with an electronic bookkeeping machine.
>
> Banks should get down to business, learn their own requirements and make their decisions on the basis of their own needs, not on the pitch of some salesman. . . . This is important, because I think in the case of a bank like ours and smaller banks it will be quite a few years before we are involved in character sensing checks.[2]

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[1]American Bankers Association, Bank Management Publication No. 147, op. cit., pp. 19-20.

[2]Quoted by Keller in "Major Breakthrough," op. cit., p. 11.

Regardless of the many difficulties that will be encountered before a completely automated check collection system is realized, the many routine, repetitive check handling operations make such a system attractive to all. The question is not in the desirability, but in the feasibility of applying electronic machines to particular situations, especially those of the smaller banks. When fully implemented, the system should benefit the entire banking system, including those institutions which now find an installation for their own needs economically impractical. The following indicates how the system would work.

> If each check had the routing symbol of the bank on which it is drawn printed in magnetic ink, and if, in addition, the account number of the drawer and the dollar amount of the check were so encoded, then we would have a banker's dream. It would be possible for the sorter to separate the "on us" checks from the "foreign" ones. The sorter could further group the checks drawn on other banks and even provide a listing of the amount of each of the checks, thus automatically preparing the "cash letter." The checks drawn on the bank itself could then be passed through the sorter and read directly into the computer. The computer could post them to the depositors' accounts, which would be kept in the form of magnetic tape or disc file.[1]

Magnetic ink printing is now an accepted and successful method of preprinting the required numbers and characters on checks. As additional banks adopt preprinting, and as existing customer checks are replaced

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[1]W. M. Davis, "Banking's Paper Curtain," <u>Monthly Review</u>, Federal Reserve Bank of Atlanta (March, 1961), p. 2.

with those that have been preprinted with magnetic ink, the check "pipeline" will fill and bank check processing routines will more nearly approach the ideal. That MICR is officially recognized is manifest by the patent granted on September 12, 1961. This patent was issued in connection with the 125th anniversary of the Patent Department and was the 3,000,000th to be granted.[1] Thus MICR, the first common machine language that is both eye-readable and machine-readable, becomes another of the milestones of banking advancement and accomplishment. The American Bankers Association regards it as one of the most important events in the history of bank operations.[2]

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[1]Schneider, op. cit., p. 20.

[2]American Bankers Association, Bank Management Publication No. 147, op. cit., p. 5.

CHAPTER V

DATA PROCESSING EQUIPMENT CURRENTLY USED[1]

In the banking industry, the application of high speed machinery to absorb and process paper work has been unique from that of other industries. First, there was a banding together of bankers, printers, and manufacturers expressly for the purpose of developing a common machine language compatible with both men and machines. Second, with the finalization of MICR, new concepts of check handling not only became possible, but rapid developments were made in applying these concepts to the particular needs of individual banks.

The industry has made notable progress. In 1956, a publication entitled "Electronics and Banks," appeared wherein it was stated that, for maximum utilization and efficiency of computer systems, bankers must recognize the following:

1. A need for special purpose equipment.

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[1]A major source of the information in the first part of this chapter is drawn from "How Banking Tames Its Paper Tiger," in the May, June, and July, 1960 issues of <u>Business Review</u>, a monthly publication of the Federal Reserve Bank of Philadelphia.

2. A need for depositor account coding.
3. A need for re-examination of traditional bank practices,
   a) As to statements--format alterations such as cyclical billing, "bobtailed" statements, etc., and
   b) Dependence on work of other banks--to eliminate re-checking of all work received from other banks when it is processed electronically.
4. A need for industry compatibility as to code characteristics in so far as code structure, location on the document, and code substance are concerned.[1]

Interestingly enough, each of these recognitions of need has materialized--with the possible exception of reliance upon the electronically processed work of other banks. Eventually, when all legal complications have been clarified, it appears that even this exception will be resolved satisfactorily.

Item 1, the development of special purpose equipment requires a rather complete examination and will be discussed later. Item 2, depositor account coding, was made necessary by computer system processing. A 'tronic system is also more efficient with the use of checking account numbers, even though Sensi-tronic and Post-tronic equipment can be operated without them. Item 3-a, cycle billing and the use of statements omitting detailed charge and credit information is now a practice of some banking firms. Item 4 became a reality when the MICR program was finalized. With this finalization, document preparation for machine handling was accelerated greatly. Machine

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[1]"Electronics and Banks," op. cit., pp. 13-15.

progress had continued also, and ready for the newly encoded documents were sorter-reader-converters and other computer peripheral equipment. Before discussing machinery of a computer system, however, other data processing equipment now being used by banking firms will be discussed briefly.

Conventional Bookkeeping Machines

Although banking has not usually been recognized as a highly mechanized industry, banks have long employed a wide variety of small essential machines. Discussed earlier was the development of one of the most important of these, the adding machine. From the adding machine, and partly from the typewriter, a new machine evolved; it is commonly known as the conventional bookkeeping machine. These machines are designed for ledger card insertion. The operator can then enter the date, symbols, and amounts on an individual's ledger card, thus maintaining a summary of all transactions and a running balance. Some models may even have full typewriter keyboards, making possible a complete description of the entry. The machine operator inserts the card in the machine, picks up the old balance, deducts checks, adds deposits, and the machine computes and prints a new balance.

The conventional bookkeeping machine is probably the most widely used major piece of equipment found in the banking industry today. It is used for nearly every banking job and by a vast majority of all banks. For most banks it has been one of the first record-keeping machines to be installed, and for many smaller banks, the only one. (See Figure 4.)

Figure 4 also reflects the almost universal use of the conventional bookkeeping machine, and even though the figures shown are for the Third Federal Reserve District only, it is a valid assumption that national figures would be little different.

Figure 5 shows the different size banks, by deposits, and the utilization of various types of equipment for handling the various documents associated with the bank services offered. An interesting observation from this chart is the heavy reliance on the conventional machines by the smaller banks. As the banks increase in size, other types of equipment are used more widely in processing the heavier work load. Also as indicated by Figure 5, conventionals are most frequently used in demand deposit accounting. They also get heavy use on all other operations except perhaps special savings accounts and payrolls--where manual methods are common--and check proving and sorting where proof machines predominate.

Window Posting Machines

The window posting machine is used primarily in printing payment or savings account receipts. Where saving account

FIGURE 4

EQUIPMENT ON HAND

(THE PERCENTAGE OF BANKS IN EACH SIZE GROUP USING THE VARIOUS TYPES OF MACHINERY)

Type of Machinery	Deposit Size ($ millions)					
	Under 5	5-10	10-20	20-100	Over 100	All Banks
Conventional Bookkeeping Machines	100%	100%	97%	100%	100%	99%
Window Posting Machines	23	47	56	75	38	41
Proof Machines	34	77	95	100	100	64
Electronic Bookkeeping Machines ('Tronics)	5	20	39	69	85	23
Punched-Card Tabulating	---	---	---	8	92	4
Electronic Computer	---	---	---	---	15	0.5

Source: Federal Reserve Bank of Philadelphia, "How Banking Tames Its Paper Tiger," Part II, Business Review (June, 1960), p. 19.

passbooks are used, these machines can post the transaction entry in the passbook and on the bank's ledger card simultaneously. Since these machines are operated at the teller's

FIGURE 5

HOW EACH OPERATION IS HANDLED

(THE PERCENTAGE OF ALL BANKS USING THE VARIOUS TYPES OF MACHINERY AND COMBINATIONS THEREOF)

Operation and Type of Machinery	Deposit Size ($ millions)					
	Under 5	5-10	10-20	20-100	Over 100	All Banks
Special Checking Accounts						
Conventional Bookkeeping Machines	90%	78%	46%	38%	17%	71%
Electronic Bookkeeping Machines (Tronics)	9	17	51	53	50	24
Combination--Conventionals & Tronics	---	2	3	8	---	2
Punched-Card Installations	---	---	---	2	25	1
Electronic Computer	---	---	---	---	8	0.3
No Major Machinery	2	2	---	---	---	1
Regular Checking Accounts						
Conventionals	95%	80%	64%	35%	31%	78%
Tronics	5	18	36	48	39	19
Combination--Conventionals & Tronics	---	2	---	17	23	3
Combination--Punched-Card & Tronics	---	---	---	---	8	0.2
No Major Machinery	---	1	---	---	---	0.2
Regular Savings Accounts						
Conventionals	55%	54%	42%	25%	15%	48%
Window Posting	16	33	38	52	39	28
Combination-Conventionals & Window Posting	4	8	16	19	---	9

FIGURE 5--Continued

Operation and Type of Machinery	Deposit Size ($ millions)					
	Under 5	5-10	10-20	20-100	Over 100	All Banks
Tronics	0.5	---	---	---	---	0.2
Punched-Card	---	---	---	4	39	2
Combination--Punched-Card & Window Post'g	---	---	---	---	8	0.2
No Major Machinery	25	6	5	---	---	13
Special Savings (Xmas Club, etc.)						
Conventionals	4%	8%	6%	---	---	5%
Window Posting	7	17	17	23	---	13
Comb.--Conventionals & Window Post'g	2	---	3	2	---	2
Punched-Card	---	---	---	6	69	3
No Major Machinery	88	76	73	69	31	78
Consumer Installment Credit						
Conventionals	34%	43%	63%	69%	23%	45%
Window Posting	16	25	17	15	---	18
Comb.--Conventionals & Window Posting	6	7	3	2	---	5
Punched-Card	---	---	---	4	46	4
Comb.--Conventionals & Punched-Card	---	---	---	---	15	0.3
No Major Machinery	44	25	18	10	8	29
Revolving Check Credit						
Conventionals	---	60%	56%	73%	27%	53%
Tronics	---	---	---	---	9	3
Window Posting	---	20	22	---	---	8
Punched-Card	---	---	---	18	55	22
Computer	---	---	---	---	9	3
No Major Machinery	---	20	22	9	---	11
Business & Agr. Loans						
Conventionals	45%	56%	79%	88%	77%	58%
Tronics	---	---	---	---	8	0.2
Window Posting	2	3	5	4	---	3
Comb.--Conventionals & Window Posting	0.5	---	---	---	---	0.2

FIGURE 5--Continued

Operation and Type of Machinery	Deposit Size ($ millions)					
	Under 5	5-10	10-20	20-100	Over 100	All Banks
Punched-Card	---	---	---	---	15	0.5
No Major Machinery	53	42	16	8	---	38
Mortgages						
Conventionals	32%	46%	66%	71%	69%	46%
Window Posting	14	16	14	10	---	14
Comb.--Conventionals & Window Posting	7	5	5	2	---	5
Punched-Card	---	---	---	4	31	1
No Major Machinery	47	33	16	13	---	33
Personal Trust Accounts						
Conventionals	16%	39%	69%	94%	39%	55%
Punched-Card	---	---	---	2	62	5
No Major Machinery	84	61	31	4	---	41
Corporate Trust Accounts						
Conventionals	5%	34%	53%	79%	31%	47%
Punched-Card	---	---	---	3	54	6
Comb.--Conventionals & Punched-Card	---	---	---	---	15	1
No Major Machinery	95	66	48	18	---	46
Payroll						
Conventionals	8%	12%	17%	42%	39%	15%
Punched-Card	---	---	---	4	62	2
No Major Machinery	92	89	83	54	---	83
Proof and Transit						
Conventionals	5%	4%	2%	---	---	4%
Proof Machines	34	74	88	100	100	62
Comb.--Conventionals & Proof	---	2	8	---	---	2
No Major Machinery	61	20	3	---	---	32

(Percentages do not add to 100% because of rounding.)

Source: Federal Reserve Bank of Philadelphia, "How Banking Tames Its Paper Tiger," Part II, Business Review (June, 1960), pp. 29-31.

window, both records are updated very quickly and without multiple handling.

On-line teller and window posting machines, used most effectively for savings accounts, are connected to the centralized electronic data processing system by either telephone-channel or telegraph-line communication equipment. When the telephone system is used, as each message is transmitted, modem (modulator and/or demodulator) changes the signal to a voice communication code for high speed transmission to the computer. From point of sending to point of receiving, each message is controlled by a series of parity checks.

The printing format on the journal tape (and pass-book) is under computer control, or can be controlled within the window machine and/or the computer, with varying degrees of printing flexibility. Where economy is to be emphasized, format control will be within the computer. If flexibility is of major concern, control will probably be in both devices.

For operating efficiency each window machine is buffered for transmitting information to the communication system and receiving information back, slowing it down to the speed of the slower printer and holding it in storage until it is printed out. After account updating the final total arrived at by the computer should be equal to the total in the tellers' window machines, thus providing proof figures for the tellers.

Proof Machines

Proof machines are used extensively by all but the smaller banks. For the larger banks their use has been almost a necessity. This is only natural, as proof of deposits is the basis for all deposit accounting, and where volume is encountered, these machines can aid materially in the proving and sorting operations. With the advent of MICR, however, new high speed sorter-readers were introduced that are capable of sorting previously encoded documents in but a fraction of the time needed for proof machines. Eventually this may outmode the currently used equipment. Still, with the new proof machines, magnetic ink encoding can be accomplished simultaneously with the other operations normally performed. Thus, where checks are entering the first bank since being written, and where they are to be later processed electronically, the transaction code and amount can be encoded by the proof machine. Furthermore, each check will be stamped with the bank's endorsement, and will be sorted into one of thirty-two (may be less on some models) individual pockets. Each item entering a pocket will be recorded by a printing on two tapes, one for the individual pocket and one for accumulation of a grand total. Hence, the primary function of the proof department, that of setting up controls for all other workers in the bank, is greatly enhanced by the listing control measures which are provided by the proof machine simultaneously with that of encoding, endorsing, sorting and proving of deposits. The versatility of these machines will make them an indispensable part of banking equipment for some time to come. For the smaller banks they should be almost as essential as a bookkeeping machine. On the average, a competent operator will be able to process 5,600 items daily through this machine.

The Third District survey indicated that almost two-thirds of the banks had proof machines. The average bank had three; no bank in the smallest category had more than one, while one large bank had eighty-five. Compared to this figure, the New York Federal Reserve Bank employs approximately 250 of these machines. These proof machines, and those of the other Federal Reserve Banks, will probably be among the first to be replaced by the newer electronic sorter-readers.

Sorter-Reader-Converters

A basic unit of any high speed check processing system is the sorter-reader-converter. This machine reads and sorts magnetic ink coded checks, deposit slips, batch tickets, and other items at speeds of from 750 to 1600 per minute. (For conversion to tape, the IBM 1419 Magnetic Character Reader can read--but not sort--51-column cards such as postal money orders at approximately 1960 cards per minute.) Documents may be intermixed, of varying sizes and thicknesses, and some models may be loaded and unloaded while sorting continues. The document length does make a difference on the number of items processible, though, as each machine travels at a constant rate of speed. For example, a Burroughs sorter-reader moves paper documents at 400 inches per second. Still, an electronic sorter is up to thirty times faster than manual sorting by one person. Using conventional proof machines it would take over thirty-five clerks to do the same job as one sorter.

Each sorter has ten digital sort pockets--0 through 9--a reject pocket, and either one or two special pockets, depending upon the machine producer. During the sorting process information may be read directly into the computer (on-line), or onto magnetic tape for further processing (off-line). When operated on-line the sorter-reader is placed under control of the electronic computer console. The machine is then transferred from a digital sorter-reader, which reads one character at a time, to an input device which scans all magnetic data on the document and relays it for automatic data processing on demand from the computer console.

When operated off-line, the sorter-reader is placed under control of the machine's own control unit. One such system is the Burroughs B301 Magnetic Processing system which translates transaction data into machine language on tape. This system automatically proves, classifies, lists, accumulates and edits for purposes of item control. It will simultaneously print listings on master and detail tapes, selectively accumulate totals in electronic registers and record selected information on magnetic tape. This system combines a sorter-reader, multiple tape High-Speed Electrostatic Lister, Magnetic Tape Unit and Edit Control Unit. Similarly, each sorter-reader system utilizes special built-in characteristics to provide the speed, flexibility, accuracy and reliability needed for the processing of different bank documents.

On-Premise Encoding Equipment

The MICR check program has resulted in some banks acquiring a variety of new magnetic ink encoding equipment. This equipment is primarily needed by those institutions processing checks and other items with fully automatic or semi-automatic equipment. For example, some method of providing on-the-spot documents, complete with magnetic ink coded account numbers, for new customers and emergency orders was necessary. An on-premises imprinting machine could quickly provide properly prepared forms. For inscribing documents not pre-qualified or for inscribing substitute or carrier documents for those items which had been mutilated or did not meet size requirements, amount and account number printers were produced and made available. One economical device produced for this purpose is the IBM 1202 Utility Inscriber, a specially designed IBM Electric Typewriter with a 14-key keyboard. For those firms desiring to continue a separate proof operation, magnetic ink imprinting proof machines were made available. These machines are capable of imprinting amount and transaction codes while simultaneously providing control of proving, sorting, endorsing, listing, and float accumulation.

Electronic Bookkeeping Machines

One approach to more rapid processing of a bank's paper work is the utilization of semi-automatic equipment generally referred to as 'tronics. The term has reference to the electronically posting Post-Tronic of National Cash Register Company, and the Sensitronic Bank Bookkeeping Machine of Burroughs Corporation. Basically, 'tronics are designed to do the same job as the conventional bookkeeping machines, but to do it more automatically. Their operation might be summarized as follows:

The machine's automatic features are triggered by magnetic stripes that run lengthwise down the back of a customer's combined statement and ledger card. These stripes are a combination of ink and finely powdered iron and are magnetically charged to record the account balance, account number (three digits only), check count, alert signal and an alignment signal. This stored information can be read by the machine's electronic reading heads. When the operator places the card in the machine, the machine reads the information off the stripes, prints the pickup balance on the sheet, positions the card on the correct line and moves to the position for posting the first debit. As the operator indexes the amount of each entry she also enters the account number which appears in full only on the item being posted, and electronically, a comparison is made with the number on the card. If the number indexed does not agree with the number magnetically recorded on the reverse side of the ledger sheet the machine will not accept the entry. It then signals to the operator, by a light, that an error has been made. If the numbers match, the operator depresses a motor bar and the machine produces a new balance by either adding or subtracting the entry, magnetizes it on the stripes, and then ejects the form. The machine also prints a record on the front of the card in regular ink, thus providing an easily readable and visually verifiable customer's statement and ledger.

As the operation becomes more automatic, so does the operator. Therefore, one bank took the precaution against machine operators unconsciously indexing the account number from the card heading rather than from the posting medium by placing account numbers on the reverse side of the form.[1]

The electronic bookkeeping machines, specially designed to fit the particular requirements of demand deposit accounting,

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[1]Dale B. Bradley, "Electronic Accounting Plan for the Smaller Bank," Burroughs Clearing House (April, 1959), p. 97.

are currently not employed in as many basic banking operations as are the conventionals. Reference to Figure 5 indicates that 'tronics are used in only five of the thirteen basic banking operations shown. However, since they have been on the market for only about five years (three when the survey was made), this situation could change. In fact, bankers with an interest in 'tronics have in some instances bought conventionals, simply because the introduction of the newer machine has made available attractively priced used conventional machines.[1]

In a comparison of conventionals and 'tronics, the electronic machine has the advantage of speed and accuracy. As a result, they have found rather wide acceptance in banks throughout North America. In general, one 'tronic was intended to handle the same amount of work as two conventionals. This relationship is verified by the Third Federal District survey, where averaged figures showed that one 'tronic could handle about 2600 special checking accounts to 1200 for the conventional, or 2200 regular checking accounts to about 1,000. Using average daily items per machine, the figures on special accounts favored 'tronics by about 1300 items to 600; and on regular checking accounts, approximately 2200 items to an average of about 800 for the conventional machine. The survey cautioned about placing too much reliance on the above

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[1]"Paper Tiger," op. cit. (June, 1960), p. 20.

figures, however, for it was said:

> These figures should not be considered exact measures of machine efficiency. In the first place, the information is based in part on bankers' estimates. But more important, the figures have not been adjusted for differences in the way the machines are used. There seems to be at least two schools of thought on how to use bookkeeping machines (either tronics or conventionals) on demand deposits. In some banks the operator uses the machine only part of the time. It stands idle while she does ancillary jobs such as filing and sorting. In other banks, the operator runs the machine straight through the day and the allied jobs are done by special clerks.
>
> Differences in work methods and operating systems could have distorted the performance figures we cite above. Yet our sample is large and the differences could have canceled themselves out. We can't say for sure, so use the figures with discretion.[1]

Two additional advantages favoring 'tronics over conventionals are that 'tronics eliminate the need for dual posting or similar checking operations after the first posting of a transaction, and that they can automatically develop trial balances.

Referring once again to Figure 4 on page 103, in the banks over $100 million category, 85 per cent were using 'tronics. This indicates that there has been a swing to this method of bank data processing as the paper load has become greater and more speed has been demanded.

An electronic bookkeeping machine costs about $12,000, yet it seems logical that smaller banks will turn more and more to these machines for their bookkeeping operations. One reason favoring this is that a 'tronic requires only

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[1] _Ibid._, p. 20.

about half the space of a conventional. Another is the possibility of fewer personnel as a result of needing fewer machine operators. The Third District survey showed that ten banks in the under $5 million category have 'tronics. The survey also stated:

> The smallest bank owning a tronic has just over $3 million in deposits. A tronic is used in one bank that has only 1,000 demand deposit accounts. We contacted both these banks by telephone and they seemed satisfied with their machines.[1]

It would appear, therefore, that 'tronics are feasible for even the smaller banks, and that a measure of automation can be achieved by their use.

The semi-automatic 'tronic systems are being used by a number of banks as a means of upgrading and modernizing their data processing systems. The size of the banks able to utilize electronic bookkeeping machines vary widely. In Three Rivers, Michigan, a community of 8,000 people, the Peoples Community Bank has installed electronic bookkeeping machines. The president of this bank, Dale M. Bradley, lists three major policy decisions which influenced the use of 'tronics. First, speed of operation and the greatest efficiency possible from a small staff; second, the desire to establish an up-to-date system that would not be rendered obsolete by future developments in bank automation; and third, the reduction of cost. 'Tronics were considered adequate to handle account growth for several years without

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[1] Ibid., p. 20.

fear of obsolescence of equipment.[1]

While smaller banks were turning to 'tronics as a step toward automation, 'tronics have not been limited to only the smaller banks. In Richmond, Virginia, for instance, the State-Planters Bank of Commerce and Trusts, a bank with $200 million in deposits, installed 'tronics. This bank found 'tronics to have the following advantages: (1) The error rate is down; (2) the operators can be more careful since they have fewer things to think about; (3) check sorting and filing is faster and more accurate; (4) operators are trained more easily and quickly on the electronic equipment; and (5) the bank now has a fully itemized stub for reference purposes after statement mailing.

A number of disadvantages were also encountered. They are: (1) Machine errors are more difficult to spot because there is a tendency to overlook the possibility of error; (2) there are still human errors made because humans are still part of the system (and of any machine system); (3) forgeries are likely to slip by because the bookkeeper tends to look at the printed name and not signature on checks; and (4) when a machine breaks down, it is more difficult to absorb the load on the remaining equipment.[2]

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[1]Bradley, op. cit., pp. 42-43, 97-98.

[2]Horace H. Harrison, "A Semi-Automated System in a $200 Million Bank," Auditgram, XXXVII (December, 1961), pp. 10-12.

Punched-Card Systems

The basic concepts involved in the processing of information by punched cards are that: (1) data are systematically recorded in cards by punched holes, and (2) the data punched in the cards may be processed automatically by machines designed for that purpose. Systems based upon these concepts have been employed by banking firms for some time. Checks are widely used which comply with the stringent requirements of a processible card. That is, they are standardized original source documents containing punched information in such a manner that a "pre-instructed" machine, or series of machines, may process the information and produce the desired reports. Account number and transaction codes are prepunched into the card checks and deposit tickets. Amounts must be post-punched. Where paper checks are used, all pertinent data must be transferred to substitute punched cards before machine processing can take place. After the cards--either original or substitute--are punched with all necessary data, the actual posting of accounts become fully mechanized. All debits and credits can be sorted into account sequence rapidly and accurately by machine.

The machinery units comprising a punched card system may vary with the particular needs of the bank. The basic machines usually include:

1. A key punch--an electrically driven piece of

equipment which is used to translate information into a machine readable language by punching holes in the card forms.

2. A sorter--a machine which arranges the cards in the desired order for further processing and may also be used for selecting certain classes of cards and for merging different batches or decks of cards.

3. A punched-card accounting machine (also called a tabulating machine, tabulator, or simply, tab)--a machine which is controlled by a wired control panel, and is "programmed" to perform the arithmetical computations and then print out the desired reports.

Verifiers, collators, and card reproducing machines may also be utilized in performing certain specialized functions.

Tabulating systems are primarily used by the larger banks as it takes volume to make them pay. Yet, they are versatile in that they can be wired to do almost any bank bookkeeping job. According to the Philadelphia Federal Reserve Bank survey, these machines are most frequently applied to processing savings accounts, payroll, trust accounting and installment credit. They are used infrequently on regular demand deposits and business loans. The latter pertain to individual situations and are hard to automate. The one job that tab does not do is proof and transit. This means that proof machines must also be employed, or that it will still be necessary to list, sort and file checks by hand.

The introduction of punched card systems to banking was not made without misgivings on the part of some. Since the punched card becomes the principal medium through which men communicate with machines, new concepts of record keeping had to be initiated. Costs of conversion and of operation also induced apprehension and uneasiness. Nevertheless, except for the fact that tab systems are not readily and economically adaptable to smaller bank operations, punched card installations have proven popular and highly successful. However, as the mountains of paper work a bank is required to process have steadily grown, their lack of a sufficiently fast operating speed for such functions as posting has become a limiting factor.[1] Sorting activities, for purposes of clearing large batches of card checks, such as sorting by district and by bank, continue to prove satisfactory for volume card check operations.

Electronic Computer Systems

"The electronic computer is one of the most dynamic

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[1]Speeds are now being increased. An article in the Wall Street Journal of June 22, 1962, reported that UNIVAC division of Sperry Rand Corporation has introduced a punched-card accounting machine--the U 1004--"up to four times as fast" as conventional. Prices remain reasonable, ranging from $1150 to $1506 for monthly rental, and $46,000 to $60,000 for purchase.

banking services to the public." So remarked A. R. Zipf in his concluding statement before the Congressional Subcommittee on Economic Stabilization Hearings on Automation and Recent Trends, November 15, 1957.[1] At that time, the computer was somewhat of a novelty to bankers and was relatively untried as a data processor of bank documents. But the prospects looked very favorable and hopes were high. Many of the promises then visualized have materialized; many more await only a maturity of the MICR program and a more complete adherence to the American Bankers Association recommendations for encoding standardized checks.

Early Beginning

The entire electronic computer development history covers but a brief span of sixteen years. As recently as 1940, most computation was done on desk calculators. During World War II, the Army Ordnance Department, in urgent need of firing tables and solutions to certain types of ballistic problems, financed the development and construction of the

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[1]From page 15 of a reprint entitled "Automation in Banking Other Than Check Processing" furnished the writer by the Bank of America where Mr. Zipf is vice-president in charge of its Systems and Equipment Research Department. Additional information was also received which has been relied upon in writing this chapter. Among the items received was "ERMA Comes of Age," by Robert Forest, a reprint from Business Automation; "Working With ERMA," prepared by the Training and Development Department of the Bank of America; "Background Information on Bank of America's Use of Electronic Equipment," a mimeographed article produced by the bank, and a letter from the bank's Senior Analyst, C. P. Weber. Additional details

first electronic digital computer, the Electronic Numerical Integrator and Computer, or ENIAC. ENIAC was completed in 1946 at the University of Pennsylvania and was the first fully electronic computer utilizing no moving parts for storage and computing. Earlier, in 1944, the Automatic Sequence Controlled Calculator (Mark I) had been built, but it was slow, of limited storage capacity, and was as "big as a house." However, even though the General Electric Company had manufactured its first digital computer in 1920, the Mark I is considered the first of modern-day computers.

The machines that followed ENIAC in the next few years were also designed for engineering and mathematical applications. Soon consideration was given to the use of computers for performing clerical operations. Yet, it was five years after their introduction before one of the new machines was given a chance to solve a business data processing problem--one for the Bureau of Census. By processing accounting information rather than merely sequences of computation, the concept of file maintenance was originated. Almost overnight the potential areas of computer use were expanded.

By 1950 it was possible to insert into a computer both the problem data and instructions on how to solve it. By 1953, stored program computers were available commercially.

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of General Electric's part in the bank's computer development was received in a personal interview with Donald E. Rosner, sales representative for General Electric's computer department.

Thus, electronic data processing was a reality; machinery systems were installed and put into operation in business and industry. Interest grew rapidly in 1954, and has continued to accelerate since. The early 1950's witnessed phenomenally fast-moving progress in computer technology. Systems capacity and speed advanced at such a rapid rate that applications and methods were not capable of taking full advantage of expanding computer capabilities. During the late Fifties technology continued to advance. However, techniques in using computers accelerated and by 1959 the gap between use and potential was significantly narrowed. By December of 1961, some 6,000 computers of all types were in operation. Of these, about 15 per cent were used primarily for scientific and engineering purposes. Another 40 per cent were in use by the military, and the remaining 45 per cent were utilized by businesses in data processing systems.[1]

Banking's interest in electronic computers kept pace with that of business in general. However, as discussed in an earlier chapter, problems peculiar to the banking industry had to be solved before a computer system could become really effective. Consequently, bankers as a group were somewhat reluctant to pioneer in computer use. However, there were exceptions. For example, the Chase Manhattan Bank of New York City worked for several years with the Laboratory for Economics, Inc., of Boston, on the development

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[1]Editorial, Business Automation (December, 1961), p. 66.

of a large-scale computer called DIANA. Installation was scheduled for late 1956, but the project was abandoned prior to installation.[1] The Central-Pennsylvania National Bank of Philadelphia was encoding checks and deposit tickets with invisible fluorescent symbols in 1955. On the west coast, the Bank of America had pioneered the initial step when in 1949, it began intensive research into development of an automatic electronic bookkeeping machine.[2] This was two years before the first commercial data processing system was installed at the Census Bureau. Contacted in 1950, to assist in the development, Stanford Research Institute in Menlo Park, California, constructed a prototype electronic computer model. The Bank of America outlined the job it wanted done, and the Research Institute custom built a hand made model to do it.

Basically, the bank deemed it imperative that the qualifications of any new system meet five requirements. First, it would have to operate at a higher speed than

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[1]Cowperthwaite, op. cit., p. 544.

[2]It may be well to point out that one of the major reasons Bank of America was interested in electronic data processing was because of its widespread branch operations in California. Without centralization, bookkeeping operations, which entailed equipment, personnel and building space, were performed at each branch. With centralization, computer systems replaced the older, slower methods of data processing, thus making one machine system do the work previously done by many. Machinery duplications were eliminated, and the number of personnel operating the machines was reduced. In addition, by the construction of special computer centers, branch bank space was freed for increased customer service area, either for expansion of existing services, or for the addition of new services.

anything known at the time; second, it must be completely accurate; third, it should eliminate routine repetitive chores; fourth, it should be able to handle all sizes and quality of paper; and fifth, it must be economical to install and operate. With these criteria in mind, objectives were established.

The objectives were few and simple, but difficult to achieve. They were that an electronic system, to be feasible for bank operation would:

1. Automatically handle all the details of commercial deposit accounting,

2. Produce a statement in a form familiar to customers, and

3. Not require a change in the style of paper checks in common use.

The objectives ruled out punched-card checks. Furthermore, since the bank officials desired to capture information at the source and deal with it as few times as possible, some method of machine-reading information from checks was essential. The development of MICR made this possible.[1]

The development and construction of pilot equipment was divided into three phases: (1) the study of banking procedures involved; (2) general logical design of machine operation; and (3) development, construction and testing of the actual machines. In September, 1955, the operational

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[1]The Bank of America, as well as General Electric, IBM and others, played leading roles in helping to formulate and develop the MICR program.

prototype model was publicly demonstrated before representatives of the press, and later, to members of the banking profession.

After the initial success, twenty-nine equipment manufacturers were contacted, provided with details of research results, and requested to submit estimates of construction and service costs on thirty-six computer units for the use of the Bank of America. In 1956, a $48 million dollar contract for equipment and service was awarded to General Electric Company for the production of thirty digital computer units.

General Electric, after discarding the Stanford built prototype, developed a transistorized, solid-state computer which they called the GE 100. Subsequently, thirty of these computers were completed and installed for the Bank of America. Nicknamed ERMA (Electronic Recording Method of Accounting), these computers were special purpose machines designed specifically for this application. They were placed in operation during the latter part of 1958, the first of their kind in the world.

The ERMA units consisted of more than computers; each ERMA was a system of connected units consisting of (1) a sorter-reader, a document handler manufactured under subcontract by National Cash Register and Pitney-Bowes Corporation; (2) a computer; (3) a high speed printer; and (4) magnetic tape units. Each system is centrally located to serve many of the bank's branches, and is also operated in conjunction with the two principal computer installations at San Francisco and Los Angeles. Since May of 1961, thirteen ERMA centers in different locations throughout the state of California have been in operation. The data processing ability of an ERMA installation is indicated in the following quotation.

> Operation has shown that ERMA will read, sort and post 550 accounts per minute, or 33,000 per hour, reading branch number, account number, and amounts encoded on checks or deposit tickets in magnetic ink, and debiting or crediting amounts to account records on magnetic tape, which will feed complete daily activity data to a 900 line per minute printer that produces the "hard copy" ledger and customer statements either at month end, cycle date, or on demand of the operator at ERMA's console.[1]

ERMA centers are now processing 2,380,000 checking accounts and 2,750,000 savings accounts for 690 branches.

The Bank of America's first computer, an IBM 702, was installed in 1955. In 1957 it was joined by a similar installation in Los Angeles. Later, in 1961, these units were replaced by IBM 7070/1401 data processing systems which now operate in San Francisco and Los Angeles to service 300,000 Real Estate loans and 1,175,000 Timeplan loans for the 690 branches of the ERMA system.

In just a little over ten years, the Bank of America's pioneering efforts produced a network of data processing systems that have reduced operating costs by one-third and put the bank at least one full year ahead of all competition

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[1]"ERMA Closed Circuit TV Preview Preserved on Film," American Banker (September 22, 1959), p. 6.

in the use of electronic equipment for check handling operations. Concurrently, benefits were also accruing to the entire banking industry. Says Mr. Zipf:

> There's no question in my mind but that our entry into the field provided the impetus for cutting three to five years off the timetable otherwise established for commercial deposit accounting.[1]

Computer Data Processing

The objectives of data processing remain relatively the same regardless of the methods used in accomplishing the task. It is primarily a question of knowing what end results are desired, designing the system to furnish the right answers in the most efficient manner possible, and providing the men, machines and methods best able to meet the requirements. In this respect mechanization using electronic computers is basically the same as mechanization using punched card equipment, bookkeeping machines, or other mechanical equipment. There are some differences, however.

Perhaps the principal difference with computers is that people find it hard to visualize the fantastic speeds at which they operate, or their capacity to execute long operational sequences without error or human intervention (assuming proper programming). For example, it has been stated that a girl with a typewriter can make about 350 key strokes a minute, and that punched card machines can read

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[1]Forest, op. cit., p. 6.

between 16,000 and 18,000 characters per minute while the speed of a computer, reading from magnetic tape, can accept a million or more characters a minute.[1] "The largest in commercial use can make a couple of million additions or subtractions in a second."[2]

A second point of difference is the necessity of mapping out at great length and in minute detail the processing steps to be followed, and then instructing the machine to execute these steps. This process, known as programming, is an integral part of a computer system. It must be correct, and it must be adequate, making provision for the handling of exceptions, even if only by reporting that they exist. However, programming involves more than just an analysis of the data processing routine. It also involves communication; it eliminates the "language" barrier between men and machines. It is through this medium that the machinery receives its instructions; and it is through this medium also that machinery results may be reduced to understandable, meaningful reports for the use of people. Furthermore, when a program is reduced to documentation and processing flow charts, other goals are met. For instance, a comprehensive picture of the work being done is made available to the various levels of management and others

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[1]Peter Arnstein, "The Challenge: Auditing Automation," Auditgram, XXXIV (February, 1959), p. 27.

[2]Scott R. Schmedel, "Decision Testers," Wall Street Journal (Midwest Edition), May 18, 1962.

who are not highly trained in computer technology.

A third major point of difference is in the high cost of failure. A computer installation is not only costly in terms of rental and purchase prices, but it requires a great deal of effort and time--usually measured in man years--to determine the economic justification for a computer system.

Still another point of difference is the fact that computer determination surveys must encompass all aspects of an organization's data processing with evaluation and installation the responsibility of general management.

The discreet banker views these unique computer characteristics--fantastic speed, exact programming, and general management assistance--in terms of what such attributes can mean to his particular bank. In this respect he visualizes a system capable of tremendous efficiency, but one that requires the use of numbered accounts, MICR checks, and expensive equipment.

Numbered Accounts. Account numbering is gaining favor among many of the nation's banks, regardless of their size, and in some cases, without thought of full automation with an electronic computer. Reason for this trend is two-fold. First, a bookkeeping development, known as Pre-Audit, employs an account numbering system which allows use of a single post system and conventional bookkeeping machines. The equipment utilized is either a Burroughs Sensimatic, a Monroe President, or a National Cash Register class 32 machine. The use of Pre-Audit provides a number of advantages to the user. Robert Perry has listed some of these as follows:

1. The equipment cost is very low.
2. Verification of old balances is provided.
3. Proof of posting of first item to the correct account is provided--as well as all credits if desired.
4. The two preceding advantages provide protection allowing a true single posting operation just as in automation. Pre-Audit can, therefore, operate at speeds in excess of any standard bookkeeping method (although slower than 'tronics).
5. It has proven accuracy to a greater degree than any other system.
6. It uses peripheral operations identical to 'tronic systems and, therefore, allows the banker to gain a new perspective without heavy capital costs.
7. The change from Pre-Audit to 'tronics is so simple that a cost comparison can easily be made in order to justify the move.[1]

Mr. Perry goes on to state that ". . . a banker moving to Pre-Audit has everything to gain and nothing to lose. He is upgrading his system without great capital costs."[2] Thus, one step toward automation is being realized by adopting this improved system of bookkeeping, a system that utilizes an accounting number plan.

The second aspect of the trend to numbered accounts for banks stems from the fact that account numbering systems are a necessity for fully automated data processing

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[1]Robert B. Perry, "Pre-Audit Bookkeeping--A Step Towards [sic] Automation" (unpublished thesis, The Stonier Graduate School of Banking, conducted by The American Bankers Association at Rutgers - The State University, June, 1961), p. 111.

[2]*Ibid*.

systems and enhance greatly the semi-automatic 'tronic systems. Quoting Mr. Perry again, ". . . the expense in time and money required for a change to numbers is inevitable in any eventuality."[1] This statement seems to point up the fact that banking has already progressed far along the road to some form of automatic or semi-automatic data processing system. It seems reasonable to assume, therefore, that competitive factors, technological improvements and cooperative data processing efforts by smaller banks will even accelerate the trend. Consequently, it would seem that any objection to numbered accounts would soon be overcome by either a desire for improvements in existing bookkeeping systems or by adoption of more sophisticated systems requiring account numbers.

MICR Checks. The use of MICR encoded checks is viewed by the majority of bankers as a requirement of modern-day banking, regardless of computer considerations for their own particular banks. This does not mean that post-encoding equipment is a must, or that magnetic processing of checks is a requirement for every bank. But it does mean that check encoding is viewed as a pre-requisite to fast and efficient check handling by the banking system as a whole. There is good reason for this viewpoint. Although not now enforced, the Federal Reserve System's Regulation J has been amended to allow refusal of items

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[1] Ibid., p. 111.

not MICR encoded. Eventually, as equipment becomes available and placed into operation, compliance with this regulation will become mandatory for all checks clearing through a Federal Reserve Bank.

To date, progress in the direction of fully mechanized processing equipment for the different Federal Reserve Banks has been rapid. Throughout the nation there are thirty-six banks and offices of the Federal Reserve System. Initially, five banks were chosen from this group as pilot banks for purposes of initiating MICR high speed check sorting and handling. Five different makes of equipment were used in these installations. New York installed a Ferranti-Packard Limited system (this system utilizes some equipment of the National Cash Register Company and Pitney-Bowes as well as a Potter sorter); Boston, a National Cash Register built system; Philadelphia, an IBM installation; San Francisco, a National Data Processing Corporation product; while Chicago installed Burroughs Corporation machines.

The Chicago bank commenced use of its high speed equipment on January 24, 1961. At that time about 8 per cent of the items were pre-printed. On October 31, 1961, the bank was processing an average of 100,000 items a day on high speed equipment out of a total of approximately 1,800,000 checks. On this date approximately 50 per cent of the items were being pre-printed. As of February, 1962, approximately 175,000 items were being electronically processed each day with about 60 per cent of the items received already pre-printed. Further improvements and additional electronic processing are anticipated, as the Chicago bank has now entered into a contract with the Burroughs Corporation for a second generation of its electronic machinery.

On March 14, 1962, it was reported through the Detroit Free Press that the Detroit branch of the Federal Reserve Bank of Chicago had installed electronic equipment produced by IBM that would process up to 57,000 check items an hour, thus making possible the handling of a portion of that branch's huge volume of checks.

In the United States there is a daily volume of approximately 12 million checks. Cooperation among all banks is needed in making possible electronic handling of this vast number of items. In a recent survey, the 396 banks in the Lower Peninsula of Michigan were participating 100 per cent in swinging the nation over to use of magnetic ink coding. Among the nation's 15,709 banks the percentage was 97.1. Both percentages indicate the almost complete acceptance of MICR checks for the future. However, because of the stock of checks printed in regular ink already in the hands of bank customers, only about 63 per cent of checks received by banks are presently pre-printed[1] with magnetic ink coding.

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[1] "Banks Swinging to Magnetic Coding," Detroit Free Press, March 7, 1962.

Expensive Equipment. With bank progress eventually requiring numbered accounts and MICR checks, these computer characteristics are no longer deterrents to a bank's use of a computer system. These two steps toward a high speed check processing system have become, or will become, common practice. But, there still remains a tremendous obstacle for a large number of the country's banks--that occasioned by the cost of equipment.

Bank automation can be classified into two basic systems: the fully automated computer system and the semi-automatic 'tronic system. By adding auxiliary units of equipment to the basic 'tronics, automation can be increased for these semi-automatic systems.

The 'tronics are essentially only excellent refinements of earlier machines produced by the same manufacturers. The Burroughs Sensitronic, costing around $11,855 plus taxes,[1] is an improved version of the conventional Sensimatic. The National Cash Register Post-Tronic, at a cost of $12,900 plus taxes, represents a betterment of the NCR 2000. Each of these machines uses a visible record ledger sheet, even though a partial magnetic memory is retained on the reverse side of the sheets used with 'tronics. However, it is through the development of this magnetic storage area and the utilization of peripheral equipment that technological advances of the 'tronic systems have been realized.

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[1]The prices quoted in this section are taken from Perry, op. cit., pp. 29-35.

Burroughs has developed an "Automatic Reader" which, when operated in conjunction with the basic Sensitronic, will read automatically the balances from an entire load of ledgers placed in it and will transfer the information to the Sensitronic where a listing of accounts is printed. While trial balances are being run at the rate of 3,000 per hour, the operator is freed for other duties.

The Automatic Reader unit can also be used for transferring balances at a speed of about 800 per hour. This function requires the presence of an operator. The machine is priced at $4,155 plus taxes.

National Cash Register Company has also developed an automatic feeder to speed up the trial balance and balance transferring functions. Used in conjunction with a late model Post-Tronic, the speed of operation is 1,300 accounts per hour for listing trial balances, and approximately 550 per hour for balance transfers. The cost of this feeder is $3,445 plus taxes.

With both a Post-Tronic and an automatic feeder the handling of ledger sheets during a posting operation can be eliminated by incorporating into the system an adding machine tape recorder, priced at about $2,500, and an automatic tape reader, costing $9,685 (plus taxes in each case). Thus, the four pieces of equipment, including federal taxes, would add up to approximately $30,225.

If further automation is to be efficiently achieved with either 'tronic system, a sorter-reader is required. Representative machines available are those produced by Burroughs, at $63,000; NCR, at $62,000; and IBM, at $83,100. Moreover, since these automatic sorters require the use of MICR checks (not required by 'tronic systems without sorters), additional equipment will also be needed. This would include MICR post printers and converters.

It is evident from the foregoing that even a sophisticated 'tronic system can become an expensive machinery operation. For this reason, many of the smaller banks do not utilize the sorter-readers nor some of the other equipment mentioned.

The fully automated bank data processing system consists of the electronic computer and a series of peripheral equipment. Each machine of the system represents either an annual rental cost or a capital outlay for equipment purchase. However, to attach a significant and meaningful figure to a computer installation is difficult, as each system is designed specifically for a particular situation. In fact, the machines used may not all be produced by a single manufacturer, but may be composed of a number of machines from just as many manufacturers. Furthermore, each installation may have an entirely different space requirement because of the availability or lack of facilities for computer housing. Another factor of cost which can also vary is that of the cost of conversion. The existing system may have a particular piece of equipment which may be utilized in conjunction with a computer system while another may not. Each of these factors, and perhaps others, will cause the price of a computer system to vary.

An indication of increasing costs and how the Bankers Trust Company has seen its data processing expenditures increase with the addition of mechanical equipment follows. About twenty-five years ago the data processing function was mechanized by the installation of a punch card installation. The annual rental cost in 1934 was $11,000. By 1945 the cost had risen to $33,000. From a single installation originally, the system had expanded to eight separate units by 1960 with an annual rental cost of $686,000. In March of 1961 an IBM 7070 data processor and IBM 1400 series equipment was to be installed which would increase annual rental costs by an additional $140,000 a year.[1] Not every bank will be so fortunate as to be able to move gradually into full automation as did this bank. Neither will all banks be able to afford the annual rental costs now payable by the Bankers Trust Company.

Perhaps one of the most illustrative cases of the cost of an EDP system for a bank is that of the ERMA installations of the Bank of America. Admittedly, not every bank would be faced with the same size of an operation as was the country's largest banking firm. However, some of the problems which this bank encountered would also have to be met

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[1]Morris A. Engelman, "Auditing Under Automation," <u>Auditgram</u>, XXXVII (March, 1961), p. 9.

by any bank making a switch to a fully automated computer system. The ERMA installations, located in thirteen centers throughout California, represent a ten-year development plan and an investment of $35 million. Moreover, the ". . . electronic equipment dictated in large measure both the design and construction of the $17 million dollar service center of the Bank of America in San Francisco."[1] And yet, astronomical as these figures are, the bank considers the program successful. The bank's officials were pleased that all the objectives and goals of the project were realized, with the profit objective exceeding their most favorable expectations. Mr. Beise, the bank's president stressed:

> We held one objective dominant; the aim to become and remain the lowest cost producer in the banking business while maintaining the highest standards of customer service.
>
> Low cost production is directly related to maximization of equipment and requires that equipment be concentrated in central areas, with considerable flexibility of use in an environment conducive to effective staff operations.[2]

Certainly not all bank EDP installations will require the huge sums of money expended by the Bank of America. Still, computer installations are expensive, and the number of banking firms capable of benefiting economically from a self-installed computer system comprise only about six per cent of the nation's banks. Equipment costs are still the

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[1]Kenneth R. MacDonald, "Bank of America's Great Data Processing Center in San Francisco," The Office, LIII (May, 1961), p. 122

[2]*Ibid*., p. 124.

greatest limiting factor.

The Machinery

The electronic computer is but one part of a highly mechanized system of machines that are collectively utilized to transform myriads of transaction data into meaningful reports and useful records. Each of the machines forming this equipment network has a special function, and each has been designed to work in harmony with other units in the system. This does not mean that they are necessarily connected "on-line," but that the work of each machine supplements and assists the computer in doing the job assigned to it.

Operations may proceed on-line, or off-line. On-line procedures are those where input-output devices are attached directly to the computer and are operating under its direct control. Those not so directed, or which are operated independently, are said to be off-line. Bank EDP systems are primarily of the latter type, although some tasks, such as savings bank operations, may be more successfully processed on-line.

A bank computer system usually includes five basic units of equipment: (1) the input unit, (2) console or control section, (3) storage or memory, (4) arithmetical and logical section, and (5) the output unit. Each of these equipment units performs a certain function in the total operation of the computer system.

As one system varies from another, so might the equipment comprising a basic unit vary, although the basic function remains the same. In some systems, for example, the input unit might be composed of a card reader, an input converter and magnetic tape units. The two machines make possible the transfer of transaction and stored data from punch cards to magnetic tapes. The tapes then become the input media for the computer.

Other systems may employ different approaches. Where a sorter-reader is used for document reading, the desired information can either be transmitted directly to the computer for immediate processing, or it may be transferred to magnetic tape for tape input to the computer. Still another system may utilize punch paper tape. This method does not allow the processing speeds of magnetic tape, however, and may be in turn, reconverted to magnetic tape, or discarded in favor of the faster methods.

The console is the control center for the computer system. Through it the operator can "communicate" with the machine and be apprised of what the machine is doing at all times. Every console unit has such things as control knobs, switches and signal lights.

As is the case with input media, records storage and output media may take different forms. With random access types of equipment--not largely used by banking firms because of high costs--large internal memory to store data eliminates the need for discharging results on external records.

Another feature is that input data can be introduced in random order without presorting or merging. With sequenced systems two streams of information, one from input and one from stored records, are introduced at the same time and are then matched and combined to provide a new "updated" record.

Where records are stored in punch card form, it is first necessary to convert these records into machine readable form, usually on magnetic tape, as mentioned earlier. In a like manner, updated information received from the computer in magnetic tape form must be re-converted to punch cards. As a result, an output unit in a computer system using punch cards may have both low speed and high speed equipment. High speed equipment would consist of a converter and printer. The converter would translate data recorded on magnetic output tapes and pass it on to the printer for report print outs. The low speed equipment would consist of a converter, printer and a card punch machine.

A Unique Computer Approach

In September, 1959, after five years of intensive research, Burroughs Corporation announced a new computer system which it had specifically designed for the data processing needs of banking institutions. The system, the B251 Visible Record Computer (VRC), retains the traditional visual records and is aimed at making electronic computer systems attractive to a larger number of banks, both from the standpoint of computer features and lower costs.

Traditional computer designs require punched cards, punched paper tape or magnetic tape for record storage purposes. With the new B251, storage is printed on regular "hard-copy" ledgers, statements and journals. This makes possible retention of such practical benefits as convenient access for teller referrals, customer inquiries, and management reviews.

For automatic processing, magnetic ink stripes on the reverse side of the ledger forms are magnetized to record the same information that is printed on the face of the record. The pair of stripes perform the same function as magnetic tapes used by other computers for input and storage of data, and have a capacity of seven computer "words" of information. The stripes also contain additional items such as account numbers, account activity, check and deposit counts and a number of computer commands. Thus, in addition to being eye readable, the form is also machine readable. Moreover, the B251 system includes a sorter-reader which is able to "read" numbers and symbols from MICR encoded documents and transmit this information directly to the computer unit.

The B251 is a complete data processing system. However, it is simple in its operation and requires only one person in attendance. Four major units of equipment are included in the system complex. A fifth, a card reader provided as another means of input, is available for selected data processing applications, and to process exception items. Outside the system, but needed to supplement it is an amount and account printer costing $3,000. An additional machine which may be required is a proof and distribution machine priced at $15,290. The four major units mentioned earlier include:

1. A high speed sorter-reader. This piece of equipment can be operated either off-line or on-line, will process intermixed items of varying sizes and thicknesses at rates up to 1560 per minute, and is completely buffered to provide data input for the B251 system.

2. A computer unit. Called the Data Processor, this machine performs all computations and decision-making functions at high speed. It is also the nerve center of the system directing the other units in their operations. The system is capable of performing 4,000 arithmetical functions a minute.

3. A record processor. This machine is an input-output unit with high speed forms-feeding and line-printing abilities. Ledger cards are transported at a top speed of 200 per minute. The wide-line printer--160 print positions--updates the ledgers and prepares other visual records (as directed) at a rate of 200 lines per minute. When a ledger card is filled, the machine files it and inserts a new card,

printing all permanent information and the account balance on it. To provide operating versatility, unit account records may be entered through three input stations.

4. A console. This is the operator control device, and it provides the means of communication between the system and the system's operator.

Also of interest to bankers is the relatively low cost of the B251 computer system. Burroughs has estimated that the system can be used to advantage by banks having a combined total of only 10,000 accounts, including checking and savings accounts, loans, and so on. In a fourteen-hour day, assuming a normal 40 per cent activity for accounts, the system is capable of handling 18,000 accounts. Purchase prices were quoted at $217,400 and monthly rental at $3,975. Thus, the economic feasibility of electronic automation for banking has been extended from approximately 6 per cent of the nation's banks to around 33 per cent. Part of the saving is attributed to the elimination of costly tape transports or readers required under the conventional computer approach. The daily detail is carried visibly on the records themselves. Also eliminated are large--and expensive--internal core memory units. The system utilizes new advanced memory core packets, each with a capacity for storing ten computer "words." This technique permits computer memory expansion as needed, saving the expense of buying core storage that will not be used. In addition, storage of individual account information on magnetic ledger stripes frees core memory from intermediate storage of data. Installation costs are also held to a minimum. The solid-state construction eliminates the necessity for specially-built rooms, air conditioning, and humidity controls.

CHAPTER VI

DATA PROCESSING SYSTEMS AT WORK

The various items of equipment discussed in the last chapter are those most commonly used by banks to assist them in their check handling and record-keeping programs. Not all that were mentioned will be used in every data processing system, nor will all be used by any one bank. This is readily apparent from the fact that some machines are but improved versions of others and are manufactured to do the same or a similar job. For example, the electronic bookkeeping machine is but a more sophisticated and improved version of the conventional bookkeeping machine. In a like manner, a number of machines may be linked together to handle more efficiently a larger volume of work for the large bank. Among these are the punch card systems, the B251 visible record computer system, and the complex of machines making up a more conventional computer data processing system.

In circumstances requiring more sophisticated systems, the check handling and data processing functions are assigned to a number of machines instead of just one particular machine such as the conventional bookkeeping machine. In addition, allied or preliminary phases of the entire data processing process may be included as a part of the function of a more complex system. Thus, a sorter-reader may be incorporated into a computer system to aid in the proof and sorting operations prior to the actual updating of the individual ledger accounts. In short, the data-processing machinery manufacturers have recognized the differing requirements of America's banks and have designed equipment to satisfy these requirements. Why do requirements differ? Simply because of differing bank sizes, service specialties, organizational structures--such as a large number of branches or a lack of branch banks--and management aims and aggressiveness.

To illustrate how machinery systems have been applied to the data processing needs of individual banking firms, a number of operating systems will be reported in this chapter. First will be a visible record computer system; second, a punch card input EDP system; third, an English banking firm's computer installation; and finally, a pioneer EDP installation made by a Michigan bank. The latter will be presented in greater detail than the previous three in order to illustrate the application of a more sophisticated EDP system to the data processing requirements common to most banks--the processing of information relative to checking accounts, savings accounts, installment loans and mortgage loans.

A Visible Record Computer Installation

On December 7, 1961, the First National Bank of Miami, Miami, Florida, began operating its new electronic data processing center. The center utilized a Burroughs B251 Visible Record Computer (VRC) system, the first of its kind to be placed in operation. On hand to view the new equipment's performance were representatives of the press and about 300 bankers from around the nation. The interest generated by this particular occasion was probably two-fold. First, the First National of Miami's EDP system was designed to handle the data processing needs of a bank without disrupting traditional accounting methods. This meant retention of the individual customer ledger records for visual inspection of transaction details. Moreover, this was the first computer designed to allow banks to retain and work with these documents--documents considered vital by some bankers. Second, computers previously available for bank data processing applications had been too costly for all except the nation's largest banking firms. With a comparatively lower price, production of the B251 VRC was aimed at providing an economically justifiable electronic computer system for the intermediate sized bank.

When a computer was first considered by First National, it based the various factors underlying any decision to be made on one basic tenet--that rising operating costs must be brought under control without sacrificing customer service.

Thus, because of more than 400 customer telephone inquiries daily, a customer ledger was considered one of the bank's most vital documents.

The bank instituted a study to determine the system best suited for its purposes. For its study, the multi-committee approach was not followed; instead, the responsibility was placed with the senior vice president and comptroller, Ray F. Basten. In making this decision the bank's president, Ralph W. Crum, declared:

> This centralization of authority for the pre-purchase studies and actual purchase decisions cut out a lot of the windmilling that goes on in such cases.[1]

Mr. Basten visited different computer installations throughout the country, always keeping in mind one basic requirement--retention of the ledger record. His studies finally led him to the conclusion that the B251 system would provide the records required by the bank and would handle the job requirements of the First National Bank satisfactorily.

The B251 VRC system uses MICR encoded documents. Therefore, about a year and a half before the computer was put into operation, MICR encoding of checks, deposit slips and other documents was started. By the time the installation was ready to go into operation, the check change-over was virtually completed. By the same time, more than 85 per cent of Florida's banks were also encoding in MICR. This would

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[1] First National Bank of Miami Trade Release of December 7, 1961, p. 1.

prove beneficial to the First National Bank because of its large group of correspondent banks. (The bank ranks 48th nationally as to its correspondent bank balances.) In December, 1961, it numbered 133 domestic and 88 foreign banks among its correspondents.

When the Florida bank installed its B251 VRC system it placed in operation a system which had been designed to meet the needs of the intermediate size bank. Yet, the First National Bank of Miami is not only Florida's largest, but also one of the country's busiest, indicating the flexibility of the system to meet the needs of banks of different sizes. This bank ranks 92nd in size in the nation with $375 million in assets. Because of expected additional growth and volume, the First National provided space in its new data processing center for an electronic accounting operation three times the size of the one installed. Moreover, the new computer system provided for several times the volume presently being handled by the bank. Or rather, it will when a second B251 and a Burroughs B270 for proof and transit are installed during 1962. With the addition of these units, the total complex will have cost about one million dollars.

Before the B251 computer system was placed in operation by the Miami bank, fifteen computer programs and routines were written, checked out, and stored, ready for instant use. The men assigned to this job were chosen from the bank's employees. Only one had any previous computer or data processing experience. Two were taken from the night proof department while the third had been in charge of the bookkeeping department. The programming team had the assistance of trained Burroughs representatives during this initial period.

Actual data processing started with the application of special checking accounts to the computer system. Personal and business checking accounts were to be added later. Eventually, all accounts in the demand deposit classification are to be placed on the computer. With the installation of the second B251 and the B270, cost accounting and savings accounts will also be processed with electronic equipment. It will also be capable of handling installment loans and mortgages. Thus, when in full operation, the bank believes that its new computer system will allow greater flexibility by providing an automation system for all its major financial accounting operations. Furthermore, the computer makes possible better operational controls, including a more strict, rapid control over uncollected funds. At the same time a highly detailed analysis of every account is provided in a fraction of the time formerly required. Consequently, the First National believes that the new equipment will allow the bank to hold the line on per item handling costs which had doubled in the previous ten years. The bank also hoped that the item cost could eventually be reduced. In commenting on this aspect, bank president Crum said, "After all, we are in the banking business, not the machinery business, and if we weren't sure that the move would pay off, we wouldn't have taken the step."[1]

How the System Operates

The Burroughs Visible Record Computer operation requires that documents to be computer processed be coded with magnetic ink characters. Before distributing checks and deposit slips to its customers, the bank would have the routing symbol, ABA transit number, and account number printed on them in magnetic ink. When the checks and deposit slips are returned to the bank they are encoded with the dollar amount and a transaction code. They are then sorted by the sorter-reader into appropriate account order. This requires two runs with the VRC and then a fine sort with the sorter being operated off-line. (See Figure 6 for general flow of daily work.) Next, during a sequence check and list post pass, the volume items are separated and totals accumulated for them. The items are then ready for posting. The documents are placed in the sorter-reader again so that it can read the data into the computer. In this operation the sorter is operated on-line and is under control of the computer. The appropriate customer records are placed in the record processor and the computer then processes the data received from the sorter and

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[1] *Ibid*., p. 4.

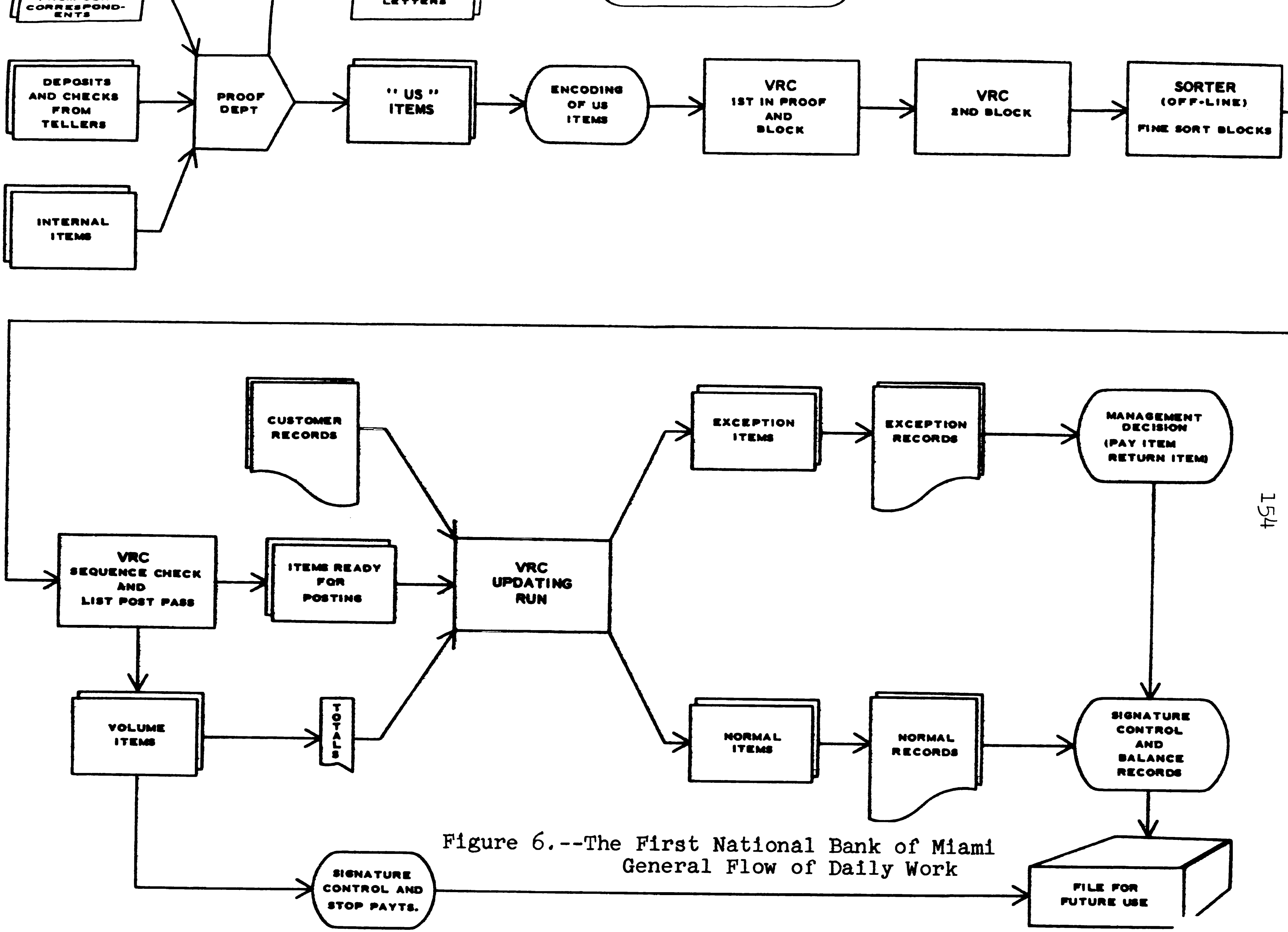

Figure 6.--The First National Bank of Miami General Flow of Daily Work

the account data extracted from the record processor. Under control of the computer, the processor automatically selects ledger cards by account number, reads the data stored in magnetic strips on the back of each card, updates both the magnetic storage area and the printed side and re-files the ledger card in proper sequence. Only the active accounts are updated.

A wide-line printer with 160 print positions is used to update the ledgers and prepare other visual records. It prints at the rate of 200 lines per minute. Printing format is controlled from a plugboard in the console. Instructions can be given the system to reject checks on which stop payment orders have been placed and refuse payment of checks if an account is overdrawn. When a ledger card is full, a blank one is drawn into the record processor automatically and all the permanent information as well as the new balance is transferred to the new card.

At the end of the month, the service charge for the month is computed automatically, entered on the account sheet and a final balance listed. The accounts are then run through the system to transfer the permanent information and the balance to new cards. (See Figure 7 for flow of statement preparation and account analysis.) The new cards are then filed for future use. The old statement record is then used to update the analysis history record and the new analysis history record is filed for future use. Paid checks and

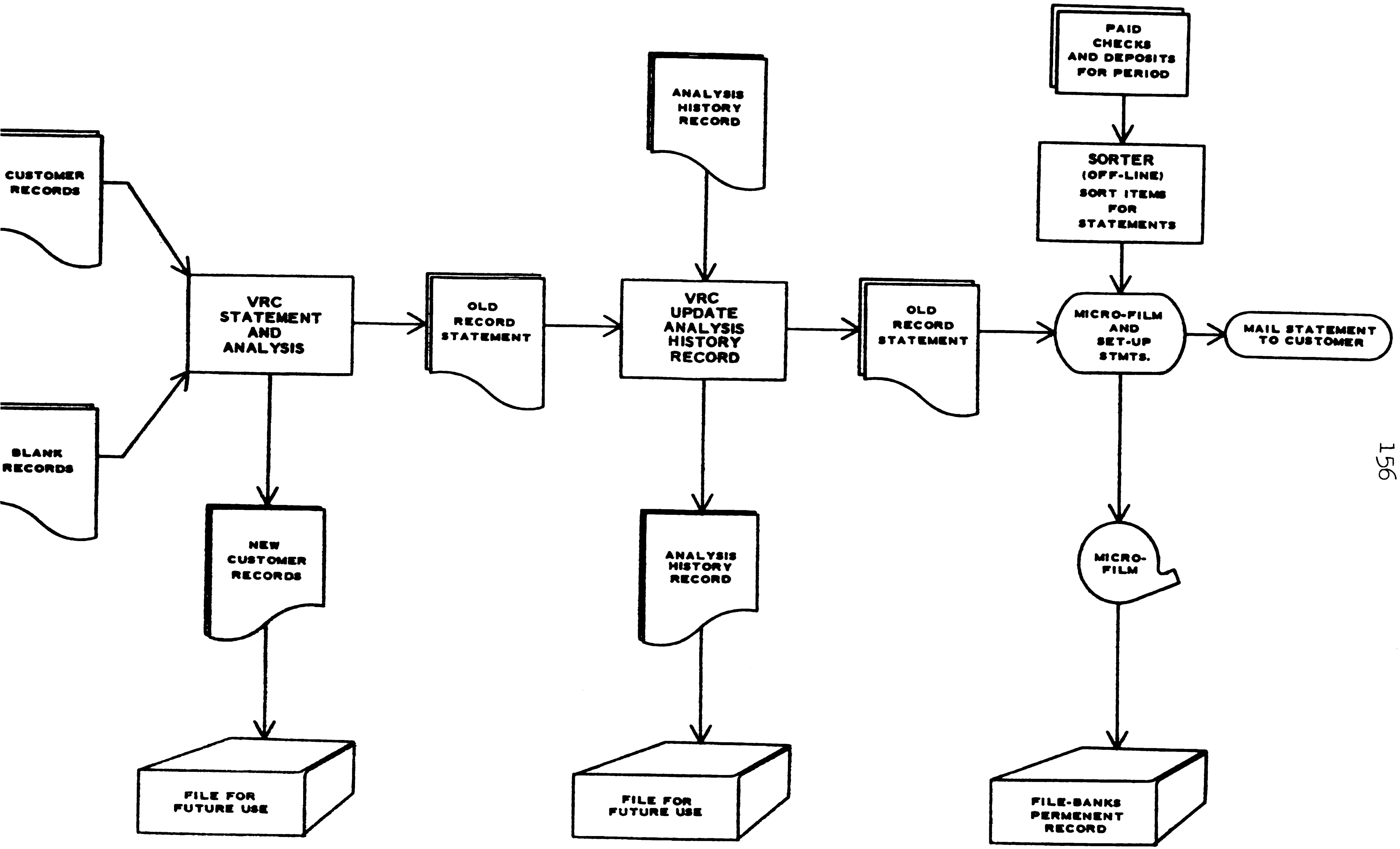

Figure 7.--The First National Bank of Miami .. Statement Preparation and Account Analysis

deposits for the period are sorted by the sorter-reader, operating off-line, for placement with the old record statement. After microfilming the items to provide a file for the bank's permanent record, the statement, the cancelled checks, and the deposit slips are mailed to the customer.

EDP With Punched Card Input[1]

The First National Bank of Boston has utilized mechanical equipment in processing certain phases of its paper work for many years. For example, the first punch card machine was installed in 1931. To replace the slower electro-mechanical equipment previously employed, the bank started its 175th year by installing what it has termed "the largest electronic data processing system in any bank in the world." An idea of its size may be gathered from the fact that seventy miles of coaxial cable runs in special "accessibility" channels under the platform on which the equipment is mounted.

The bank's system is a DATAmatic 1000, the product of DATAmatic Division of Minneapolis-Honeywell Regulator Company. This system employs either punched card or paper-tape form input and magnetic tape for its recording, storage, delivery and recovery of data. Each reel of tape is 2700 feet long and three inches wide, providing storage for over 37,000,000

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[1]Information in this section is drawn from "Data Processing Comes of Age at The First," a printed pamphlet issued by The First National Bank of Boston.

decimal digits of data. The bank has stated that this immense storage capacity is equivalent to a string of type-written figures over fifty-seven miles long.

The system's central processor is input and output buffered. This means that it is capable of simultaneously "reading" 60,000 decimal digits per second from one magnetic tape, "writing" information at the same speed on another tape, while processing yet a third set of data. In other words, reading, writing, and computing operations can be overlapped.

Prior to installing its DATAmatic, the Boston First National made an exhaustive study of its data processing requirements and all the factors involved. When the decision was finally reached to "go electronic," personnel were selected from the bank's staff and charged with the responsibility of putting the overall system into operation. In less than two years after ordering the new equipment the system was ready to start functioning. This time was spent in training and developing the required people for the new jobs; building, installing and testing the new equipment; and organizing and completing the programming function. The bank utilized its own staff for this latter process.

Most banks approach electronic data processing by converting but one phase of its operations to the new machinery at a time. At the First National a punch card type check was in use for about 30,000 special checking accounts. This provided a partially prepared means of input to the system, thus making selection of the first application a simple matter. Original plans called for Corporate Trust and Transfer operations to be the second application. This part of the bank's operations involved updating and maintaining ledgers for more than 765,000 individual accounts as well as preparing and issuing some 2,500,000 dividend checks yearly. The bank's other big-volume operations were scheduled next. These would include 60,000 loan accounts and the accounts of more than 78,000 underlying debtors in the Factoring operation. Later, Personal Trust and Payroll accounting would be added. Eventually, the plan called for all checks to be processed electronically, utilizing the input qualities of magnetic ink encoded documents. At the outset, however, punched cards and punched-paper tape were the data processing media containing the transaction data.

Briefly, the system, as originally applied to Special Checking accounts, was designed to operate somewhat as follows: (A schematic drawing of the equipment layout appears on page 160, Figure 8, while Figure 9 illustrates the processing sequence flow.) Previous to data entering the processing center, punched card checks, pre-punched with customer account numbers, had been issued to all special checking account customers. Upon return of the checks to the bank, additional punching of transaction codes and amounts took place. Next, the cards were sorted into account number sequence. In addition

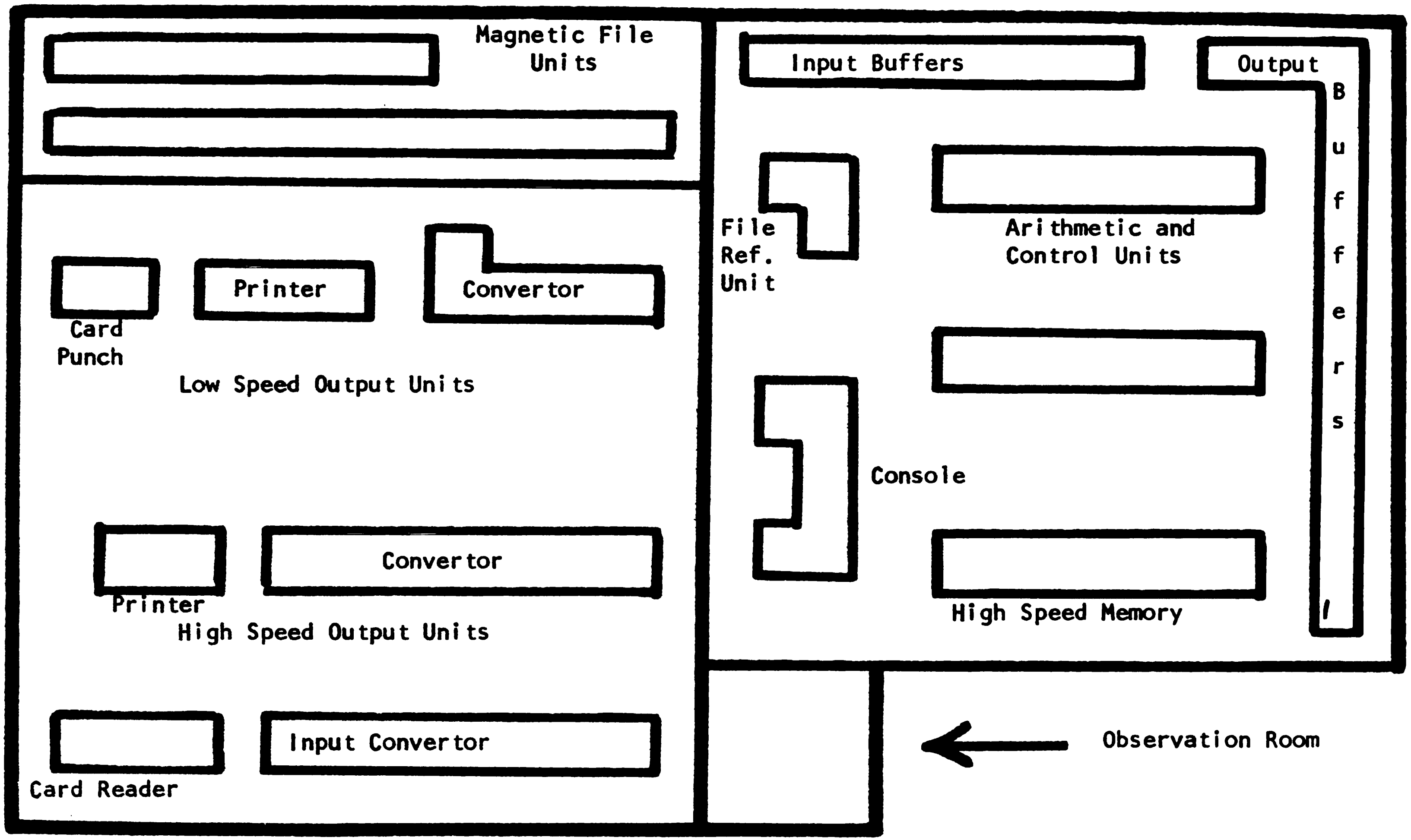

Figure 8. -- Data Processing Center -- The First National Bank of Boston. (A schematic drawing. Omitted from the above drawing are a few non-operational pieces of equipment.)

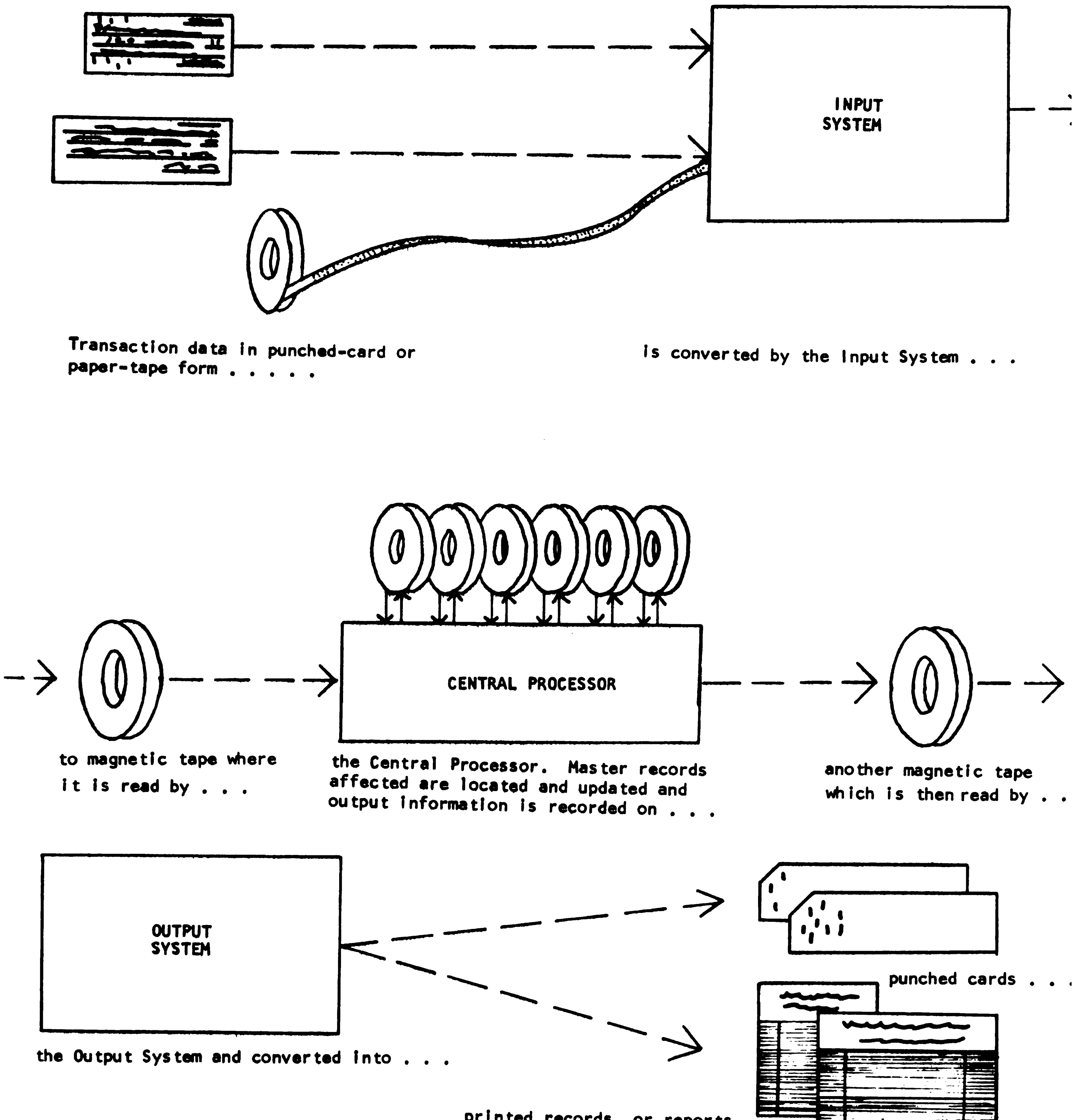

Figure 9. -- Processing Sequence Flow

to these operations, all checks had been previously processed through the receiving and proof departments of the bank.

The input system referred to consists of machines which can sense, or "read," the holes in the punched cards at the rate of 900 cards per minute. Electronically the data is then transmitted to the Converter, a machine which translates this information into machine language and "writes" it on magnetic tape. This is the input or "transaction"[1] tape.

The central processor includes the computer console. This is the control or nerve center of the system where the operators communicate with, monitor, and control all the units of the system.

The central processor also includes the input and output buffers, the arithmetic and control units and the high speed memory. The latter is a storage area consisting of a series of tiny magnetic cores where instructions and other data are stored temporarily during each processing cycle. The input buffers accept data fed from magnetic tapes and transfer it to the high speed memory. The output buffers return data from high speed memory to magnetic tapes. The

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[1]Kaufman, op. cit. "A transaction is the recorded information corresponding to an event. The meaning in electronic data processing is broader than the term 'accounting transaction.' It includes records for any type of information-producing situation, including those without accounting value in the strict sense, that is, without direct financial statement influence."

arithmetic and control units perform the actual calculations, making computations in accordance with programmed instructions.

Adjacent to the computer console is the file reference unit. This auxiliary equipment permits the operator to examine the magnetic tape files for specific information stored on them and extract it directly. This procedure allows the computer to be used for more important work. The magnetic tape files consist of the computer program and the "stored" master records which are updated in the processing procedure.

The output system consists of two different groups of equipment. The one, high speed output equipment, includes a printer and a converter. The converter translates and edits data recorded on output tapes and passes it to the printer. The printer then prints out the reports at the rate of 900 lines per minute.

The remaining output machinery consists of a low speed printer and converter. They operate in much the same manner as the high speed units, transferring data from output tapes to printed reports or to punch cards. The printer has an operating speed of 150 lines per minute and the card punch produces 100 cards per minute. The printer and the card punch may be actuated by the converter independently or both simultaneously.

An English Computer System[1]

In July, 1961, Barclays Bank, Limited, of England, opened its first computer center. It listed the following as contributing factors for the center's establishment: (1) an ever-increasing volume of work, (2) staff shortages, and (3) over-crowding of bank premises. These factors sound familiar, as they summarize similar reasons given by American banks for computer feasibility studies. Since the systems approach used by Barclays is a little different, though, it is presented here as another example of electronic data processing at work.

The computer center at Barclays is regarded solely as a data processing department for the twelve branch banks it serves. Its main function is to provide branch managers with rapid and accurate bookkeeping services. Therefore, the branch manager still has the responsibility of direct control of each account. As a result, all documents relating to a customer are retained by the branch and are not sent to the computer center. Instead, a data communication network links the branch banks to the computer center and transaction details are transmitted back-and-forth via this network. For data processing and record-keeping purposes the computer center maintains tape files of the bank's 40,000 current accounts

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[1]The information contained in this section is taken from "Centralized Book-keeping," Data Processing (London: Iliffe Production Publications Limited, January-March, 1962), pp. 48-55.

(demand deposit accounts) on magnetic tape.

Eventually, details of about 16,000 transactions will be transmitted daily from the twelve branches to the computer center. In turn, reports, customer statements, warnings of irregularities, lists of closing balances and items requiring special attention will be relayed back to the various branch banks. All transactions affecting the status of a customer's current account are also recorded in print in a daily list at the branch. This list is prepared with the accounting machine. In addition, a machine readable record is punched in paper tape.

Each branch of Barclays Bank utilizes National Cash Register 32/08 accounting machines to which a paper-tape punch is connected. The remainder of the equipment is manufactured in England and includes Creed 6S/6M tape readers, Creed 75 teleprinter reperforators, a Creed 3000 high-speed tape punch, and an EMIDEC 1100 electronic computer. The actual operation of the system is somewhat as follows: (A data processing sequence chart, Figure 10, illustrates the informational flow through the system.) At the branch banks, details of customer transactions are entered on an NCR 32/08 keyboard accounting machine from account numbered checks and credit slips. Connected to this machine is a paper-tape punch utilizing five-channel paper tape. For credits and debits plus and minus symbols are punched into the tape. Transactions are recorded in the paper tape in batches of

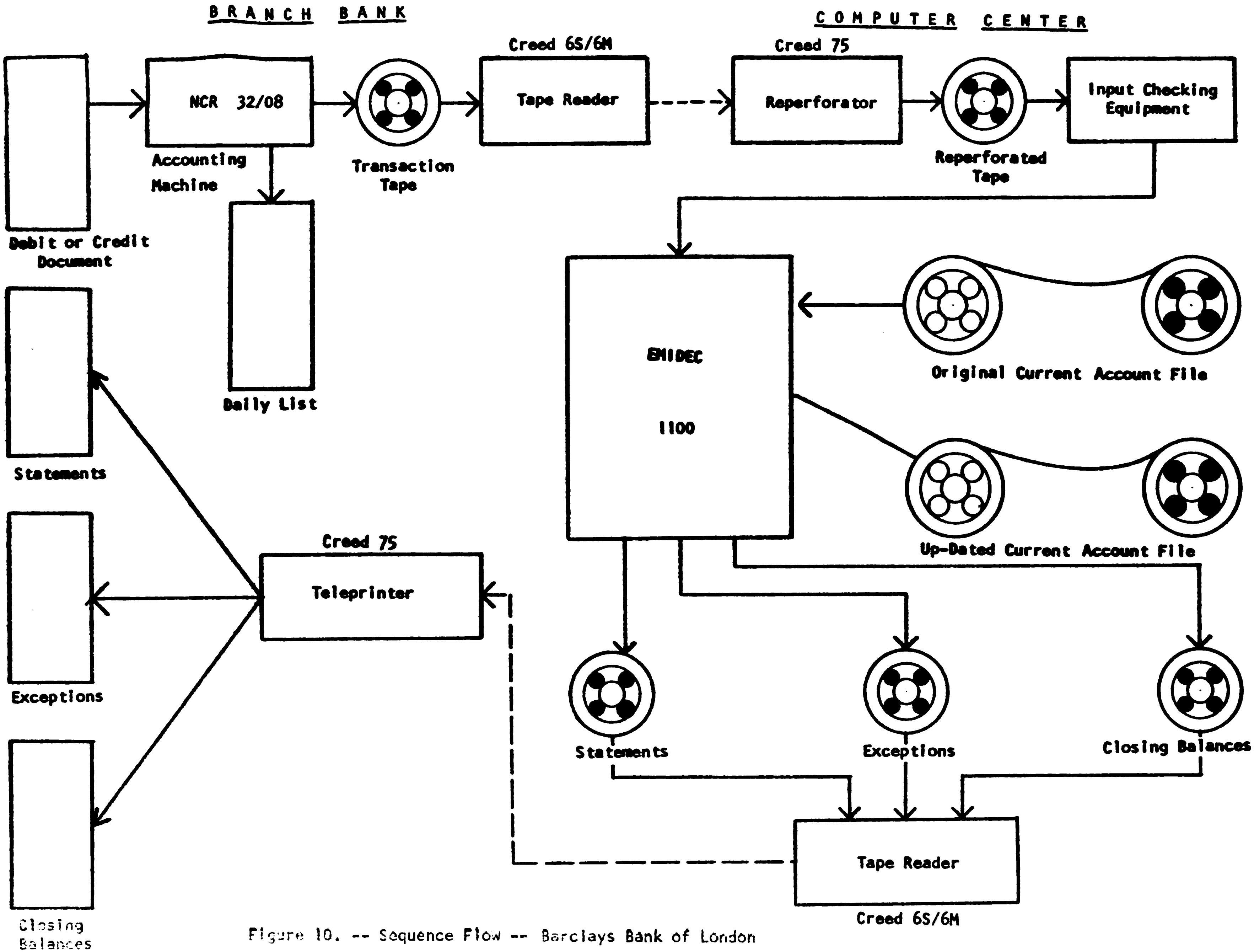

Figure 10. -- Sequence Flow -- Barclays Bank of London

about fifty. ("Hash" totals are used for checking.) After the significant facts of each transaction are punched into paper tape, the tape is fed into the Creed 6S/6M tape reader and the information is transmitted over private teleprinter lines to the computer center. At the center, an identical five-channel tape is produced by a Creed 75 printing reperforator. This tape is then passed through a data input checking device before the information is entered into the EMIDEC 1100 computer. Details of the various current accounts are stored on magnetic tape and these are updated twice a day. Revised balances, lists of exceptional items and other output data are recorded in paper tape by a Creed 3000 high-speed tape punch. By means of a tape reader this information is then transmitted over the teleprinter lines to the respective branches where it is printed out into required statements, exceptions and closing balances.

At the center, the units of the data receiving and transmitting equipment corresponding to that of each of the twelve branch banks linked to the system are housed in twelve cabinets. These are arranged in three groups of four cabinets, with each group being supervised by one operator.

Advantages claimed for the Barclays Bank system are that:

1. The volume of routine bookkeeping work performed by branch personnel is reduced;

2. Branch managers can exercise more precise control

over accounts than previously; and

3. Improved service is provided for the bank's customers.

EDP at Michigan National Bank[1]

Among the earlier pioneers in electronic data processing was the Michigan National Bank, a banking institution of semi-autonomous offices in eight different Michigan cities. Michigan National first conceived the idea of a central data processing center in 1954. Operations were expanding, check volume was rising rapidly, and each individual office was either adding to an existing machine system, or replacing existing machinery with newer and faster equipment. And,

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[1]Michigan National Bank is ranked as one of the country's large banks. At the end of 1960 it was 50th in size in the nation and 4th largest in Michigan. Its growth since its organization in 1940 has been steady and rapid. It reported total assets of almost $569 million at the end of 1961, and has approximately 290,000 checking and saving accounts and 140,000 borrowers. Checking account check and deposit items number around 5 million a month. Operations include seven other city offices besides the main office and branches in Lansing, Michigan's capital city.

A broad banking policy of the Michigan National Bank allows the separate offices to operate almost as separate entities. Each office is self-governing. Each has a board of directors with a bank senior vice president as senior officer. Each makes its own policy as long as it remains within the standard operating framework. Consequently, prior to installation of the centralized EDP system, eight different bookkeeping systems were being employed, each with varying degrees of automation. However, the inclination was toward IBM punch card equipment and five of the eight offices had such systems in operation, although not all bookkeeping functions had been fully converted. For example, the Lansing office was still using conventional Sensimatic bookkeeping machines to post checking account transactions. One office, though, had gone so far as to have all personal accounts using the large IBM card checks.

since each office operated somewhat independently, the bookkeeping systems installed at each office meant duplication of equipment and also of operating personnel. Also, as with most banks, the bookkeeping machines were standing idle a large share of each twenty-four hour day. Visualized, therefore, was a centralized bookkeeping center with a high speed electronic computer as the focal piece of equipment.

Prior to arriving at a decision for EDP, cost studies were made of data processing methods and procedures then employed by the bank. In addition, three of the bank's officers visited with other banks, viewing their installations and comparing different costs. They wanted to find out if Michigan National was doing something wrong, if operations were not being properly handled. They wanted to find a way to reduce high unit processing costs. Indicative of a dual problem, personnel and costs, is the following:

> There were many people employed in the Lansing bookkeeping area. There were thirty girls and two supervisors on commercial books alone, and there were many, many more than this. Everytime we added an account it seemed like we had to add a girl. This is the position we were getting in and pretty soon it was going to cost us $25 to maintain an account. It was just getting to that expense. This is primarily why Michigan National went to the study of a larger system, a centralized system trying to eliminate the possibility that some day checking accounts would price themselves out of the market.[1]

Finally satisfied that Michigan National's problem was not too different from that of other large banks,

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[1]From a personal interview with one of the bank officers on March 13, 1962.

available electronic equipment was looked at and equipment manufacturers were asked to explain the operation of their equipment and their systems. The officers also viewed the efforts of the Bank of America and other banking institutions that had investigated EDP and had taken steps to research or implement a data processing system built around electronic equipment.

Eventually the decision was made to "go electronic," and selection of machinery became the next problem. Three manufacturers, International Business Machines, National Cash Register, and Burroughs, were favored. From these, the equipment of Burroughs Corporation was finally selected. Reasons for selecting Burroughs might be summed up as follows:

1. Burroughs equipment was widely used in banking operations and had proven highly successful and dependable. Hence it was felt that Burroughs' wide banking experience and appreciation of banking's special problems would prove to be advantageous in developing the new machinery needed for electronic check handling and data processing.

2. Burroughs was the only company that would state a definite delivery date. (The MICR program had not been finalized and equipment production was being temporarily delayed pending final recommendations.)

3. Burroughs promised to produce the type of equipment needed to meet the check handling and information processing requirements of the bank, without eliminating any

reports or records deemed vital by bank management. Burroughs indicated they would produce the machinery to fit the specific needs of the bank, not requiring the bank to alter its operations to the extent required by the other companies. A bank official, commenting on this said: "Maybe it was all sales, but they did a good job, saying that they would tailor make their machinery around our banking problems, and that 'the things that you need you will get from our equipment.'"[1]

Michigan National Bank found that converting from one system of data processing to another was fraught with many problems and entailed countless hours of time as well as unstinting effort on the part of those responsible for the task. The process is not yet complete, but before the year is over the bank will have converted to what it has termed "a completely electronic automatic bookkeeping system."[2] The process of conversion will be discussed under three general headings: (1) Customer and public relations, (2) personnel, and (3) system implementation.

Customer and Public Relations

> The importance of the area of customer relations cannot be over-emphasized. It is the first and most singularly critical phase of check mechanization. The

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[1] *Ibid.*

[2] "Michigan National Announces Total Electronic Bookkeeping," *Mid-Western Banker* (February, 1961), p. 49.

> success of the most comprehensively studied program rests upon the reaction of customers to the change.[1]

These words by a vice president of Michigan National Bank, the director of its Electronic Processing Control Center, emphasize the importance with which the bank viewed its customer relations relative to its proposed change to EDP.

Early in its conversion program the bank took steps to apprise its customers and the general public of what the bank was contemplating. Direct mail, newspaper advertising, radio, and television were used, and finally, personal contacts were made. The program was inaugurated to inform and to educate the bank's many customers of the changes that would be necessitated by the adoption of magnetic ink encoded checks and a new high speed computer system for check handling. Many problems were presented because the bank was first, and at that time the only bank in Michigan advocating magnetic ink pre-printing of checks. Customers required convincing that everyone else, in time, would follow. Many customers, aware of paper processing problems of their own, readily cooperated. Others were at first more reluctant. Generally speaking, however, very little difficulty was encountered. The bank's basic approach was probably largely responsible for this. The bank established a

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[1]Leonard M. Selden, "Solving the Input Problem--First Step in MICR," Burroughs Clearing House, XLIV (November, 1959), p. 38.

department to coordinate customer-printer problems, to determine the customer's needs, and to assist the check suppliers to meet those needs. An explanation of the personal contact phase of the check conversion program will illustrate the bank's method of operation.

The contact phase was concerned primarily with non-controlled[1] accounts. The controlled accounts were supplied with magnetically imprinted checks immediately upon release of final type font specifications by the American Bankers Association in the latter part of 1958.[2]

As final type specifications were released, Michigan National was prepared to go to its non-controlled accounts with the information needed to start the check change-over phase. These were the most difficult to change over. Realizing this, the bank made every effort to help the accounts make the transition economically and without interfering with their existing accounting methods. Cooperation with the customer's check supplier also aided in an orderly transition. To effect the program, key personnel were assigned from each bank office. The central office coordinated

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[1]Non-controlled accounts are those that order their checks directly from check suppliers. Controlled accounts refer to those accounts that order and receive their check supply through the bank. The bank thus acts as an intemediary between its customer and the check printer.

[2]The Michigan National Bank was the first bank to encode checks with the recommended E-13B type font. The Bank of America, the first to magnetically encode checks in magnetic ink, had used an earlier type font, anticipating that it would be recommended.

the activities of each and furnished advice as to check conformance and compatibility with magnetic ink printing requirements. Field representatives from the equipment manufacturer also assisted bank personnel during this indoctrination period.

At the start of the check transition program the bank investigated every one of its commercial accounts, separating them into those controlled and those non-controlled. To each non-controlled account personalized letters were mailed, announcing the plan for MICR encoding of all checking accounts. A questionnaire was also included with the letter. (See Appendix C and D for copy of letter and questionnaire.) Requested were two samples of each check form, related accounting documents, and window envelopes, if used. Established to handle the replies, a clearing center compiled and studied the information contained in the returned questionnaires. As each customer's reply was processed, check reorder dates were noted, checks were analyzed to determine the extent of any design changes needed for MICR compatibility, and a customer's file set up.

Punch card check users were contacted as soon as possible. The reason for urgency was the possibility of check redesign, especially where the customer was using the ABA-reserved card columns for punching. Punching in the magnetic ink reserved area was the only problem presenting any real processing difficulty. The bank overcame this difficulty in one of two ways: By using (1) a substitute document to be processed in lieu of a check, or (2) a carrier envelope into which a mutilated, or non-standard check could be inserted.

A problem was also encountered where firms were using punch card checks associated with an internal accounting system. Here, some reluctance about changing plug board wiring was met, but the bank's policy of providing all assistance possible and sparing the customer any undue expense resulted in a smooth transition to the new type checks.

One type situation required a decision as to (1) whether existing check supplies should be bought back and destroyed, or (2) whether it was less expensive to post-qualify checks in use so as to make them acceptable to the new system. This type situation arose where the bank thought it expedient to ask the customer to begin using MICR checks immediately.

When the questionnaires were returned, contacting each and every check supplier noted therein was given priority. The purpose was to determine whether or not he intended printing checks according to magnetic ink requirements, and if so, when. Assistance was offered to each printer and a great deal of time was spent working with these people. It was necessary to convince them that they had an interest in the program, too. If they were to remain in the check printing business they had to buy test equipment capable of measuring tolerances according to the more stringent requirements. The bank personnel talked to printers and held seminars with them. Bank sorters were made available for test runs and documents were also submitted to an evaluation center to insure their readability by other makes of equipment besides that used by Michigan National. Mr. Selden has written that the time spent with these check printers was well spent, ". . . because again the results have proved both rewarding and very gratifying."[1]

At Michigan National, customer and public relations have continued to rank high in importance as conversion to EDP has progressed. For example, when a particular accounting function of an individual local bank office is being converted, one of the Electronic Processing Control Center's employees goes to the office involved just to answer questions. This practice serves two purposes. First, it makes it possible to give any customer a complete answer to questions about accounts, the reasons why changes are being made, and how the record-keeping process is facilitated by electronic equipment. The bank's personnel, thus freed from answering long and involved questions, can continue their regular work. The combination of ready and appropriate answers and continued prompt service creates an atmosphere of confidence and goodwill. Second, it provides assurance

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[1]Selden, op. cit., p. 38.

to the bank office's employees and helps to indoctrinate them with a better understanding of the program. It supplements a well-planned program, and even though instructions and procedures are all down in book form, and each office has a copy, problems are averted that would normally occur, and personnel are given a chance to become familiar with the new procedures. Bankers as well as customers, until they have the results of their own experience, need to be assured that the abrupt switch from long and familiar procedures and forms to entirely new ones need not present undue problems.

People are interested in something new and different. Hence, the EPC Center has been used to assist in helping the "new" in data processing at Michigan National become familiar and accepted. Interested viewers, whether customers or competing bankers, have been invited to see the various pieces of equipment in operation. Operating procedures have been explained; evolutionary steps, mistakes to be avoided, and so forth, have been outlined to other bankers to help them get started. In fact, an officer of the bank has stated, ". . . we have gone to interested banks and given them everything we have learned."[1] He viewed the over-all enhancement of electronic data processing and the benefits which will accrue to banking and the public through its use as being far more important than any competitive considerations.

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[1]Personal interview, op. cit.

An interesting story concerns the introduction of the new, brief, "bob tailed" statement form. (See comparison of statement forms, pages 179 and 180, Figures 11 and 12.) Anticipating trouble as the first statements were mailed to customers of the Lansing office, three women employees from the statement windows, two employees from the new accounts area and four from the "old" bookkeeping department were trained for a week in how to answer questions intelligently relative to the new form. When statement mailing time came, the trained employees were standing around waiting, but no one came in. A few calls were received, explanations given, and that was all. More queries were received concerning the statement date and cycle billing than concerning statement form. The statement itself did not present any problem. And the same was true with the business accounts.

Previously business account statements had carried a daily running balance. Some companies stated that they needed this information and some of the officers of the individual offices involved wanted to supply it. When queried as to why they needed it, they did not know. Neither did the companies, only that they had been getting such information for years. When asked to try the new forms for a month they readily accepted them. Basically everything available before was still provided, but in different form. Account reconciliations were made easier and information

IN ACCOUNT WITH 55 - 95 - 39 REGULAR CHECKING-ACCOUNT STATEMENT

FIGURE 11

KARL OR HAZEL SKOUSEN
1612 J SPARTAN VILLAGE MO.
EAST LANSING, MICHIGAN

CHECKS		DEPOSITS	DATE	NO OF CHECKS PAID	BALANCE
BALANCE BROUGHT FORWARD →			Sep 1'61		276.27*
		244.00	Sep 5'61		520.27*
199.40	100.00				
15.00	25.00		Sep 11'61	4	180.87*
28.24			Sep 21'61	5	152.63*

179

LAST AMOUNT IN THIS COLUMN IS YOUR BALANCE

FEDERAL DEPOSIT INSURANCE CORPORATION
$10,000 MAXIMUM INSURANCE FOR EACH DEPOSITOR
MEMBER

CODE	
CC - CERTIFIED CHECK	MS - MISCELLANEOUS
DC - DEPOSIT CORRECTION	OD - OVERDRAWN
EC - ERROR CORRECTION	RT - RETURNED CHECK
LS - LIST OF CHECKS	SC - SERVICE CHARGE
CM - CREDIT MEMO	DM - DEBIT MEMO

A RECONCILEMENT FORM HAS BEEN PROVIDED ON THE REVERSE SIDE FOR YOUR CONVENIENCE. CO-OPERATION IN PROMPTLY RECONCILING THE ACCOUNT AND IMMEDIATELY REPORTING ANY DISCREPANCY TO THE AUDITOR OF THIS BANK WILL BE APPRECIATED.

EAST LANSING STATE BANK

EAST LANSING, MICHIGAN

RECONCILEMENT

BALANCE FROM CHECK BOOK	$			
OUTSTANDING CHECKS: No.				
— BANK SERVICE CHARGES (IF ANY)				(D)
TOTAL	$			(A)

DEPOSITS NOT CREDITED . . . . $______________
(IF ANY)

BANK BALANCE AS PER STATEMENT $______________ (B)
(FROM REVERSE SIDE)

TOTAL $______________ (C)

TO PROVE BALANCE AS SHOWN ON STATEMENT:

List your balance from check book in space provided above. Sort checks numerically or by date.

List above all checks not returned with statement comparing the checks returned with check book stubs.

If all deposits have been credited, total (A) should agree with statement (B).

If any deposits have not been credited on statement add these to balance shown by statement (B). Total (C) should then agree with total (A).

If there are any bank service charges, they should be deducted from your check book and on line (D).

"BOB TAILED" CHECKING-ACCOUNT STATEMENT

MICHIGAN NATIONAL BANK

COMPLETE BANK AND TRUST SERVICE

CHECKING ACCOUNT STATEMENT

FIGURE 12

THIS STATEMENT COVERS THE PERIOD FROM 1 06 62 TO 2 07 62.

ACCOUNT NUMBER	PREVIOUS STATEMENT BALANCE		TOTAL ADDED FOR DEPOSITS		TOTAL DEDUCTED FOR CHECKS		SERVICE CHARGE *		CURRENT BALANCE
321 715 8	456 30	+	275 47	−	497 59	−		=	234 18

22 CHECKS AND 3 DEPOSITS ARE INCLUDED IN THE ABOVE FIGURES.

K M SKOUSEN OR HAZEL M SKOUSEN
1113 F UNIVERSITY VILLAGE
EAST LANSING MICH

* AMOUNT OF THE SERVICE CHARGE SHOULD BE DEDUCTED FROM YOUR CHECKBOOK BALANCE.

EPCC-308

PLEASE RECONCILE YOUR STATEMENT PROMPTLY
(SEE REVERSE SIDE)

can be obtained quicker. But aside from these advantages, the better than three years of customer indoctrination had proven effective, and the actual transition was made smoothly and with very few problems. And most of those that did develop were minor and were readily disposed of.

Personnel

When EDP was first considered by Michigan National Bank, employee indoctrination was recognized as of utmost importance. Having time to plan thoroughly--the bank had a good three years to implement its employee program--steps were outlined which would make the transition to a new data processing system as smooth as possible for all concerned. Mistakes were undoubtedly made, but the pervading idea was to educate each employee in such a manner that he could intelligently explain the system's operation to an inquisitive customer, and to allay any fears which the customer might have. It was desired that he become familiar with the entire program. Consequently, right after the bank had decided on Burroughs equipment, and about two years before getting into electronics, a series of breakfast meetings were arranged for the employees at each bank office. Since this was prior to selection of a computer section "team," the bank office's operation officer introduced representatives from Burroughs Corporation who then explained what was going to happen, how an EDP system would work, the part that each employee would play, what the effect would be on each of them, and so forth. Reactions were favorable. Employees were assured that no individual would lose his job, and that, in most cases, any job changes would result in upgrading to a more interesting, less monotonous and possibly better paying job. Later, employee tours were taken to the computer center, where the new equipment was viewed in operation. As the process of conversion proceeded, they were kept apprised of developments and progress.

Primarily, the people needing assurance were those employed as bookkeepers, as the bookkeeping jobs, as such, were to be eliminated. In some offices, such as Lansing, the punch card department would also be eliminated. Prior to either event, however, it would be necessary to create a new Electronic Processing Control Center, staff it, install machinery, write programs, test and "debug" them, and in general create an organization capable and qualified to install and operate a highly technical EDP system.

Early in 1959, a man with considerable EDP experience was employed and appointed as director of the EPC Center and given the responsibility of developing it into a functioning unit. Appointed to assist him was a man from the bank's own IBM punch card department. Next, a number of individuals from each bank office were given an examination by the center director, and from this group eight, with a ninth added later, were selected and trained as programmers. This was different in some respects, from what some banks were doing, but the thinking was that it would be much better and easier to take men who knew banking and teach them programming rather than the reverse. It also made it possible for those bank employees who were interested to become an integral part of the new data processing program. One advantage of using bank men was that they did not have to ask questions about bank operations. For example, if a person had been working in installment loans he was initially given the job of programming that area, or a man from commercial bookkeeping was given that job to program, and so on. Each programmer was trained in all aspects of programming techniques. This training, plus his previous banking experience, made him a valuable member of the permanent programming staff. The bank policy of using bank men also did one other thing. It backed up with action the story that bank personnel would be upgraded wherever possible and that no one need worry about his job.

Indicative of the actual transfer of personnel is the following relative to the Lansing office.[1]

When the conversion to EDP was started, bookkeeping had thirty-five women employees. About half of these were transferred to other areas in the bank; for example, one went to proof, two into the installment loan department, and several into teller work. Some transfers may have overstaffed an

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[1]The information contained in the remainder of this section is taken from a personal interview with the personnel officer of the Lansing office of the Michigan National Bank on March 21, 1962.

area temporarily, but it was estimated that normal turnover of the bank, regarded to be between 40 and 45 per cent each year, reduced any excess in but forty-five to sixty days. Each local bank office's bookkeeping departments would be affected similarly.

Those who were not transferred out of bookkeeping became known as the check paying department. This department is responsible for the actual charging of an account after visual inspection of check signatures and other check irregularities. They also do check filing and statement mailing, and prepare the information for general ledger transaction entries. With such a responsible job, not too many of the more competent and higher salaried bookkeepers were transferred to other departments. Those retained were kept there purposely because of the value of that department to the bank. However, this department will soon be streamlined again by the introduction of a new check filing system. This improvement will allow a further staff reduction by one half.

Another department of the Lansing office affected by the EDP system was the IBM punch card department. This department was completely eliminated at the end of January, 1962. Thus, the people of this department and those of the bookkeeping department were the ones most vitally affected. By September, 1961, as a result of the normal process of not replacing those who left, and through the transfer of one man to assist the Director of the EPC Center, only five employees were left in the punch card department. By the end of January, only one person remained and he was put into a regular training program for tellers and has since been transferred to the credit analysis department. At one time during the latter months, it was even necessary to transfer one person into the department to keep it functional.

A total of four men were employed by the punch card department. Of these, one was made assistant to the Director of the EPC Center (he has since been hired away by another bank to head up its computer center), two others were also transferred to the center, and one was put in charge of the check paying department. Commenting on the entire personnel transfer and transition process, the Lansing office personnel officer has said:

> I have been amazed at how smoothly the transition has worked out. In all areas where we have transferred these people they have worked out real well. . . . We've probably, here in Lansing, "saved" maybe twenty-two jobs, somewhere around that, between twenty and twenty-five. But, they've got thirty-one people working in the electronic processing center. . . . No employee has lost his job because of EDP.[1]

System Implementation

The electronic data processing machinery installed by Michigan National Bank at its EPC Center located in the new Stoddard Building in Lansing represents a combined effort

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[1] *Ibid*.

on the part of the bank and Burroughs Corporation. The bank wanted an EDP system which would enhance and speed up data processing from normal banking operations and the manufacturer designed and built an equipment system to meet customer specifications. At the heart of the system is a Burroughs 220 computer, a general purpose computer with wide flexibility of input and output sub-systems, and one that is relatively simple to program, operate and maintain.

The input system is custom built for banking purposes. Included in this system is a special-purpose, solid-state electronic computer control unit, magnetic tape units, an electrostatic multi-printer, and a MICR document processing sorter-reader-converter. The latter device is the paper handling unit, and has the capacity to put through up to 1,560 items a minute. Yet, it is the slowest piece of equipment in the group. The electrostatic printer prints a master tape and any one of three "special-purpose" tapes simultaneously. Both the sorter-reader and printer are connected to the control unit for direction and operation. As checks and other documents are fed into the sorter-reader, audit listings are printed on a plastic type tape by the electrostatic printer while all "readable" information is simultaneously recorded on magnetic tape. The magnetic tape is then used as the medium for data input into the computer.

The output system consists of magnetic tape units, a control unit, and a high-speed printer capable of printing

120-character-wide lines at a maximum rate of 1500 lines per minute. The latter is controlled by wired panels and is used to print checks, customer's statements, ledgers, journals and the many different reports required by the bank.

Since electronic equipment was first ordered by Michigan National many changes have been introduced into systems procedures. For example, it was initially planned that a sorter-reader-converter would be located at each bank office. Using it to read magnetically encoded documents, only magnetic tapes would be transported to the processing center in Lansing. But, improvements were made in the machine and its price rose accordingly. In addition, higher speeds were attained, and the equipment would only have to operate about ten to twenty minutes a day at some of the offices, lying idle the remainder of the time. It was decided, therefore, that only the processing center would operate the document handling system, and a courier system would transport the original documents to-and-from the EPC Center. This system is still in use, although some bank men admit it is only in "the pony express stage."

Planned for automatic processing are checking accounts, savings accounts, installment loans, mortgage loans and payrolls. Plans do not presently include electronic processing for general loans, the general books, trust accounts, and mobile home loans. The latter are processed by a punch card system owned and operated by Michigan National Bank and located at its Grand Rapids, Michigan, office. It is considered a possibility that two processing centers will eventually replace the eight different machine systems that were previously operated by the bank's different offices. Those operations which are adaptable and economically feasible to program and process by electronic equipment will be sent to the Lansing EPC Center. Those which can be better processed by punch card equipment will be sent to the Grand Rapids center.

Conversion of the different bank operations to EDP has been carefully and methodically planned and is progressing in the same manner. Since the combined payrolls do not represent a large number of items, these were simultaneously converted for all offices. Other functions, however, have been converted progressively, one office at a time.

First to be placed on magnetic tape for electronic machinery processing were the Lansing office's mortgage records and savings accounts. Lansing's checking operations were also processed electronically before those of the other offices. However, during the period of waiting for their "turn," the other offices transported their checks to Lansing where they have been sorted and then returned to the "home" office for posting to individual customer ledgers. This procedure has eliminated sorting of checks and the use of sortographs at all bank offices.

By planning ahead, the conversion process has been smooth and has progressed on schedule. In March, 1962, all mortgage records were on computer "records;" the checking accounts of seven offices were to be on by the end of July, as will the 30,000 accounts of Michigan Bank of Detroit (on a correspondent basis); by the end of August, all savings accounts were to be transferred to magnetic tape and processed electronically, and installment loans were to be converted before the end of the year. The latter is awaiting a "tab" to paper tape converter before completing the remainder of the installment loan conversions. The five functions of the housing office have been automated for some time.

In addition to processing the bank's own information, the bank has started doing some service work for larger businesses. Two examples of bank account reconciliations being done are Michigan State University (for a period of approximately twenty months) and Michigan Bell Telephone, Port Huron (fifteen months). The latter has an average of about 30,000 checks a month. The reconciliation process has been reduced from anywhere from a week to almost a month to at most a matter of a few hours, and in some cases less than an hour.

Not all operations utilize the same input medium. Checking operations use a sorter-reader as a reader only, reading and converting the magnetic ink coded characters into computer language on magnetic tape. Because of the computer's higher rate of speed all account sorting for number sequencing is accomplished by combining information on magnetic tapes through use of the computer. Installment loans are processed in a similar manner, and all payroll records are also on magnetic tape. All payroll record changes, overtime, and so forth, are introduced by punched paper tape. Savings accounts and mortgage loans are first placed on punched paper tape by use of a Burroughs 1200 Typing Sensimatic with a paper tape and check-digit-verifier attachment. The computer flexibility makes either paper tape or magnetic tape input possible.

Since its inception a few years back, the electronic data processing plan of Michigan National Bank has been modified and changed many times. Additional pieces of equipment have been added as needed. By the end of 1962, the conversion process will be virtually complete. And yet, it is not expected that changes are completed. Rather, improvements will continue to be made. Costs are being rapidly brought into line, bank personnel are gaining experience and are continuing to improve their programming and reducing their processing times. New services to be offered to the bank's customers are being planned and correspondent banks are talking and being talked to about use of the computer center. It appears, therefore, that progress will accelerate as the initial conversion period draws to a close. Two comments from bank officials are pertinent.

One said that he visualizes that the real value of the bank's installation is in the future and may not be realized in full for another five to ten years. The other expressed himself as believing that the present system would be subject to replacement in about another three years.[1]

Operations and Procedures

As indicated previously, the operations being electronically processed by Michigan National Bank are checking accounts, savings accounts, installment loans, mortgage loans, and payrolls. To better illustrate the operations and procedures of these areas a brief description will be given of each.

Checking Accounts. Bookkeeping for checking accounts is accomplished through use of the EDP system. To facilitate high speed operations, all checking account files are maintained on magnetic tapes. All necessary data regarding checks and deposits is introduced through use of magnetic tape previously prepared by the sorter-converter system. Information regarding new accounts and alterations is introduced through punched paper tape.

In addition to checks and deposit tickets, sixteen source documents are used to process checking account activity. Two of these are used for preparing punched paper tape

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[1]Personal interviews, op. cit.

while the remaining fourteen are encoded with magnetic ink for processing through the sorter-converter input system.

Since all posting to checking account records is electronically controlled, some means of identifying each individual customer must be used. For this purpose, each customer is identified by an account number. Checking account records are filed on magnetic tape where they are recorded in account number sequence. Separate reels of tape are maintained for each bank office.

Each segment of information must be identified when introducing new accounts and alterations into EPC records. This is accomplished by use of a numerical identification code assigned each segment of data to be recorded. In a like manner, various types of transactions are properly posted to records, and analysis of accounts for purposes of computing service charges are made possible by identifying transaction data with numeric combinations called Document Codes. Likewise, batch-tickets are identified by three digital numerical combinations called Batch Codes. Color coding is also used extensively for easy visual identification.

In the local offices, two types of in-bank equipment are used for preparation of media for subsequent processing by electronic equipment. Punched paper tape for introduction of new account and alteration data is prepared through use of a Burroughs Sensimatic Accounting Machine with a Paper Tape Perforator attached. This equipment produces Alpha-Numeric punched paper tape as required. Also coupled to the Sensimatic and the Tape Punch is a Check Digit Verifier. The purpose of this unit is to check the validity of account number data indexed on the keyboard of the Sensimatic and to prohibit the punching of incorrect numbers.

Magnetic ink encoded documents are prepared for processing through the sorter-converter system by either IBM Encoding Proof Machines or P703 Burroughs Amount and Account Number Printers. The proof machines encode checks and deposit tickets with transaction codes and dollar amounts as part of the bank proofing operation. The Burroughs machines are used independently.

A number of reports and statements are required for use in the local offices. The flow of information through the EPC Center to these documents is illustrated on page 194, Figure 13. Daily reports produced are the Checking Account Transaction Journal, Checking Account Balance Report, Exception Reports, and New Account and Alteration Report. Other documents prepared are the Service Charge Journal and two types of Statements, abbreviated and detail. The daily reports are relied on to furnish information formerly contained on conventional bank "hard copies." Therefore, the use of these will be discussed in more detail.

The Checking Account Transaction Journal is a two-copy report listing all accounts in account number sequence to which transactions have been posted on the date of report.

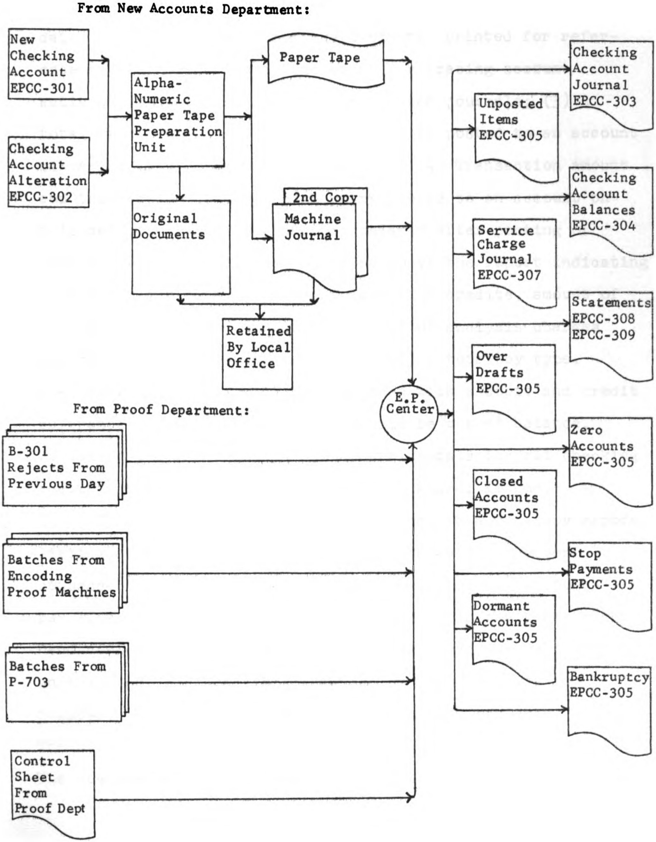

Figure 13 --In-Bank and Electronic Processing Center

Information contained in the report includes: (1) Account numbers, listed in sequence, of all accounts active on that date; (2) Date of last previous activity, printed for reference or to provide a starting point for tracing account activity through use of daily transaction journals; (3) A total of the number of debits and credits posted to an account since the last statement was prepared; (4) Transaction amount and transaction code for each entry posted to an account on this date; (5) A current account balance after posting of previously listed entries; (6) A recap of the report indicating totals for old balance pick-up, amount of credits, amount of debits, new balance, number and amount of analysis charges posted, and number of accounts and dollar total by type. The recap provides a crossfoot balance with a debit and credit reference total, should control totals be out of balance. Following the recap totals are control totals for all checking accounts for cross reference with the General Ledger.

The Checking Account Balance Report is a two-copy report listing all checking account balances in account number sequence. The accounts are listed two-up, or two accounts per line of print, with a reference number in the upper right hand corner of each page indicating the first number listed on the page. Information contained on the report is as follows: (1) All accounts in account number sequence; (2) The type of account, by type code assigned each account; (3) The customer's abbreviated name for verification or reference;

(4) Date of last transaction, printed for reference or to provide a starting point for tracing the history of an account; (5) Current account balance as of report date; (6) Indication of stop or hold on those accounts for which notification has been received by EPCC; (7) Dollar amount only of last deposit, shown for verification on customer telephone calls; (8) The last statement date, for use as a reference point when making corrections on an account; and (9) A report recap of totals indicating number of accounts and the dollar amount of balances.

Exception reports are two-copy reports and are all printed on the same form with the report name for each type of exception printed as part of the report heading. The various exception reports and column listings completed for each report are shown in Figure 14.

The New Account and Alteration Report lists new accounts for which records have been set up in EPC files and alterations to current records. Information which would be contained in these reports seems rather obvious so will not be detailed here.

Savings Accounts. Two forms, New Accounts form and Change Customers Record form, are used as originating source documents for savings accounts. Completed forms are forwarded to the Alpha/Numeric Paper Tape Unit where a typewritten journal is produced along with a punched paper tape. The tape contains all information necessary for processing at the EPC Center. One copy of the typewritten information

FIGURE 14

EXCEPTION REPORTS

Report Name	Acct. No.	Name or Reason	Date of Previous Activity	Date of Orig. O. D.	Amount of Trans.	Trans. Code	Bal.	Stop Hold
Overdraft	X	X	X	X			X	
Unposted Items	X	X			X	X	X	X
Zero Accounts	X	X	X					
Closed Accounts	X	X	X					
Stop Payments	X	X			X	X	X	X
Dormant Accounts	X	X	X		X	X	X	
Bankruptcy	X	X	X				X	

and the punched paper tape is forwarded with the day's work to the EPC Center for processing. The original source documents are retained in the local office. Where a hand posting method is used the deposit and withdrawal tickets are also retained in the local office.

Transaction data may be received with either of two methods. Where a window posting machine is used, one copy of the Window Machine transaction tape will be forwarded to the back-office Sensimatic where a journal listing and punched paper tape will be produced for these transactions. Where a hand posting method is followed, the deposit and withdrawal tickets representing the day's transactions are totaled by the teller on an adding machine. In this case the totals, along with the deposit and withdrawal tickets, are forwarded for journal listing and paper tape punching. After journals and tapes have been prepared they are forwarded to be electronically processed. The teller's total tape is used for balancing purposes by the Sensimatic operator.

On receipt of the journal copy and the punched paper tape by the computer center, the paper tapes are fed into the computer for processing. The following reports are produced for return to the respective offices.

Daily:

Closed Accounts

Transactions and Exception Journal

New Accounts and Alterations

Memo Entry Tickets

Accumulated Listing of Active Accounts (Current Week)

Returned Transactions

Weekly:

Account Balance Journal (Balance Listing of All Accounts)

Monthly:

Dormant Account Service Charge

Quarterly:

Interest Journal

Interest Memo Tickets

Potential Dormant Accounts

Dormant Accounts Listing

As with checking accounts, an explicit coding system is required for computer processing.

A flow diagram of savings account processing appears on page 200, Figure 15.

Installment Loans. Installment loan processing by the electronic processing center is similar to that of checking account operations. MICR encoded documents are used, thus making it possible to transfer transaction and account identification data to magnetic tape through use of the sorter-converter system. And, as with all computer processing, installment loan processing requires an extensive and explicit system of coding to be used.

An Installment Loan Source Document will be made up whenever a new loan is originated. Each day, these documents will be forwarded to the Conversion Section for punching into paper tape which will, in turn, be forwarded to the EPC Center for processing there. Any erroneous and/or inaccurate information included will require corrective action. For example, if an account number is in error but does not duplicate an existing account number, the account will be set up by the computer. To correct the error, this account will then have to be closed out and a "new" account, with a correct account number, set up. Where the account number is in error and does duplicate an existing account number,

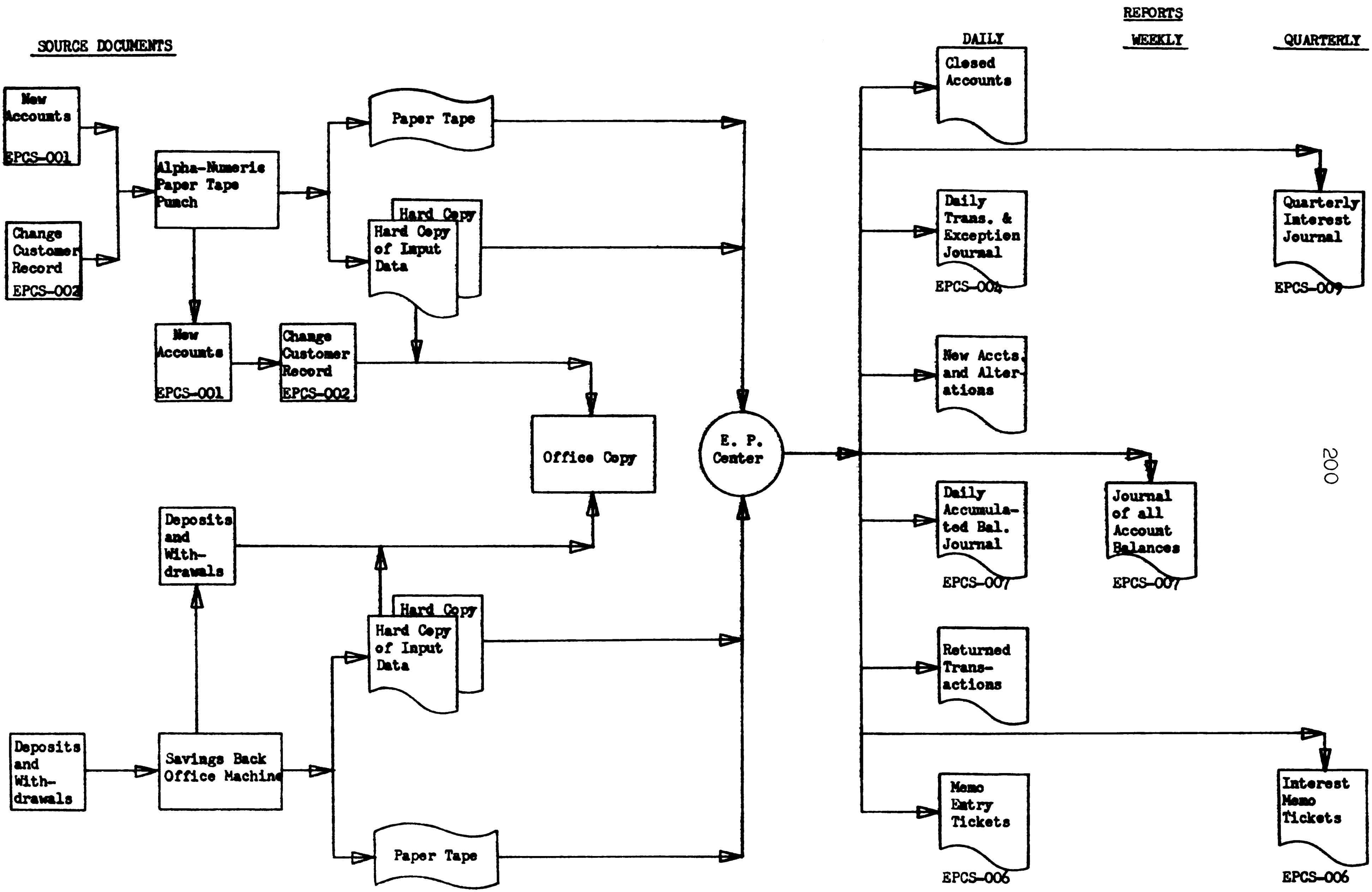

Figure 15.--In Bank--EPC Savings Operation

the erroneous account will be rejected by the computer and the loan, also with a correct account number, will have to be re-submitted as a new loan the next day.

Installment loan coupon processing requires that all payment coupons be encoded with magnetic ink (MICR), the encoding being done on a Burroughs P703 Amount and Account Number Printer. Since the encoding machine is a two-position printer, two passes through the encoder are necessary, one for pre-printing the payment amount and one for pre-printing the type loan, account number and due date. Prior to encoding, though, the coupons must be arranged in "Month of Payment Sequence" to coincide with the payment schedule.

Payments are received by mail and by tellers at receiving windows. In each instance, encoded coupons should accompany the payments. If they do not, and if paid in person to a teller, a Counter Coupon is made up. This coupon must then be magnetically qualified before it can be processed. Mutilated coupons will be placed in carrier envelopes at the MICR encoding station. To accompany the payment coupons to the encoding section, an adding machine tape is prepared by the teller for regular payment coupons received and another for Counter Coupons originated during the day. These will be used for "proving" purposes. A batch ticket will also be prepared at the encoding station for forwarding with the other documents to the EPC Center. Upon receipt of documents and tapes from a bank office, the EPC Center processes new loan and loan payment information and prepares a

Daily Loan Report for return to the local office.

Mortgage Loans. The mortgage loan accounts of Michigan National Bank are processed through the computer system similarly to savings accounts. That is, files are maintained on magnetic tapes for high-speed operation, and these are updated through use of the electronic computer. Input to the computer is by means of punched paper tape containing transaction data. In the preparation of punched tape, seven basic input documents are used. These documents are: (1) The Mortgage New Loan Document, (2) Mortgage Alteration Document, (3) Mortgage Payment Notice, (4) Irregular Payment Credit, (5) Escrow Voucher, (6) Mortgage Escrow Debit, and (7) Mortgage Miscellaneous (debit or credit).

Produced by the output system for use by bank officials are the following daily documents and reports: (1) Mortgage Payment Journal, (2) Mortgage History Record, (3) Mortgage Payment Notice, and (4) New Loan, Alteration and Exception Report. In addition to the daily items the following are produced on a semi-monthly, monthly, annual or demand basis: (1) A mortgage past due report, (2) a mortgage past due notice, (3) a statement of mortgage activity, and (4) trial balances.

Account identification numbers and transaction codes are employed to make electronic processing and control possible. A numeric code is also used to distinguish the various types of mortgages. In addition, on serviced mortgages, a service number is assigned to an Investor to clearly identify mortgages belonging to that Investor.

When a mortgage loan is completed by the Mortgage Loan Department, a completed Mortgage New Loan Document is forwarded to the Alpha/Numeric tape unit where the new loan data will be punched into paper tape. At the same time, a "hard copy" of the new loan data is typed. This copy and the punched paper tape are sent to the EPC Center for processing and the Mortgage New Loan Document is returned to the Mortgage Loan Department. To illustrate the informational flow through the bank for both bank mortgage and service mortgage operations, flow diagrams are presented on pages 204 and 205 (Figures 16 and 17).

Payroll. Michigan National Bank's policy of semi-autonomous operation of its local offices permits wide latitude by each office in its personnel policies. Nevertheless, the offices are rather uniform in that a majority of all the bank's employees are on an annual or monthly salary basis. This permits effective use of electronic equipment at the electronic data processing center for the preparation of the twice-a-month payrolls.

Payroll data is maintained at the EPC Center on magnetic tape. To effect a change, either for addition of a new employee, or to change the status of present employees, needed payroll information is submitted to the Central Office on a New Employee and Change Record. For supplemental

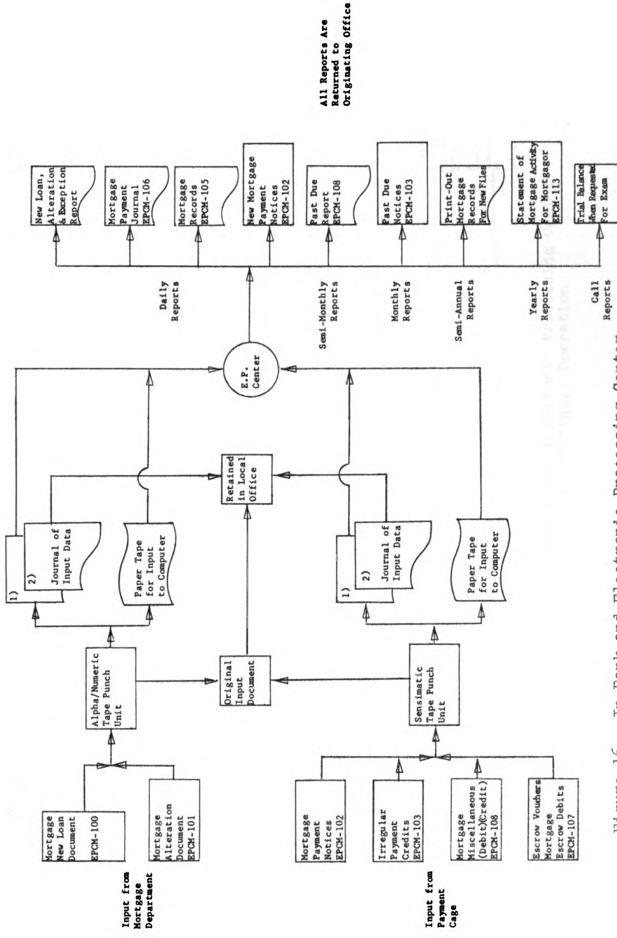

Figure 16.--In-Bank and Electronic Processing Center Bank Mortgage Operation

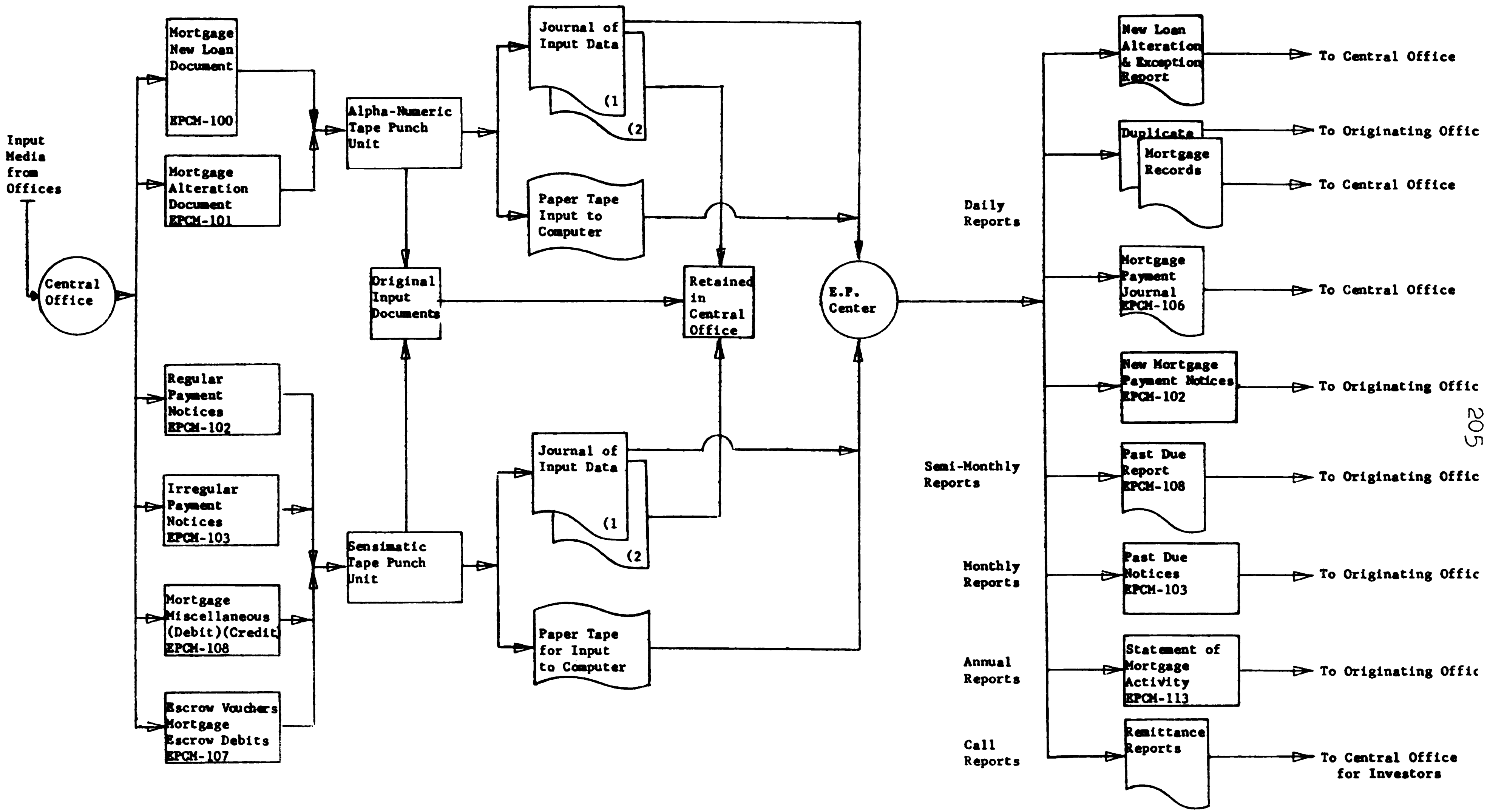

Figure 17.--Central Office and Electronic Processing Center Service Mortgage Operation

pay information such as hours worked for hourly employees, overtime, lost time, bonuses and so forth, a Supplemental Payroll Distribution Sheet is used. Two copies of this form are completed by the local offices. The original is forwarded to Central Office for processing and the copy is retained for the local office record. Forms must be submitted at least five days before the pay date in order to allow for payroll preparation and processing. When received by Central Office, all payroll data will be punched into paper tape, the input medium for the computer system. The source documents are then filed in Central Office.

The payroll for a pay period is computed and processed by the electronic equipment. Produced by the high-speed printer for each pay period are Payroll Checks and attached Statements of Earnings, Payroll Registers, and Earnings Summary Reports. By local office, reports and checks are prepared in Social Security Number sequence. The Social Security Number is also printed on the Statement of Earnings portion of the check.

The Payroll Register covers the period for which the checks have been issued, while the Earnings Summary Report shows accumulated figures for each employee. Both reports are issued each pay period. The Payroll Register contains a detailed breakdown of each employee's earnings for the period for which the check is issued. In addition, the last page of the register contains a recap of totals by column and department plus an office summary total. Using the office totals, each office prepares General Debits and Credits for the Central Payroll Account. The Earnings Summary Report contains "quarter-to-date" and "year-to-date" earnings information for each employee. A recap on the last page of the report summarizes column totals by department and office. Reports are retained by each office for the period of time required by Federal regulations. As required, quarterly reports, annual reports and W-2 forms are prepared. Report copies are mailed to each office and W-2 forms are forwarded to the respective offices for distribution.

Summary

The reports presented in this chapter indicate the fact that each bank, although faced with similar requirements for customer transaction records, customer statements and management reports, does not approach the problem of check handling, record keeping and reporting by employing a uniform system of data processing. Rather, systems have been devised to meet the peculiarities of particular situations and then appropriate machinery has been employed to make the systems work. In each case, the desired results of the particular bank have been achieved. For example, where a visible customer ledger record was considered necessary, it was retained; where advantageous attributes of an existing punch card system were desired, they were retained and incorporated into a faster, newer system; where transfer of original documents--primarily checks--was not desired, a communication system was developed whereby information taken from these documents could be transferred and a computer's capacities utilized; and where a fully automatic EDP system was viewed as the answer to more than the check handling problems of a bank, a data processing system was designed which made possible the processing of all record keeping requirements of that particular bank, even though some activities may not be electronically processed because of economic and convenience considerations. Thus, through a combination of efforts, first through coordinated endeavors culminating with the development of MICR, then by data processing system designers, and finally by machinery manufacturers, alternative systems of data processing have been made available to the nation's variant banks. Notable are the pioneering and continuing efforts of individual bankers and banking institutions.

CHAPTER VII

JOINT DATA PROCESSING FACILITIES AND COMPUTER SHARING

In the preceding chapter, examples of different data processing systems currently in operation were presented. It should be noted, though, that these were only examples and that many minor deviations from each of these systems can and do exist. In fact, in any particular situation, good data processing systems design dictates that the system be organized in such manner that desired results can be expeditiously and economically attained. The machinery configuration is only of secondary importance and should be combined so as to enhance the purposes of the data processing system.

For those banks whose volume warrants a fully-automatic system, there are certain basic advantages such as speed, reduction or elimination of human error and general overall efficiency improvement. In spite of the advantages, not all larger banks which can economically justify an EDP installation are now fully automated. However, the trend to electronic equipment seems to be growing for this size bank as plans for EDP system adoption continue to be reported. Since only the larger banks can afford to install an individual system of highly-sophisticated electronic equipment, and since it appears certain that individual automation will be impractical for a vast number of American banks in the forseeable future,[1] what measures must the remaining banks take to accomplish their paper-processing requirements on a competitive basis? The answer seems to lie in the cooperative use of automated machinery. In fact, ". . . some bankers see cooperative use as the small banker's salvation when the electronic age reaches full flower."[2]

While the nation's banks range in deposit size from less than $1 million to more than $10 billion, small and medium sized units greatly predominate, as the following figures show.[3]

Size of Bank Based On Deposits	Percentage of Total
Less than $5 million	64%
Between $5 and $10 million	18%
Between $10 and $25 million	11%
Over $25 million	7%
	100%

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[1]A conclusion reached from survey results of automation in the Third Federal Reserve District as reported in "How Banking Tames Its Paper Tiger," Business Review, Federal Reserve Bank of Philadelphia (June, 1960), p. 16

[2]Ibid., p. 16.

[3]Figures given by Denton A. Fuller, president of Liberty Trust Company, Cumberland, Maryland, as quoted by Mathew J. Hoey, "The Role of Regional Clearing Bureaus in the Era of Electronic Check Processing" (unpublished

With such a preponderance of smaller banks it is only natural that considerable exploration be done in the area of computer sharing and joint ownership of central data processing centers. According to the Association for Bank Audit, Control and Operations, at least nine groups of banks are now planning joint computer facilities.[1] It is only natural to assume that individual banks are also seeking ways to utilize the capabilities of computer systems.

Methods of Computer Sharing

There are several ways in which small banks that cannot afford their own equipment and their own programming staffs can nevertheless reap the advantages of EDP. Some of the approaches which may be taken are as follows:

1. An independently operated service bureau.

2. A data processing center provided by an equipment manufacturer.

3. A prime user operated type--a large bank shares with a small bank, or an unrelated-industry business user provides facilities for small bank use.

4. An existing bankers' organization operation or one organized to facilitate check clearings and data processing.

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thesis, The Stonier Graduate School of Banking conducted by the American Bankers Association at Rutgers - the State University, 1961), p. 35.

[1]As reported by K. S. Axelson, "Computers for Everybody?" Management Controls, IX (February, 1962), p. 18.

5. A cooperative undertaking--joint ownership and operation.

6. A separate corporate organization--a service center type owned by a group of small banks.

Service Bureaus

By using the facilities of a service bureau, the smaller bank can derive benefits from automation at an earlier date than if it waited until it could justify an EDP system of its own. It can also gain valuable experience without investing heavily in equipment, personnel or time spent. The service bureau may even provide flexibility of service which would permit use of the service center by the bank's own personnel. Thus, bank personnel could be conveniently and inexpensively trained under the direction of service bureau employees, and objections to computer centers because of the confidential nature of the data being processed could be overcome.

Apparently the service bureau approach is the most popular computer sharing method.[1] As a result, development of computer service bureaus is growing. However, the majority are established primarily for data processing activities of general business organizations. But, due to the flexibility of general purpose equipment facilities, and with

[1]According to a Third District survey of 1960, one out of three banks favored it. Federal Reserve Bank of Philadelphia, op. cit. (July, 1960), p. 6.

the inclusion of some special units of equipment such as the sorter-reader-converter, adaptations can, and are, being made for banking requirements.

Herbert Bratter, writing in Banking magazine, lists a number of advantages for a service bureau approach to cooperative computer sharing. They are as follows:

1. The benefits of automatic data processing can be achieved without waiting for low cost electronic equipment.
2. There is no need to train a large staff of equipment specialists.
3. Major capital investments in computer equipment and a computer site are eliminated.
4. Maximum utilization of large-scale equipment to gain efficiency and lower per unit costs is provided.
5. Greater accuracy, control over uncollected funds, stop payments, service charges, calculations, and so forth, is made possible.[1]

Equipment Manufacturer Processing Centers

This approach is similar to that of the independent service bureau. In each instance, machine time is rented to small-scale users. The operating personnel, depending on the particular center, may also be center-employed or user-employed. Thus, the same advantages would probably accrue to bank users as with an independently operated data processing center.

Equipment manufacturer centers are increasing in number. At present more than 100 such centers are reported

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[1]Bratter, op. cit., pp. 58, 62 and 130.

to be in operation throughout the country.[1]

Prime-User-Operated Type

Similar to the two previous approaches to computer sharing, the prime-user-operated type is but another method whereby EDP facilities are made available to small-scale users on a time rental basis. In this instance, the large bank, or the large industrial firm, functions as the computer center for the smaller bank. There is no incidence of joint control or joint ownership involved. It is merely a congenial and jointly beneficial relationship where excess computer system capacities of the owner-organization are made available to the renter-organization. Since a correspondent relationship usually exists, many of the barriers usual to competitive institutions are already largely lessened. This does not mean that competition between the two organizations does not exist, for it does. But, since the operation of an efficient central banking system requires a high degree of cooperation, banks of all sizes must work together as parts of a larger whole, or as parts of the system. This same type of cooperation can be carried over into computer sharing. There are those, however, who contend that natural competition between banks will tend to be reduced by this method of computer sharing. To some

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[1]Axelson, op. cit., p. 17.

extent this may be true. Still, it does not appear to the writer that competition will be inhibited to any appreciable degree. With the American system of banking, cooperation is required and banks must continually work together. Yet, the competition between banks continues strong. Where working relationships are already formed, it seems only logical that computer sharing relationships can also be entered into without inhibiting to any great degree the competition for increased customers and service outlets. Where excess computer time is available, the bank management responsible for the system will be aggressively soliciting work from its smaller correspondent banks. Therefore, as EDP becomes an accomplished fact, as the larger banks become fully converted, the prime-user-operated, service-bureau-type approach should grow in popularity and provide a measure of automation to the country's smaller banks.

Alan B. Purdy lists two basic reasons why correspondents will play a larger role in the automation development of smaller banks.

1. The direct working relationship will allow a review of the detailed aspects of the approach to automation based on the philosophy adopted.
2. The correspondent's own studies will have given him an insight into the problem area.[1]

In addition to these, it should be mentioned that cooperative ventures also provide a method of systems improvement

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[1]Purdy, <u>op. cit</u>., p. 35.

for the smaller bank. At the same time, though, processing procedures among the participants tend toward uniformity. A particular bank may have less stringent data processing requirements and may view this as a possible drawback.

Regional Clearing Bureau Facilities

This last approach to computer sharing is one advocated in a thesis by Mathew J. Hoey. His theme is twofold. For example, Mr. Hoey says:

> The best approach to the handling of increasing numbers of checks by many of the smaller and medium-sized banks of the country will be found in the twin approaches of (a) establishing regional clearing bureaus to handle all aspects of the check operations of the participating banks, and (b) equipping such bureaus with electronic devices in order to optimize their service potential and thus realize the full benefits of automated check handling at minimum cost to the participants.[1]

This is but another method of establishing a service-bureau type organization. However, the approach is intriguing in that it advocates not only a more efficient processing of checks, but also more rapid presentation of checks to drawee banks. Before such a system could be placed in operation, though, the feasibility studies referred to earlier, those dealing with operational, facility, economic and psychological aspects, would need to be considered.

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[1]Mathew J. Hoey, "The Role of Regional Clearing Bureaus in the Era of Electronic Check Processing" (unpublished thesis, The Stonier Graduate School of Banking conducted by the American Bankers Association at Rutgers - the State University, 1961), p. 5.

Doubtless all banks would not participate in such a plan, even as some banks are not members of the Federal Reserve System. But, such a program, if properly planned and placed in operation, would undoubtedly speed up the check clearing and collection process, and make available in a centrally located area an automatic data processing system adequate for the surrounding smaller banks' needs. In advocating this particular method, Mr. Hoey has written:

> . . . while it obviously is highly desirable to process checks at high speeds incident to the sorting, proving, and posting operations, one of the major problems confronting most banks is the need for faster collection of checks drawn on others, and the major difficulty encountered in this area lies not so much in the processing of items on a bank's own premises but rather in the delays incident to the physical presentation of items to, and their possible return by, the drawee bank. Since this cycle of presentation and return may take as long as 11 days, even for items payable at country banks in close proximity to the collecting bank, it will be apparent that the most significant gains in terms of more expeditious check collection, at least for the smaller bank, can be achieved in terms of faster over-all collection rather than simply faster on-premise processing.[1]

<u>Joint Bank Facilities</u>

Joint bank facilities may not be economically feasible for a small group of banks located in relatively remote areas. One barrier may be distance. Yet, distances can be made short in terms of time by modern transportation and communication methods. Thus, distance, in and of itself, is no

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

barrier. But, because of costs which arise when lightly patronized, and hence expensive, transportation or communication media are used, costs become prohibitive. For such banks, and any others unable to take advantage of automation savings, eventually increased operating costs will have to be passed on to their customers in the form of higher service charges and higher interest rates, or to their owners in the form of lower dividends and/or reduced earnings. It is fortunate that such remotely located banks are not usually subjected to the keen competition of the more densely populated areas.

However, joint facilities are feasible for a comparatively large number of smaller banks. Where volumes warrant, computer systems may be installed; for lighter-volume smaller banks, semi-automatic systems may prove adequate.

Many of the problems associated with computer sharing are similar, regardless of whether the equipment used is automatic or semi-automatic. In a like manner, computer-sharing approaches of (1) a cooperative undertaking, and (2) a separate corporate organization are similar. The principal difference lies in the organizational structure and the methods established for control and operation of the joint facility. Therefore, the discussion that follows applies with almost equal force to both of these approaches.

Elements of Feasibility for Computer Sharing

Stanley R. Klion has listed four elements of feasibility that should be carefully and judiciously investigated before a joint facility is undertaken. The joint facility study should be made in terms of (1) operations, (2) the facility itself, (3) economics, and (4) the psychological problems of working with competitors. Using these as a basis, Mr. Klion then discusses what a group of banks should consider and how they might proceed with a feasibility study of a joint data processing facility.[1] His article, considered pertinent here, is summarized below.

Operational Feasibility

An operational feasibility study would include an evaluation of the following:

1. Volumes to be generated by each bank,
2. Current procedures employed by each,
3. Significant procedural differences and variations,
4. Kind of account numbering system each bank will want,
5. Individual treatment of holds, stop-payments, and so forth,
6. A review of communication requirements,

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[1]Stanley R. Klion, "Joint Data Processing Facilities for Banks," Banking, LIII (May, 1961), p. 58. The complete article is found on pages 58-59; 122, 124, and on pages 19-22 of Management Controls, IX (February, 1962).

7. Clearing house arrangements,
8. Kind of general forms in use,
9. Computation of service charges and interest, and
10. Present degree of mechanization in each bank.

Facility Feasibility

Facility feasibility factors to consider would include:

1. Timing, or machine scheduling to differing bank needs and requirements,

2. Protection against disclosure of confidential data,

3. Question of independence of joint facility management,

4. Question of quality of personnel,

5. Procedures to be followed in the event of machine breakdown, and

6. The division and rights of member banks in over-all management responsibility. Mr. Klion suggests that each bank should contribute equally to the cost study and have an equal voice in management and the many decisions that will have to be made, regardless of bank sizes or volumes.

Economic Feasibility

Economic feasibility requires:

1. A comparison of each bank's present data processing costs with expected data processing costs under the proposed

joint facility. Since some operation routines connected with proof, transit, and so forth, cannot be completely eliminated, care is needed to insure inclusion of all costs.

2. Preparation of a workable type of cost accounting arrangement so that facility management can have a proper and equitable fee schedule to recover operating costs.

3. Full consideration of initial costs of indoctrination and other one-time costs.

Psychological Feasibility

The element of psychological feasibility is probably the most important of the four. First, it involves the ability and willingness of member banks to work together cooperatively to arrive at day-to-day decisions and to give and take as necessary.

Second, persuasion should be avoided. A desire to participate should be evidenced by each bank.

Third, each bank must recognize the need for sequential conversion to the facility regardless of any seeming competitive or economic advantages with being "first."

Procedures for Computer Sharing

After discussing the above elements of feasibility, Mr. Klion suggests that the procedure to follow in investigating possibility of a joint facility would be first, to be sure that each bank really wishes to participate, and second, to form a joint facility feasibility committee consisting of two levels of personnel. At the senior level should be an officer from each bank with sufficient authority to represent the bank's top management. The second level should consist of a representative of each bank familiar with bank procedures and skilled in data processing functions. The third step would be to consider major policy questions that must be reconciled among the members before the facility can become operable; and fourth, to make a cost analysis indicating the true costs for each bank. Joint facility costs should be compared with present costs and the potential for savings indicated for each individual bank.

From the foregoing, it is evident that there are many obstacles and pitfalls to joint data processing facilities operation. Yet, the advantages are enticing and may become imperative, as many bankers recognize the need to move ahead into some type of automation so that a nearly complete magnetic ink check handling system will be a reality. For example, note the following:

> With the changes under way in banking today, the worst course of action a banker can take is to stand still. Every bank can accomplish improvements in operations that will pay off, to the customer, the stockholder and the industry.[1]

Regardless of the need to move ahead, though, some

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[1]Pike, <u>op. cit</u>., p. 94.

bankers view joint facilities with apprehension, at least in the relatively near future. They wonder about machinery obsolescence and the huge volumes required to make an electronic computer system feasible. The following is an indication of this stand:

> No matter how we regard the problem, we must recognize that completely revolutionary changes may and probably will develop at any point. These could make obsolete whatever might be done today; and the present cost of installation is so big that we neither can afford to make a mistake in installing it nor in continuing it. It is my opinion that for small banks, even in a joint venture, the practicalities of the situation are likely to hold us to a punched card operation.
>
> Unless you are able to centralize 20,000 to 30,000 accounts and can depend on a daily average volume of 40,000 to 50,000 items, electronic sorters and computers are probably too expensive for the present. This will very likely change, but it may well be several years before these basic obstacles can be overcome. . . .[1]

An Example of Joint Facility Use

A joint data processing center is the unique project of three different and highly competitive Michigan banks.[2] Since each of the banks is relatively small, a 'tronic bookkeeping machine system was installed. The three, located in neighboring communities along the St. Clair River, are the

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[1]Van Vechten Shaffer, "Problems in Pooled Automation," Banking, LIV (October, 1961), pp. 63-64.

[2]The remaining part of this section draws heavily from the following sources: "Banking News," Burroughs Clearing House, XLIV (March, 1960), pp. 15-16, and "Automation for the Smaller Bank," Banking, LII (June, 1960), p. 62.

Commercial and Savings Bank of St. Clair, the Marine Savings Bank of Marine City, and the Algonac Savings Bank of Algonac. This pioneering venture is a pooled operation where a separate service corporation, Central Records, Incorporated, was formed to provide the benefits and safeguards of automation that otherwise would not be available to the banks individually.

The Central Records company was formed after fifteen months of comprehensive analysis and study. In addition to consideration of expected volume, cost and service factors, and the use of future equipment now under development, three major problems had to be solved: (1) what equipment to use, (2) where to locate the Central Records company, and (3) how to organize the company.

The equipment survey was a joint effort. The equipment finally selected included two Burroughs electronic bookkeeping machines together with an auto-reader to verify totals. For on-premise printing of checks and other documents, a Todd high-speed check imprinter was installed. Addressograph-Multigraph equipment was used to print name plates and file guides and to assign account numbers. Also installed was equipment that automatically and simultaneously prints the customer's name and address on the combined ledger-statement forms that have been imprinted on the reverse side with three magnetic stripes for electronic bookkeeping.

After selection of equipment, each bank made changes in basic forms used, as these had to be identical. As part of the system, extensive use of color coding has been followed to avoid confusion and to maintain segregation of records.

To be centrally located was not enough. Considered to be more important was accessibility. As a result, the study inquired into local traffic conditions, transportation facilities, availability of messenger service, and minimum telephone costs. Eventually, operations were centered in a modernized office in Marine City, a point about mid-way between the other two communities.

The organization structure chosen was a corporate set-up along the lines of a mutual cooperative. With this structure, the center remained relatively independent as a functioning unit. However, the individual banks own the equipment and lease it to the service corporation and retain control of the organization. The operating staff for Central Records is recruited from outside the three banks. The operation is established on a non-profit basis, with each bank paying a service charge based on a per item cost of the work performed for it. Initially, operations were confined to deposit accounting for all three banks. Additional bookkeeping functions are to be added as the plan progresses.

The study also revealed to the three banks concerned that the Central Records plan would save time, space and money for each of the banks. For example, two bookkeping machines are utilized by Central Records to process the same volume of work formerly done by the three banks on a total of eight machines. Space previously occupied by these old machines has now been made available for expanded services and convenience. In addition, the Central Records' staff of five people is doing the same amount of work, and may possibly be able to do more, than nine full-time bookkeepers and four part-time helpers were able to do individually in the three banks.

The Central Records' plans call for employment of a bank courier firm plus one regular staff man to deliver items to the center and return them to the banks. Initially, the plan called for processing about 4,000 items daily. In-clearings are to be proved, checked and fine sorted by 11:30 of the morning received. They will then be picked up, posted the same day, and held by Central Records until the following morning. Over-the-counter items received by each bank will be run through proof and fine sort and then delivered to Central Records late the same day for posting the next morning.

The use of a joint processing center such as Central Records, Incorporated, may raise legal questions. It seems more than likely, though, that such would have been explored by the banks' officers prior to construction of their processing center. Questions which might be raised are discussed by John J. Clarke in an article appearing in the April, 1962, Business Lawyer. He presents his arguments under three headings: (1) Presentment at the off-premises processing center, (2) proprietary interests in cooperative processing centers, and (3) problems of confidentiality.[1] In regard to the latter, the extreme care used is illustrated by the telephone system utilized by the banks and the data processing center. First, the phones in Central Records follow the color coding scheme used for the data processing records and documents. Since all center employees soon became acquainted with these color differences, there would be no mistaking which bank was calling for information, even if oral identification was not given over the phone. Second, the telephones have unlisted numbers; only designated individual bank officials have access to their bank's numbers. By this medium, information concerning a particular bank or its customers can only be given to a proper official of that bank.

Some Do's and Don'ts

Edwin J. Steinmetz, president of Central Records, offered the following helpful hints to other banks contemplating a similar joint processing center.

1. Before starting, be sure that the willingness to cooperate outweighs any basic desire to compete.
2. Don't expect to rush into it (15 months may be too long. It will take at least 4 or 5).
3. Assign somebody the job of setting forth a specific plan or procedure and then have the others discuss it. Don't assume that a program will evolve if the responsibility for starting it

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[1] John J. Clarke, "Electronic Brains for Banks," The Business Lawyer, XVII (April, 1962), pp. 532-547.

is not fixed.

4. Concentrate on the currently available equipment that will meet your specific needs; don't get too involved with devices in the development stage.
5. Pick a site in terms of travel time and communication to the participating banks rather than just distance. Don't house the center in one of the banks.
6. Select an organizational setup that is jointly controlled by the participants but is not operated by any of them.
7. Determine your needs on the basis of peak loads rather than average volume.
8. Carefully estimate the growth potential several years in advance to be sure of maintaining adequate facilities.[1]

Other Computer Sharing Aspects

Computer sharing is promising and seemingly will become a vital force in bank operations. Obstacles will eventually be overcome, but not until the larger banks, the banking pioneers in EDP, become considerably more automated and have had more experience than at present. High installation costs may hold initial joint facility efforts to 'tronics or a punch card system, but even this approach would allow a gradual shift to more highly sophisticated systems. In addition, as improved machinery becomes available, there is no reason why used electronic equipment should not become available at reasonable prices. This could be a big inducement to smaller banks to utilize sufficiently modern and fast equipment for their less voluminous operations. Another factor is the continued

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[1] "Automation for the Smaller Bank," op. cit., p. 62.

improvement of electronic equipment, a factor which is making a joint equipment facility more feasible for an increasing number of the very small banks. Both Burroughs and IBM have introduced what they term a "complete accounting system for smaller banks" with costs low enough to make installation of such a system attractive. A similar system is also being made available by the Radio Corporation of America.

Also introduced, but so recently that the use of the equipment is limited, is the National Cash Register Company's 315 system. The most novel feature of this system is its Card Random Access Memory unit (CRAM), an external storage device utilizing seven magnetized strips on Mylar cards. Since more than 32,000 digits may be recorded on each card, and 16 CRAM units can be included in each 315 system, more than 133 million digits of decimal storage capacity is made potentially available.

Of special interest to banking is the on-line communication network which uses three different remote units. These consist of window posting machines, teleprinters for transmission of messages to and from remote locations, and a device for automatically capturing information at the point of origin and feeding it directly into the computer or recording it on punched paper tape for input when a data collection system is needed. As many as 128 window posting machines or 2,048 remote inquiry units may be used with a single 315 system. NCR also says there is no limit on the number of data collection units that can be used. Banking and financial institutions can utilize this new equipment in demand deposit, savings account and mortgage accounting. The modular concept equipment is expansible from a basic $4,000-a-month system.[1] The implications for joint data processing facility use are obvious.

Promising though it is, computer sharing is no panacea. As in any cooperative venture, psychological as well as technical problems arise. However, it would seem from the foregoing, that there are many possible routes for increased automation for the smaller bank through joint facilities operation.

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[1]The information concerning this equipment is from "Systems for Business Data Processing--NCR 315," Management Controls, IX (June, 1962), pp. 106-108.

CHAPTER VIII

IMPLICATIONS OF PRESENT EDP TECHNOLOGY ADVANCES

Introduction

During the last thirty years great changes have taken place in data processing methods used by banks. The experience of Harlan H. Griswold emphasizes some of these differences.

> Just a little over twenty-eight years ago I went to work for a bank for the first time as a messenger. In due course I was appointed bookkeeper. This involved working at a stand-up desk with hand posted ledgers which then, and even in retrospect, seemed huge. I was positioned between the cage of the Paying Teller and that of the Receiving Teller. Each cage had a little slot in it so that the teller could pass work to me throughout the day.
>
> The Receiving Teller took each deposit, added it up mentally to be sure it was correct, separated the cash and the checks and then passed the tickets through the slot to me. Right then and there I posted the tickets by hand on the customer's ledger sheet in the book before me.
>
> The same thing happened with the Paying Teller. As rapidly as he cashed a check drawn on our bank, he passed it through the slot to me and I posted it then and there.
>
> At the end of the day my job was to balance up the Boston Ledger for which, fortunately, I had the use of an adding machine. There were no Wage and Hour Laws and, before anybody went home, tellers included, everything in the bank had to balance. As I recall it, we could not tolerate a ten cent difference. Sometimes this meant a considerable amount of overtime work for which there was not extra pay. In those

> days it was felt that no pay for overtime was good discipline to assure that the books would be kept in balance throughout the day. It was a great novelty when we numbered our savings accounts. It is hard now to recall the antagonism with which both the banks and the customers reacted to numbers. A little later, in 1937, when banks came under the Social Security Act, I recall vividly my own resentment and that of my peers in becoming a number for this purpose.
>
> Our bank was one of three in the community situated on three of the four corners of the main thoroughfare. Ours was the only bank of the three that had an adding machine. At the end of the month our practice was to complete all our records and then lend our adding machine to the other two banks. This was only twenty-eight years ago.[1]

The transition from practices of Mr. Griswold's early days in banking and those of today has required many changes, some in methods, others in procedures, and a number in mentation and "practimation."[2] Lately, there has been a general acceleration. Reports and management information have been made available earlier and in greater detail, a trend to centralization of records keeping has developed, control measures have been modified and implemented to new methods, and bookkeepers, as well as others, have been required to learn new skills.

Acceleration has been brought about mainly by introduction of electronic equipment, as data processing has developed rapidly during the relatively few years of its

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[1]Harlan H. Griswold, "A Computer Philosophy for the Smaller Bank," Journal of Machine Accounting, XIII (February, 1962), pp. 19 and 21.

[2]A coined word used for advertising machinery systems that provide "automation hand-in-hand with practicality," or simply, "practical automation." (Friden).

existence. The basic machine that has made it possible, the electronic computer, is now employed for many uses. The first generation of computers was considered an engineering miracle. The second generation, with greater experience, brought adaptations to special purposes and more utilitarian logic. The third generation is likely to further the economics of the logic through such innovations as parallel programming and integration of machinery components and communication systems.

It was during the second generation of computer equipment that electronic computer systems were utilized in handling checks and processing bank data. Bank check volumes and clerical work were growing at an unprecedented rate; manual and mechanical data processing systems then used were fast becoming inadequate. Consequently, a desire for quicker clearing and processing of checks drawn became prevalent. There was a general urgency to speed up highly repetitious bookkeeping activities and to reduce manual check handling chores. Furthermore, since accuracy is a major requisite in banking--accuracy in record-keeping transactions as well as money transactions--machine accuracy and built-in machine error-checking qualities were hailed as means of increasing accuracy and eliminating some human error.

The use of electronic equipment has produced a number of changes not only in bank clerical functions but also in management planning and control policies. A number of interesting implications have developed. In addition, new machine systems have given cause for reflection on past auditing techniques. The major purpose of this chapter, therefore, will be to discuss some of these implications, changes and developments. To facilitate presentation, discussion will be grouped under the general headings of (1) operating personnel, (2) management, (3) dangers of implementation, (4) additional implications, and (5) auditing.

Operating Personnel

The operating personnel most affected by the utilization of electronic equipment for bank data processing are those associated with the bookkeeping function. As machines take over the actual record updating, ledger-posting bookkeepers are no longer needed. In their place, however, personnel are needed to operate the new machines now utilized for check handling and bookkeeping purposes. Thus, with electronic equipment being installed in banks, two personnel problems arise. First an adjustment is necessary in the clerical labor force to bring into proper relation the new ratio of labor to capital. Second, personnel possessing a variety of new skills and competent to design, operate and manage electronic data processing systems must be obtained.

Clerical Labor Force Adjustment

For the first group, qualifications will need to be reassessed, retraining required, and then transfers made to different jobs. Usually, such transfers will be made at the same or a higher pay scale, depending on the job assignment, regardless of the additional costs of retraining and familiarizing personnel with their new tasks. If clerical employee capabilities cannot be effectively utilized elsewhere, personnel will be released. However, this seldom happens and in those few cases where employee reductions are initially made, they will be slight, and will take place gradually; as people leave their jobs, they will not be replaced. Due to the type of personnel employed for many of banking's purposes, no one who wants to work need lose his job, as a high rate of turnover exists.[1]

Note the following:

> Automation has invaded the white-collar field, resulting in a saving of personnel costs. Such savings, however, usually come painlessly. Normal turnover among white-collar women workers is so rapid that, by some estimates, the boss, on average, can figure one third[2] of his office girls will quit every year. Accordingly, to trim the staff, he need only rely on what one management consultant has

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[1]In a letter from Bank of America's C. P. Weber, senior analyst, February 27, 1962, it was reported that "not even one person lost his job with Bank of America either directly or indirectly as a result of automation." Michigan National Bank of Lansing, Michigan, reports the same thing.

[2]Women employee turnover for bank bookkeepers probably exceeds this figure. Michigan National Bank's estimated turnover for its Lansing office is between 40 and 45 per cent, while the Bank of America reported its turnover for the year 1956 as 78 per cent.

facetiously christened the "A & P method"--attrition and pregnancy.[1]

Transfer from one department to another can take place without long overstaffing any one department. Knowing this, bankers have not hesitated to assure personnel that their employment is secure.

Present Adjustments. Part of the work formerly done by bookkeepers is still necessary. Since no device has, as yet, been introduced to verify the correctness and authenticity of the signature on a check, and since full reliance on account numbers only seems a dubious if not unwise practice, a function (authentication of signatures) now known as check paying is continued. Thus, part of the ex-bookkeepers can become check payers, at least until methods are developed which will make elimination of this step possible. In addition, personnel are needed in the data processing center, making further utilization of bookkeeper personnel a possibility. Bookkeepers personally qualified may be used in teller work, and so on.

It has been stated by bankers that a more stimulating type of work is the lot of transferred bookkeepers. This may be true in many cases. Yet, not all tediousness and boredom have been eliminated. In fact, it appears that there has only been a transfer of routine tasks from

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[1] "News from the World of Business," Reader's Digest, July, 1962, p. 193, reported originally by Edmund K. Faltermayer, "What Comes Naturally," in the Wall Street Journal.

manual to machine methods, with some machine tasks being even less stimulating than the manual tasks. For example, check signature verification and check filing does not seem overly stimulating, even though it is a highly important function. Similarly, after the "newness" has worn off, electronic sorter machine operators find their work repetitious and often boresome in nature. Thus, although some jobs have been eliminated which were considered less desirable because of their unstimulating and repetitive nature, new ones contain some of the same characteristics.

Possible Future Adjustments. Foreseeable developments in banking indicate that any early reductions in personnel which might have been experienced from EDP will be largely offset by demands for employees in other work categories. New services will be introduced and personnel time and skills will be directed toward more productive and creative work. Thus, the net employee total will change but little, and may eventually increase in number. For example, the Bank of America, with one of the largest bank EDP installations, added 1300 employees during 1960[1] rather than experiencing a reduction. Although the proportionate increase is probably insignificant, the point is that EDP has not resulted in personnel reductions, let alone the large-scale reductions originally predicted for it. In

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[1]Arnold E. Keller, "Automation--The Job Maker," a reprint from Management and Business Automation (April, 1961), p. 2.

addition, 45 per cent of those staff members formerly employed as bookkeepers received higher paying positions.[1] If this same pattern holds true for most banks using EDP, and it appears that it likely will, personnel savings will not result from eliminating people presently employed. Rather, as banks experience growth and expand customer services, the need for a continuously increasing number of clerical employees to cope with the rising mountains of paper work will be significantly reduced. Hence, electronic equipment, while not causing appreciable, if any, initial reductions in employee numbers, will permit future personnel savings because of its capacity for large added volumes of work. Furthermore, as automation progress introduces new innovations, it seems likely that additional human time and proficiencies will be freed for developing and introducing new services into the nation's economy for the benefit of all.

Computer Center Personnel

A second type of personnel is needed to cope with another personnel problem arising from use of electronic equipment, the problem of competently staffing the computer center. With automatic equipment, the trend toward centralized accounting should be accelerated. The processing

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[1] *Ibid.*

capacity and the cost of equipment involved will almost make this change mandatory. To staff the newly created EDP centers, personnel with appropriate qualifications and new technical skills will be required. Employment criteria and training techniques will require modification to obtain needed employees. Programs will need to be instituted which will provide an adequate supply of qualified, competent personnel at all times.

For those individuals who can qualify and who have an interest and a liking for this type of work, the computer center offers a number of new positions. Sorter-reader-converter operators, console operators, programmers, output equipment operators, librarians for magnetic tape files, and miscellaneous machine operators have had to be trained by banks going to EDP. Trained personnel were not available to fill the new positions which EDP brought about. And, as more installations are made, the demand will continue high for qualified personnel.

Illustrative EDP Center Organizations. Peter Andre has said that EDP systems' personnel fall into three different categories: (1) system design, program maintenance, and supervision, (2) operations and control, and (3) clerical workers.[1] "These three categories group personnel by similar qualifications and desirable characteristics and level

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[1]Andre, _op. cit._, p. 17.

of intelligence."[1] Shown on page 241, Figure 18, is an organization chart for a relatively large system, designating the job requirements in each group, with salary range and number of employees required for each classification. In Group I are included an EDP center manager, a systems analyst, an operations coordinator and programmers. Group II is composed of console operators, tape handlers, processors, a control clerk and a control clerk assistant. Group III consists of input machinery operators and a transcript clerk. It should be noted that the organization shown here is designed for use by a savings bank.

A second organization chart, page 242, Figure 19, designed for a large commercial bank, utilizes a slightly different organization structure, dividing computer center personnel into sections. General supervision is administered by the center director and his assistant, with the assistant presumably officiating as systems analyst. Computer room personnel, the console operators, output machinery operators and a supervisor are designated as the Computer Section. The Settlement Section includes a supervisor, sorter-reader-converter operators and the settlement clerks. Programmers are in a separate Programming Section. The Conversion Section is responsible for a smoothly functioning and orderly conversion process to the EDP system. Personnel include a field representative who is responsible for indoctrination

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[1] *Ibid.*,

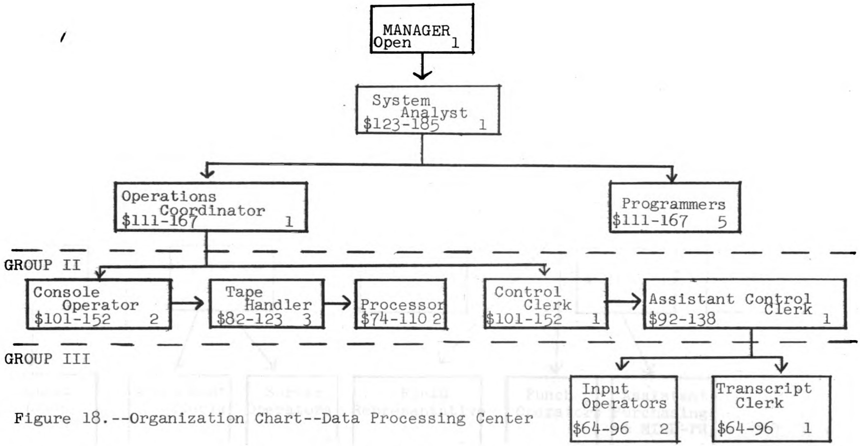

Figure 18.--Organization Chart--Data Processing Center

Source: Peter J. Andre, "A Program of Electronic Data Processing for Savings Banks" (unpublished thesis for The Stonier Graduate School of Banking conducted by the American Bankers Association at Rutgers University, New Brunswick, N. J., June, 1961), p. 18.

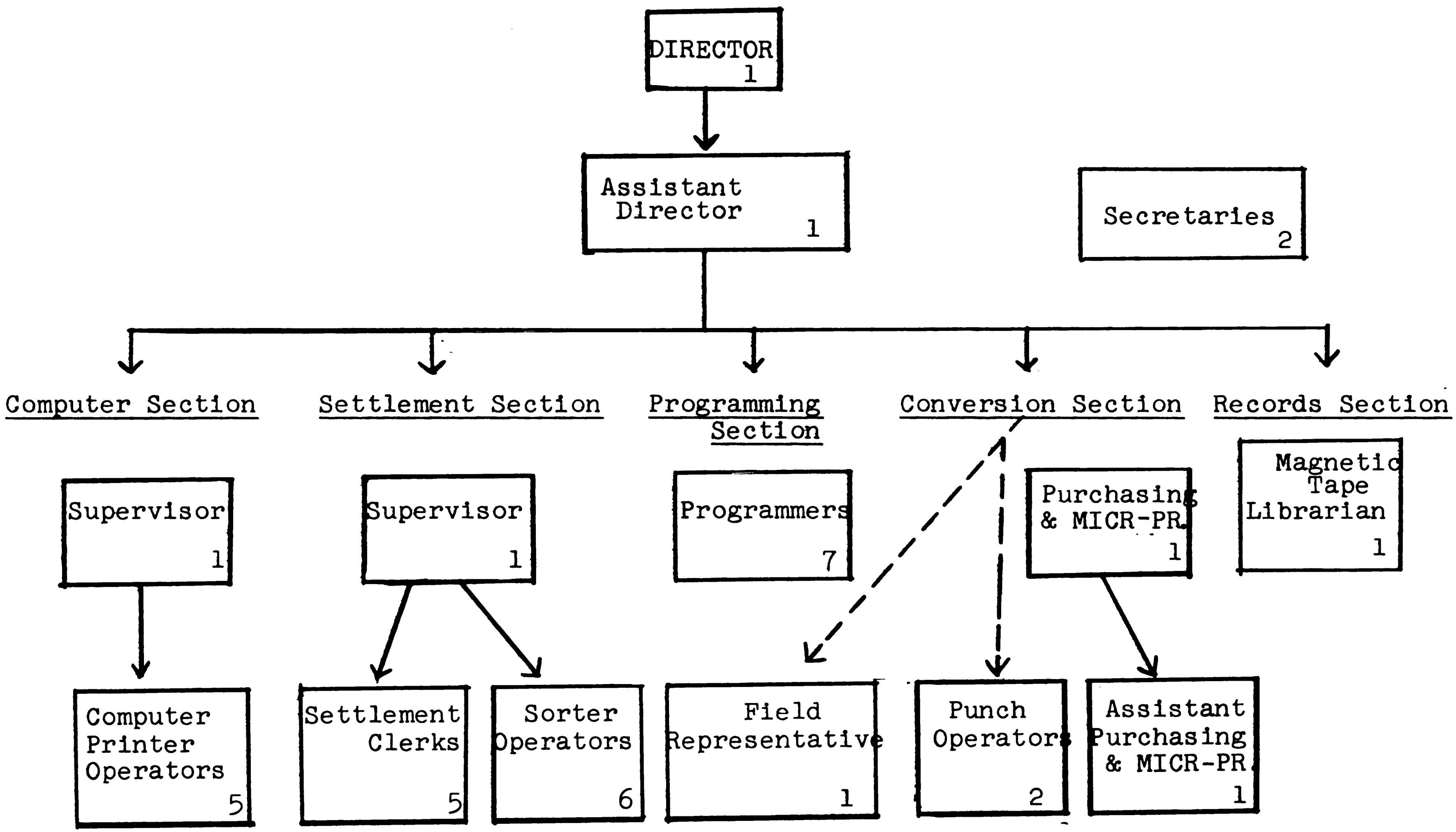

Figure 19.--Organization Chart--Data Processing Center

Source: Michigan National Bank, Lansing, Michigan.

programs for outlying bank office and branch personnel, as well as for actual conversion arrangements with officers of these units whenever an activity is to be placed on the computer. Paper tape punch machine operators for original computer input are also included in this section. Two other employees are included in this section; one officiates as MICR program director and purchasing agent, the other as his assistant. These men are responsible for all public relations and activities relative to the magnetic ink character recognition program. During the early stages of preparing for EDP, it was their job to meet with check printers, and work with them on mutual printing problems. They also had the responsibility of assisting bank customers--especially non-controlled commercial accounts--in making the switch-over to MICR checks. In addition, they have been required to work closely with the field representative in outlying bank offices and branches. Their combined efforts were needed to see that the conversion to machine processible checks, and then the bookkeeping activities to the electronic machines, was made as smoothly as possible. As the bank's own conversion process nears completion, their capabilities will be further utilized in converting correspondent banks and others to systems for electronic data processing by the bank's computer service center. A further responsibility of these two men is the purchasing of operating and maintenance supplies for the computer center. A magnetic tape librarian is the only member of the Records Section. In addition to section personnel, the center director and his assistant, two secretaries are presently employed.

The two organization charts illustrate differing organization structure concepts. The first has apparently eliminated all middle management except an operations coordinator, while the second, employing more personnel, utilizes section supervisors for their computer and settlement sections, two highly important operations. It is also possible that individuals in the other sections act as supervisors for the activities within each section. In addition, while the first has arranged employees according to "similar qualifications, desirable characteristics, and level of intelligence," the second has grouped employees according to particular functions transpiring within the computer center. Both indicate the variety and number of jobs provided by an EDP installation. While some are still clerical in nature, most are higher paying, more interesting and in some instances more stimulating than the older bookkeeping jobs connected with manual data processing systems.

Management

The number of benefits and advantages which bank management may receive from an electronic data processing system will vary according to a bank's particular circumstances and the aggressiveness, ability and ingenuity of that management. As well as direct benefits, there are also a number of intangible benefits which may accrue. These may include data for more comprehensive reporting, determination of most advantageous use of a bank's funds, information leading to favorable branch bank establishment, as well as other additional management information.

Advantages may be grouped under three basic headings: "cost reduction, a means of providing better accuracy and service, and an opportunity to improve procedures in a way that was not feasible before."[1] Without commenting fully, certain aspects of these advantages will be discussed in this section under the headings of: (1) cost reduction, (2) planning and control, (3) maximizing profits, and (4) internal organization. A subsequent section will pertain to other aspects and will be titled "Additional Implications."

Cost Reduction

Banking has a higher ratio of clerical costs to total costs than any other industry. Consequently, since it was believed that wages would increase at a higher rate than machine costs, purchase of automatic equipment to perform clerical tasks seemed to be good business. In addition, economies reportedly being received by other business industry users of EDP were anticipated for bank users.

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[1]Klion, op. cit., p. 19.

Bankers have for some time been concerned with the possibility of increased service charges to the banks' customers. Thus, the application of electronic equipment to process the paper and handle clerical activities of a bank became important in order to hold customer service charges within reasonable limits. Also viewed with interest were the possibilities of improving existing services and expanding the variety and number of services offered. Finally, even though banking requires cooperative efforts for a smoothly functioning central banking system, banks are highly competitive. Consequently, many bankers felt there was danger in ignoring new developments which might benefit them.

The Other View on Cost Reduction

There is nothing about a computer and its use that will guarantee efficiency or an increase or maximization of profits. There are many things--systems, personnel, training, morale, and so forth--which enter into efficiency, besides machines. Likewise, profits are not the result of only one facet of a business's operation, but are a derivation of everything that a bank does. Earnings depend on lending policies, interest rates, and a myriad of other things. Expenses reflect charges for interest paid, wages, depreciation and many other items.

As a result of bankers' realization that profit depends on so many factors, and not just on clerical cost reduction, some banking institutions were at first reluctant to move into the use of electronic equipment. Some bankers were unable to see where cost reductions might be realized. The number of costs for computer operations seemed endless, and the amounts appeared staggering. Therefore, computer systems were visualized as feasible for only a relatively small number of banks, perhaps the largest two or three hundred. However, those banks having computer systems have gained from their experiences and their pioneering efforts are pointing the way for additional banks to follow. Computer modifications and improvements have also taken place. These developments, as well as others, make electronic computers economically justifiable for a far larger number of individual banks. It is estimated that 5,000 or more may now find one of the available computer systems feasible. Nevertheless, the conversion period is costly and requires a great deal of time and effort. Therefore, data handling costs have not been reduced for a very large number of the banks employing computer systems. For example, note the following from the Third Federal Reserve District's survey:

> Quite a number of bankers have told us that they actually do not expect savings from mechanization in the short run. They say they go in for it with the more distant future in mind. Mechanization to them is a matter of saving space, or just being able to conduct future operations in an existing building. They say mechanization means greater accuracy, better service to the customer, and better control through centralized accounting. All these are important objectives but their effect on profits may be hard to isolate.

> It is entirely possible that some mechanization may actually reduce short-run profits. It costs a lot to install new machinery and get it operating smoothly. . . . Detailed studies must be made, operators trained, complete systems changed, jobs programmed, and so on. It may be several years from the day the order is placed before a computer does any productive work. And even after an operation is on a computer, management also may continue for a while to do it the old way--just to be sure. Then it may take several more years to get enough operations on the computer to use it at an efficient percentage of capacity. All the while the computer and its large staff of high-salaried personnel may be draining, not adding to, profits.[1]

Other writers have written on the futility of increased mechanization merely for dollar cost savings. For example, John Postley has written:

> One of the most popular advantages advertised on behalf of electronic data processing equipment is that of direct dollar savings. However, while such savings can probably be achieved in some cases (even though very few such examples can be cited today), the most important data processing dividends are not normally to be found in this area. Net savings provided by such things as personnel and floor-space reductions offset by increases in equipment and unit personnel costs are not likely to be a major consideration.[2]

Winslow Pike (as reported earlier) implies that banks are not in a position to evaluate cost savings because they do not know their exact costs and have not reached their attainable efficiency under previous systems. Note also the following comments of Robert Gregory and Richard Van Horn:

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[1]"Paper Tiger," op. cit. (July, 1960), p. 5.

[2]John A. Postley, Computers and People (New York: McGraw-Hill Book Co., Inc., 1960), p. 7.

> Achieving efficient use of new equipment within data-processing systems will probably be more difficult in the future than it is today. The general level of knowledge and experience with equipment will increase; but the rate of equipment improvement will continue to challenge the ability of people to use it for business-data processing.
>
> To date, it appears that few business-data systems using electronic equipment represent radical departures from the structural arrangements for processing previously in use. The task of introducing new equipment seems so great that system changes tend to be restricted to the minimum compatible with the use of new equipment. The brave hope is that the structure will be changed after the problems associated with new equipment installations are solved.[1]

Earlier they had written:

> Costs are incurred at every stage of processing while benefits result only from managerial action. Even good decisions are valueless unless they lead to action.[2]

One action that might further management objectives would be the adoption of comprehensive cost accounting and budgeting techniques for more effective responsibility accounting, performance measurement, and management by exception--the foundations of a management control structure. By this action, each element of the management structure, the machinery system, and the data processing and information producing processes would be organized to promote efficiency, aid in cost stabilization or reduction, and further the organization's aims and objectives.

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[1]Robert H. Gregory and Richard L. Van Horn, Automatic Data-Processing Systems (San Francisco: Wadsworth Publishing Company, Inc., 1960), p. 616.

[2]*Ibid*., p. 28.

Prospective personnel reduction, with its attendant benefits, has been one of the most common reasons given for undertaking electronic data processing installations. For example:

> One particular saving expected of electronic data processing hardware and techniques may prove to be the most crucial of all. This is the potential saving of manpower to accomplish the data processing job. . . . A much larger saving, purely in terms of numbers of people, can usually be expected in large systems. In some situations it is this manpower saving which is the major one dictating the use of electronic data processing equipment, especially in situations where the work load increases or the personnel force must be cut or both. (Italics mine.)[1]

Other writers generally dispute the contention that savings through personnel reductions will occur. Given as arguments are the facts that personnel requirements have not been significantly reduced and where reductions have been made, cost reductions therefrom have been offset largely because of greater skills requirements and accompanying higher pay of computer center personnel. Two statements supporting the lack of savings from personnel reductions are cited below:

> There is general agreement that the greatest potential for significant savings with EDP does not involve clerical replacement.[2]

> Drastic personnel reductions will not occur. Economic justification must take into consideration the

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[1]Postley, *op. cit*., p. 8.

[2]Editorial, *Management and Business Automation*, V (February, 1961), p. 45.

other benefits.[1]

The foregoing indicate the general futility for banking organizations to install EDP equipment solely on the basis of effecting cost savings. Savings seemingly will not start to accrue immediately on equipment installation, nor on completion of a successful conversion. It will take time to incorporate all the various facets and factors into a dollar-saving economic unit. Savings will come about as the result of a gradual build-up from a number and a combination of factors, and from improvements in many areas of a bank's operation. In some instances, savings may not accrue at all. For savings to be achieved, a determined effort must be made to bring them about, and the responsibility for seeing that they are achieved must be specifically assigned.

In summary, Postley is quoted once again.

> It must be said that it is far from well established that any saving in direct costs can be achieved by replacing manual operations with computer operations in the commercial environment. There is presently every reason to suspect that failure to realize savings in computer systems over manual systems when problem complexity is concomitantly increased will continue to be the typical situation.
>
> In many cases, however, it has been demonstrated that certain significant expansion in terms of volume of operations can be achieved with electronic data processing equipment at little or no *additional* cost, while a corresponding increase in the volume handled in a manual system would result in an almost corresponding increase in cost.
>
> The point is that complexity is added in order to make systems better; systems are not better merely because they are more complex. . . . Hence one may say that savings accrued are due in

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[1]Andre, *op. cit.*, p. 85.

in large measure to the computer system which makes the new data processing system possible.[1]

Planning and Control

"Even more intriguing than improvements in record keeping is the prospect of marked enhancement in the effectiveness of management controls."[2] In other words, electronic data processing will make possible effective "management accounting," an accounting which accentuates reports and statistical data useful to management in establishing policies, developing plans, and controlling operations. Mere statistical recording for the sake of records is supplanted by record keeping which will supply timely, accurate and meaningful reports which, in turn, permits the controller to control, and the manager to manage. Where management has heretofore looked to accounting primarily for stewardship and formal recording purposes, planning and control can now be emphasized.

These two functions of management, planning and control (especially operating control) generally involve two different levels of management. Planning, a function of top-level management, requires information from both external and internal sources and has been accomplished, to a large extent, by decision-making based on intuition.

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[1]Postley, op. cit., p. 16.

[2]Data Processing by Electronics, op. cit., p. 6.

The electronic computer should make possible a number of analyses and reports which would allow management not only to meet the immediate demands of the present, but permit planning for profits over a longer range. "The bank with a five-year forecast of its organization, personnel, facilities, services, and investments can begin to control rather than simply react to its environment."[1] Thus, a computer system permits simulation of operations. If the parameters and relationships between volumes and costs and manpower and prices, and so forth, have been established, proposed projects, or alternative project proposals, can be pre-evaluated.

The second level of management is primarily concerned with control of conditions within the enterprise. And, where top management uses analyses, projections and predictions, lower management uses operating reports. Its interest lies in providing information to top management for its use, accurate proof of earned and unearned income, a logical order of data flow and data communication and a system of adequate internal control. Thus, it is important to realize that a computer is only part of automation; it requires new thinking, and it must be combined with an adequate system of planning and data communication if it is to be effective. Commenting on this aspect of an EDP system, Virgil F. Blank has written:

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[1]K. S. Axelson, "Management Controls in Banking," Management Controls, IX (April, 1962), pp. 55-56.

> The first important consideration in applying systems and procedures techniques to electronic data processing is a matter of attitude. It is a matter of adopting a frame of mind equivalent to the viewpoint of management. It is only in this way that the eventual potential of EDP will be realized.[1]

Maximizing Profits

One major advantage claimed for electronic equipment is that it can be used to provide management with information not otherwise practically obtainable. Therefore, the implication is that management can utilize this information to improve operations and make profit maximization a possibility. This, in turn, means that an EDP system can aid in planning for the future and can provide information needed for forecasts and projections. That the possibility exists cannot be denied. However, whether or not the "possible" becomes "probable" depends upon the use made of the machinery system as a management tool, as a tool to originate accurate, dependable data for decision-making.

What management really wants when it installs a costly EDP system is its money's worth. Because of high costs of the equipment, costs of installation, and costs of converting to data processing with computer systems, this may not be easily accomplished. Nevertheless,

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[1]Virgil F. Blank, "The Management Concept in Electronic Systems," The Journal of Accountancy, CXI (January, 1961), p. 61.

Gerald L. Phillippe has listed and presented four major benefits which can be achieved by its use which will further this objective. They are: (1) timeliness, (2) selection and evaluation, (3) business planning, and (4) business intelligence.[1]

(1) Timeliness is perhaps the most significant of the four. High-speed equipment is making possible a complete report of each previous day's activities the first thing each morning. Therefore, decisions are based on facts, and not on estimates. Decision-making becomes more effective, as accurate and proper information is made available when it can be advantageously used. In addition, computations and calculations can be quickly and accurately accomplished if, and when, they are necessary. Furthermore, reports previously desired but not available because of complicated computations, and delays occasioned from putting more pressing work first, are now made feasible and can be routinely prepared. In short, management decisions become educated decisions based on the right kind of information accurately and electronically prepared when needed.

(2) Selection and evaluation refer to the process whereby the various activities and functions of a bank can be differentiated, analyzed and then appraised. This can

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[1]These benefits were listed by Gerald L. Phillippe, comptroller of General Electric, in a presentation to the Sixth Annual Data Processing Conference of March, 1960, entitled, "What Management Really Wants from Data Processing," and reported in "Data Processing Today: A Progress Report," American Management Association's Report No. 46, pp. 7-13.

be done by looking at each activity separately, by looking at pairs of similar activities, or by viewing all as a whole. Studies can be made to determine the strengths and weaknesses associated with a particular service. Steps may then be taken to eliminate the weaknesses and make that service more productive and profitable. The extent and area of risks may be defined and assessed. Plans and proposals may be tested in advance by use of mathematical models simulating realistic banking situations, thereby averting costly mistakes. As a result of these and perhaps other considerations, management personnel can improve their decision-making ability and receive stimulus to their thinking and creativity.

(3) Business planning, as discussed previously, has reference to the long-range, integrated plans of the institution as a whole. It is primarily oriented toward the future and planning for growth, expanded services, improvements and progress in general. By making the computer center an adjunct of management and not solely just another accounting tool, it can become the "nerve center" of the complete business operation.

(4) Business intelligence "assumes not only the collection and processing of information, but also its proper selection and evaluation through a business information system. . . . [This] process leads to a new and superior

form of intelligence which can be interpreted, retained, and applied."[1]

The foregoing discussion is not intended to infer that machines can be substituted for the human element in management. On the contrary, "automation is one of the critical areas where management must manage."[2] This same idea is somewhat aptly expressed by Mr. Fiock when he states:

> The new computer way requires skill, better planning, more precise control; the potential gain is great, but the price of failure is dramatic.[3]

It becomes evident from the foregoing that profit maximization requires that management information be made available by (1) coordinating the capabilities of the machinery system with good planning, (2) designing a functional and proper organizational structure, (3) instituting a suitably designed system for data flow and processing, and (4) providing a means of measuring the performance of the combined system of men, machines and information.

Internal Organization

The internal organization of many banks will probably be changed because of increased use of automatic equipment. For the larger bank, an effective implementation process

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[1] *Ibid.*, p. 13.

[2] Diebold, *op. cit.*

[3] L. R. Fiock, Jr., "Seven Deadly Dangers in EDP," *Harvard Business Review*, XL (May-June, 1962), p. 88.

will require cutting across traditional department lines. Middle management may resist such changes, and some ill feeling may result. The effect will be to slow up the EDP program temporarily or to reduce its effectiveness. Some departments will be combined with others, or will become largely staff organizations with the responsibility of planning operations rather than carrying them out. The operations function will likely grow in importance and require delineation and elevation, as more and more banks realize the importance of proper systems and procedures.

As banks become highly integrated, there will be fewer levels of administration between senior and junior management. This will result from the fact that, as departments are combined or their functions changed, fewer functioning departments will require supervision. In turn, employment, promotion and progress of new men entering a bank may be influenced. In some cases it could enhance promotion chances, while in others the reverse may be true. In any case, it appears that methods of training top-level management will need revision, or new methods will need to be devised. This results from the fact that fewer intermediate-level supervisory positions will need to be filled, and that EDP supervisory personnel will require training not previously needed. For example, EDP supervisory and computer operating personnel may need training in accounting systems design as much as they need bank operations training and experience.

Dangers of Implementation

As indicated earlier, good planning requires more than just buying advanced design and highly sophisticated machinery. L. R. Fiock, Jr., suggests that business men are not aware of some of the dangers involved in setting up and evaluating an EDP system. He implies that both time and money have been wasted because of what he terms "Seven Deadly Dangers in EDP."[1] These seven points of Mr. Fiock both amplify and summarize the preceding material.

1. Poor procurement--The implication is that electronic equipment is bought because of the near magical results reportedly received from its use, without due consideration being given to the cost of realizing such results. Once bought it may not be efficiently utilized; it has far more capability than is usually used. Or the equipment may be purchased because of the "boss's" desire for a new prestige symbol, because of someone's whim, or the desire to be among those first in the field. These reasons, or any others like them, are not sufficient. "A well-planned management improvement program should be the only incentive to spark an acquisition."[2] This recognizes the need for proper planning through feasibility

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[1] Fiock, Jr., op. cit., pp. 88-96.

[2] Ibid., p. 90. See also Gardner M. Jones, Electronics in Business, M. S. U. Business Studies (East Lansing: Michigan State University, 1958), pp. 39-42.

studies, adequate preparation, and consideration of organizational elements, costs, machine capabilities and so on, as well as of hoped-for results.

2. Ignorance of procedures--This implies that most executives do not recognize the limits, capabilities or shortcomings in their present methods. Mr. Fiock states:

> Full computer potential will never be reached until blissful mis-impressions of present policy execution are shattered.
>
> . . . .
>
> If you are going to take the step, you should accept the fact that over 80 per cent of the getting ready is self-analysis and planning.[1]
>
> Costs of present methods of operation have risen at the average annual rate of 15% for the past 10 years, according to the Federal Deposit Insurance Corporation. Furthermore, until each bank reaches its maximum of efficiency and knows its exact costs, it cannot evaluate properly the comparative cost of any other system. <u>The majority of dollar savings that have resulted where automated equipment has been installed, have been the result, not of new hardware, but, of systems and procedures improvement at the time of installation and could have been achieved without the new machinery</u>. (Italics mine.)[2]

3. "Service" over "control"--Some companies have employed computers on a "service" basis while others try to establish a "control" network. Service involves selecting equipment and paying rental costs. A control network is predicated upon the basic principle that "all of the various functional controls are fabricated into a single operations control system for the entire facility."[3]

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[1] *Ibid.*, p. 90.

[2] Pike, *op. cit.*, p. 93. [3] *Ibid.*, p. 91.

The service approach is becoming increasingly recognized as a danger. Says Mr. Fiock:

> If it sets its sights on a control network, upper management should skim by the interesting specifications of computers. Internal circuitry can be fully exploited by technicians, but only management policy direction can set the goals to be attained within a particular organization. This fundamental often eludes management long after installation.[1]

4. Middle-management resistance--Mr. Fiock declares: "Every aspect of an effective EDP installation appears as an unwarranted--indeed ominous--intrusion to middle management."[2] He then lists the following reasons why.

> 1. Computer programming for a control network demands precise, written definition of all instructions--from basic policy to clerical instructions--many of which were previously verbal.
> 2. The mere presence of so much staff activity is disturbing to the functional manager. He will not voluntarily seek the specialized service of outside staff people.[3]

In discussing these reasons Mr. Fiock contends that staff activity may subject the middle manager to unsympathetic outside criticism, and that unwarranted scrutiny of his detailed procedures will result from staff analysis. He fears exposure by magnetic tape storage making full review of his functional area possible. Thus, he fears that "false" conclusions may be drawn without being able to offer a defense. In this regard he also feels a sense of misgiving because he must make advance commitments and will not have an opportunity to reconsider each decision

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[1]*Ibid.*, p. 91. [2]*Ibid.*, p. 91. [3]*Ibid.*, pp. 91-92.

personally as it is made. (The fact that he was not capable of such reconsideration previously does not alter his present anxiety.) The middle manager also fears loss of control and has an irrational resistance to change. Primarily the latter stems from fear of self-indictment for having lived with inefficiency so long.

Regardless of the fears and misgivings on the part of the middle manager about EDP and his relationship to it, there does seem to be a valid reason for apprehensiveness. Many of the functions previously performed by him will be relegated to the "mechanical brain." This could result from the management-by-exception principle being carried to the point that computers apply decision rules. If, and when, this occurs, other means must be developed for giving experience to top-level managers, for part of their training ground would disappear.

Present computer development, and especially its current application to data processing in banks, does not warrant the fears indicated in the foregoing discussion. This stems from the fact that EDP centers are now more likely to be viewed as mere service centers, as only bookkeeping departments with new machines (a danger in itself). For example, one banker has stated that the centralized EDP center of his bank is a service organization operating within an organization. Its primary and practically sole function is to process the bookkeeping activities of the bank's various offices and branches.[1] However, if the capabilities of electronic data processing equipment are fully exploited, especially as new innovations and improvements now visualized become a reality, and full system integration is developed, middle management will face an almost inevitable shift in power and status and may eventually largely disappear. If full system integration is not made possible, then one must admit that banks cannot attain full EDP utility.

5. Inadequate staff--The implication here is that the computer is just another machine, that existing methods are worthy of confidence and that present personnel are qualified to operate it. The fact is that EDP is more than "just another machine;" it is a completely new approach to data processing requirements. As a result, competent and qualified personnel will be needed. One writer has stated:

> Perhaps the most important requirement imposed on a firm by the introduction of EDP equipment into the data processing activity is a new kind of expertness, that of the "data processing specialist."
> This man is not primarily a computer programmer although he must know computer programming, he is not primarily an operations research specialist although he must have an understanding of operations research, and he is not primarily a computer designer or manufacturer although he must be familiar with the problems and capabilities of the computer designer and manufacturer. All these skills are likely to be required for the introduction of a new data processing system and they must be brought together for one common purpose by a project leader cognizant of the considerations involved. While he must have a real understanding of all the technical areas just

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[1]Personal interview, op. cit.

> mentioned, the really new skill with which the data processing specialist is concerned is that of the operational impact of machines on management of all levels, employees not directly concerned with the machine, the computer operators themselves, and perhaps the general public for certain firms. It is these man-machine relationship problems which this specialist must be prepared to solve.[1]

For their EDP centers, bank executives have selected, trained and utilized experienced bank personnel, people familiar with banking and its operations. The person directly in charge is usually a member of top-level management. However, as bank automation continues to expand, additional qualified men must be found to staff the developing EDP centers. Two statements supporting this view follow:

> It is one of the paradoxes of automation, that, the more we entrust our work to machines, the more urgent it becomes to find the right human beings to handle them. . . . The success of a data processing installation depends at least as much on what goes on outside the computer as what goes on inside it.[2]

> Good intelligent people were never more needed, nor less available. There will be fewer jobs for "bodies," but more jobs than applicants for "heads."[3]

6. Poor staff location--This refers to organizational structure. Mr. Fiock discusses control from both the operating man's viewpoint and that of the controller, stating that their views are divergent and that perhaps a hedge

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[1]Postley, op. cit., p. 78.

[2]J. Allen, "The Selection and Training of Computer Personnel," J. H. Leveson (ed.) Electronic Business Machines (London: Heywood and Company, Ltd., 1959), p. 7.

[3]"Projection 62," Business Automation, VII (January, 1962), p. 63.

produced by splitting the methods and programming staff into two groups might be a good temporary solution.

In the writer's opinion the viewpoints of the operating man and the controller are not <u>so</u> divergent as to require a hedge and a splitting of methods and programming staff. It would appear, in fact, that if the viewpoints suggested here are so narrow and divergent, neither officer is contributing his full effectiveness to the enterprise's progress, and might well be replaced. A bank, to be profitable, requires unbiased consideration of both aspects. The temporary solution advocated here is no solution at all; it would only foster a continuance of short sightedness and narrowness of viewpoint. New concepts, in order to be of maximum value, must be instituted in such a manner as to take full advantage of the benefits to be derived from them. If they are not going to be so instituted, then those methods which have been used may well be continued, probably with modifications. EDP is costly; by continuing the older methods, high costs associated with EDP would be averted. New machinery, especially expensive electronic equipment, cannot be economically justified as a mere substitution for older machines. To utilize effectively the capabilities and capacities of EDP equipment, drastic changes from "worn out" thinking will be required. For example, John Postley has said:

> To achieve the real benefits that await us from these machines, it will be necessary to uproot

> organizational relationships and responsibilities which have been developed over many decades and even centuries.[1]

7. Evaluation on the bias--Many evaluations are made by people responsible for the machines. Thus, regardless of whether the installation is a good one or a bad one, the reports are favorable. Mr. Fiock also lists some traps to avoid.[2] Avoid measuring performance through cost-saving analysis alone. Do not fall for easy-to-figure measures of EDP efficiency. A look at base rental or purchase price alone does not tell much. Consider the environment. Do not be misled by machine representative's reports of feasibility and over-all results.

From the foregoing it is apparent that there are pitfalls to installing an EDP system without first giving consideration to the many problems involved and then formulating plans and procedures to be followed. Definite goals should be established and a competent organization then set up to direct all the bank's activities toward their achievement. Where different concepts of control are involved, they must be resolved and developed on a fully coordinated basis.

Additional Implications

Innovations of the nature of electronic computers are likely to have a far-reaching effect on every segment of

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[1]Postley, op. cit., p. 116. [2]Fiock, op. cit., p. 95.

our economy: on governments, industries, and individual institutions, as well as individuals. For the banking institutions, and especially those installing EDP equipment, the changes will be great. For example, it has been said by one banker, "Automation isn't just plugging in a fancy new machine full of transistors and diodes; it is a whole new way of life. Don't underestimate the changes it will bring to bank operations."[1]

Changes indicated by this quotation cannot take place without a number of repercussive implications. A few of the implications for banking will be discussed in this section.

New Services

Competition drives banks to continue expanding the range of services. Bank managements must, therefore, consider that the range of banking services will be widened, with bank customers eventually receiving not only additional services, but cheaper, faster and more accurate services. Economy will result because of reduced service charges or because they have not been raised. An indication of new services envisioned are "on the job banking, check-credit, payroll preparation, check summarization, freight

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[1]"Electronic Banking," Business Review, Federal Reserve Bank of Philadelphia (May, 1962), p. 14.

payment plans,"[1] and others. Note some of the services already being planned:

Merchandise Bank in Chicago--Complete payroll service to outside firms and bank reconcilements for business firms.

First National Bank of Chicago--Electronic bookkeeping systems for its correspondent banks and accounting services to its corporate customers.

Mellon Bank of Pittsburgh--Electronic processing service to more than 400 banks in its immediate area.[2]

Michigan National Bank--Check account reconciliation services for commercial accounts, and electronic data processing services for correspondent banks.

The First Wisconsin National Bank in Milwaukee--"First Tronic" financial record-keeping services for small businesses, professional men, and families.

Waterbury National Bank in Waterbury, Connecticut--The Automated Accounting Center of Connecticut was opened in January, 1961. Services include "perpetual record" inventory maintenance, time-card analysis, regular bookkeeping and account reconciliation service, payroll computation, and the like. Forecasting of the seasonal demand for small business products and market analysis studies will also be possible.[3]

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[1]Kuhns, op. cit., p. 52.

[2]"Automation Answers," Compiled by NABAC's Technical Division, Auditgram, XXXVIII, No. 1 (January, 1962), p. 36.

[3]As reported by Hoey, op. cit., pp. 106-107.

George W. Dick makes the following statement in this regard:

> Despite the truly remarkable achievements of the past 15 years in computer technology, we have managed thus far to barely scratch the surface. . . . By 1970 we can provide, through electronics, the means to give man virtually complete control over the manner in which his business is conducted--not just on a day to day basis, but far in advance, and the remoteness of data sources will be at worst a minor problem.[1]

Increased Shift Work

Because electronic equipment is too costly to stand idle, shift work should increase. Much of a bank's daily operations can be processed and made ready for the next day by operating the equipment through the night.

Revised Communications

Communication methods will require revision, with "transportation" of reports and bank operating information increasing in importance. Banks with a number of offices and/or branches must develop effective courier systems and communication systems between the EDP center and the outlying units. As improvements and progress continue to be made, integration will become more of an accomplished fact. As this takes place, methods may be devised whereby complex networks for data flow and information transmittal

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[1] George W. Dick, "EDP: Still in Its Infancy," _The Commercial and Financial Chronicle_, CXCIV (July 6, 1961), p. 3.

will largely replace the need for actual physical transfer of checks prior to account updating. (See Figure 20.) Regular means of transportation could then be employed for subsequent check transfer, since the need for speed would be diminished.

Cooperative Efforts

For many bank managements new problems will arise because of the necessity for some sort of computer-sharing scheme. Forms must be made compatible with the requirements of the joint equipment facilities. Organizational structures will have to give effect to reliance on an "off-premise" or independent data processing center. Cooperation with the other banks using the shared facilities will have to assume proportions not experienced with other banks previously. A degree of system uniformity will have to take place, and as stated earlier for office and branch banking firms, satisfactory transportation and communication systems will have to be devised.

Each of these requirements presents an obstacle to computer sharing for small bank managements. Therefore, at the present stage of development, it is highly unlikely that a large number of smaller banks will readily join in a computer sharing venture. Rather, it would seem that electronic bookkeeping machines will become more popular, and where necessary, data processing centers employing

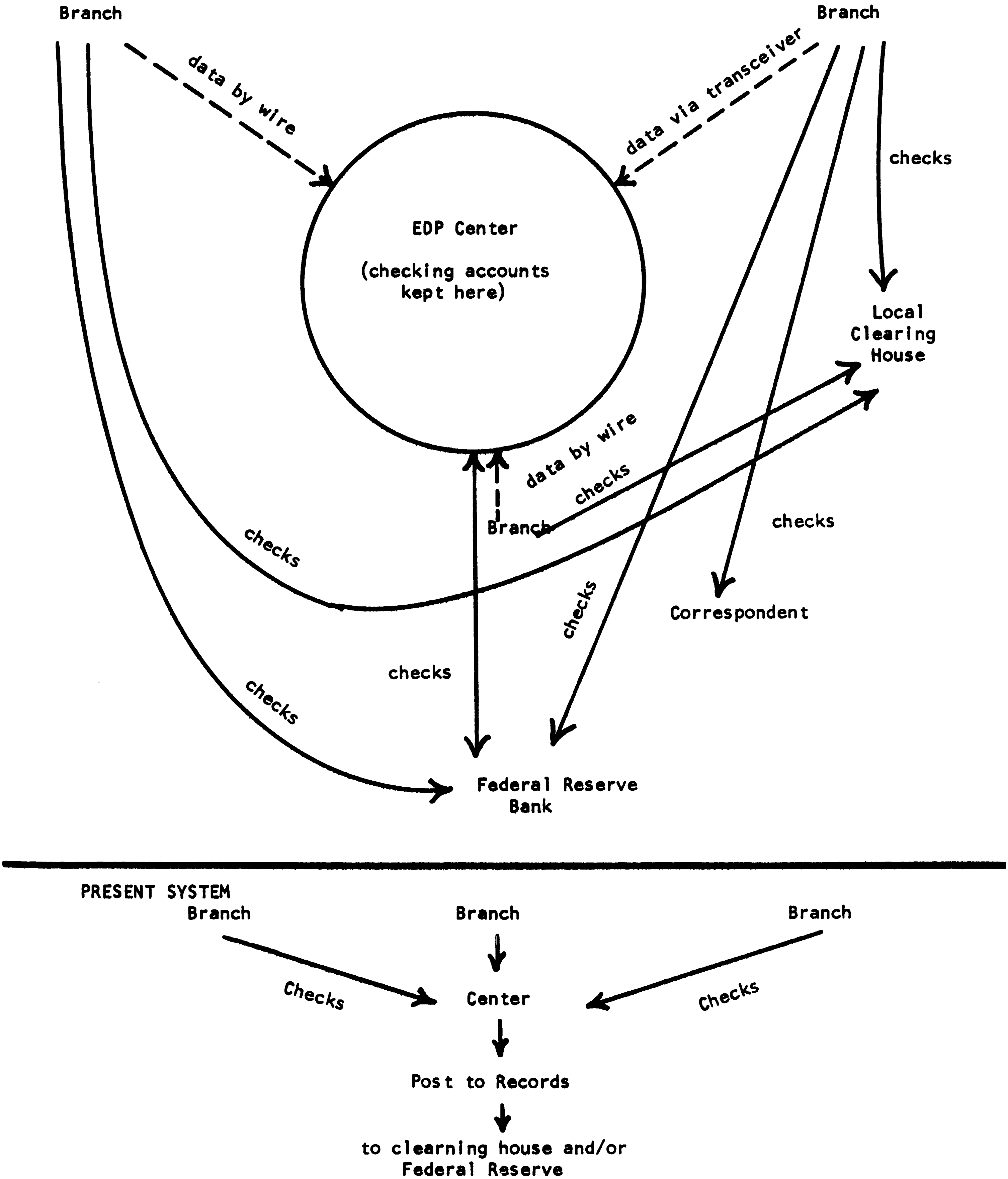

Figure 20.--Revised Communications

this type of equipment will be developed. (The example given earlier of the joint processing center established by three banks in Michigan illustrates the use of these machines.) However, as future developments unfold, new innovations will require smaller bank managements to utilize the capabilities of fully automatic equipment. Failure to do so could possibly result in a gradual withering of small-town banks, or more probably, their absorption by larger banks which do use more efficient methods. It may well be that present bank managements will be unable to change their outlook sufficiently to permit participation in cooperative ventures. In such an event, small bank change-over will have to await assumption of management positions by a new generation.

Questions of Merger

Some bank managements may find additional inducements for mergers and consolidations because of electronic computers. A computer system requires volume to operate efficiently. The fixed expense nature of costs associated with an installation would result in lower unit costs as volumes increase. Therefore, because of the huge capacity of a computer, it seems that mergers and consolidations will become more attractive.

This also may be part of the answer as to why a bank ranked 50th in deposit size nationally at the end of 1960 was ranked 61st at the end of 1961.[1] Definitely the drop in this bank's relative position (the bank gained substantially in absolute deposit amounts) was caused partially--and primarily--by mergers of other banks, but were these mergers partly because of automation? One may speculate that, in the future, this could be true.

Bank mergers have increased during the Post-World War II period. Certainly, automation is not the only reason. Robert Marshall has said:

> Basically, the current bank-merger movement reflects the adaptation of commercial banks to changing economic conditions, particularly through the acquisition of "ready-made" banking offices.[2]

"Acquisition of 'ready-made' banking offices" and the reduction of unit operating costs through increased volume, processed by an electronic computer system, could quite conceivably increase the number of mergers and accelerate the trend in bank mergers. Smaller banks, with limited capital, and yet faced

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[1]This particular bank was the Michigan National Bank of Lansing, Michigan, although other banks would have been similarly changed in rankings.

[2]Robert H. Marshall, "Bank Mergers and the Nature of Competition in Banking," *The American Journal of Economics and Sociology*, XX (October, 1960), p. 81.

with the possibility of being forced into large capital expenditures for automatic data processing equipment (it has been estimated that "every bank will jump--or be pushed--into automation by 1970"[1]), might well seek an agreeable merger relationship with a larger bank already using an EDP system. Another size bank that would look with favor on merging with smaller banks is the border-line bank, the bank not quite large enough to economically employ an individual system of its own, and yet with too much volume for its present data processing system to handle adequately.

What about the smaller bank? Must it either join in some computer sharing scheme or merge with others to produce enough volume to warrant a computer system? Except for banks isolated geographically, it would appear that all banks must take steps to compete economically with others. This will probably involve some form of semi-automation or automation. The only alternatives seem to lie in either more effective administrative control or increased service charges to the bank's customers. Reasons supporting this view are summed up quite concisely

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[1]Richard R. Kraybill, "Hard Facts About Hardware," Banking, LII (September, 1959), p. 84.

by K. S. Axelson.

> The long upward trend of bank profits now shows signs of faltering. Aggregate net earnings of the 100 largest commercial banks began to decline last year; profit margins have been shrinking for a much longer time. Steeply mounting costs, tighter competition, and the growing complexity of bank operations are all increasing the pressure for more effective administrative control.[1]

In addition, the banking industry has been going through a period of rapid change. More and more banks will be forced to compete in the capital market for funds. To do so, histories of stability and good earnings records will be required--earnings which can reflect a rate of return on capital funds more in line with that of commerce and manufacturing than has been reflected traditionally.[2]

As capital requirements increase, as competitive pressures mount, and as data processing loads become heavier--and more costly--for existing machinery systems to handle, the merger route may look increasingly desirable to more and more banks.

Unionization

The bookkeeping chores of banking institutions have long been considered rather monotonous, low-paying and tedious. Other clerical bank jobs do not fare much better.

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[1]Axelson, *op. cit.*, p. 55. [2]*Ibid.*

Proof machine operation, signature verification and check sorting and filing, in fact, most of the activities of what is usually referred to as "the back office" are relatively routine and exacting in their nature. So too are the teller operations, even though the routine becomes varied to a degree because of frequent teller interrelations with banking customers. Thus, the repetitive, exacting kind of work most bank employees are required to do does not produce a high degree of self-satisfaction. Neither are bank jobs generally considered other than as low-paying. Therefore, except for one major factor--the high incidence of women employees and their relatively rapid turnover--present banking personnel practices and pay scales make banks ripe for union pressures.

As banks convert to EDP equipment some of the jobs referred to above will be done by electronic machines. A new type of personnel--machine operators, programmers, and so on--will be needed to operate the various pieces of equipment. New technical skills will be required, but many of the same characteristics associated with earlier manual methods will still prevail. The work will continue to be repetitious and exacting. It must be so, simply because of the nature of banking's requirements. To a large extent, monotony, boredom and tediousness will only be shifted from one method of operation to another.

Bankers contend that the newer methods and the switching of former bookkeeping personnel to other jobs will often result in job upgrading with higher status and bigger pay checks the result. Alan Purdy, on the other hand, has stated that: "Increased union organizational activities must be considered."[1] Although he says that all arguments can be countered, unions are likely to contend that a general down-grading of jobs is taking place, that job insecurity will be increased, and that technological unemployment may result.[2] If Mr. Purdy's reasoning is accepted, it provides the first of two reasons why there is a possibility that, as banks introduce electronic equipment to bank data processing requirements, union activity among bank personnel may become more pronounced. If Mr. Purdy's reasoning is not accepted, it seems reasonable to assume that his quoted assertion is still valid, simply because of banking's reputedly low pay-scale for its clerical employees.

The second reason is associated with the personnel required for staffing an EDP center. The people required are relatively highly skilled technicians. Hence, a longer period of training is required and a more permanent type of employee results. Where women were predominant with manual methods, men will predominate with machine methods. The women who do become skilled and are employed as computer technicians are more likely to be "career women," and,

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[1] Purdy, op. cit., p. 14. [2] Ibid.

like the men, will be more inclined to seek permanent employment. Thus, not only are skills different, but the employment outlook of the people involved is different. Hence, as the ranks become filled with qualified personnel, as a new career group of machine operators evolves, it is only logical to assume that unions will make an effort to organize these groups. The result of bank automation, therefore, may be for greater union activity with bank personnel, rather than less.

Unionization will take a long time in coming, however, simply because of the nature of persons in these jobs. Generally, they have conservative, pro-business outlooks. But, given persistent agitation, and with an increase in the more permanent type, technically oriented, employees, (less resistant to organization, but still not too susceptible) in time, metropolitan banks, at least, probably will become organized--particularly if technical people remain in short supply for an extended period.

Legal Implications

Computer use also gives rise to some legal implications for management. For example, for income tax purposes, what constitutes suitable "books and records?" What measures must be taken to assure adequate information for Internal Revenue agent examination purposes? Section 6001 of the 1954 Internal Revenue Code stipulates that the Revenue

Service may require any records to be kept which it finds necessary. An official of the Internal Revenue Service has stated, "specifically, we anticipate that the regulations will require the retention of a historical type of general ledger with written account names."[1]

IRS Requirements. "Tax records" were defined by IRS chief Caplin and reported in the Wall Street Journal of February 28, 1962. Companies using data processing machines should provide four basic kinds of information as follows:

> Such systems . . . should be designed to write out at regular intervals totals of various accounts, such as those covering income, expenses, inventories and fixed assets. [He asks] also that supporting documents be kept readily available by account classification, both for current and prior years' activities; and that companies further have on hand "clear and concise" explanations for agents' use of how their systems work.[2]

The question naturally follows: Will compliance with Internal Revenue Service requirements prevent full utilization of electronic equipment capabilities and thereby be a source of additional cost? Or, stated differently, if full equipment utilization is planned, can Internal Revenue Service requirements be met? Present methods, with periodic printouts, and with printed records now being produced and retained, probably meet the requirements. With a fully

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[1] Statement made by Dean Barron, Director, Audit Division, Internal Revenue Service. See "News Features," Journal of Accountancy, CXII (December, 1961), p. 23.

[2] Wall Street Journal (Midwest Edition), February 28, 1962.

integrated system and with elimination of intermediate steps and detail records, the answer does not seem so obvious. For example: (1) Where employee pay records are maintained by banks as a service, is there any danger of loss of withholding tax, expense, compensation and other tax data normally stored on magnetic tape? The possibility exists, but where original payroll cards and records are maintained, account and amount reconstruction from these records is possible. However, where on-line time clocks and other devices, activated by employee identification "slugs," feed directly into computers, no such reconstruction is possible. (2) Where payments between firms are made by book transfers of bank balances (i.e., revenue for one client, expense for another), is loss of tax data a possibility? Probably not, for although tape-record loss might occur, clients still have original documents. (3) In cases where banks' functional expenses are derived from allocation and re-allocation, and identity of expense is lost as far as original expense is concerned, is there any danger of loss of support data? Possibly, as at present this allocation appears on worksheets. If allocation is done by machine, where would it appear, if at all? The answer depends on the degree of intermediate detail which machines are programmed to print out in the allocation process.

Regulatory Agency Requirements. Probably of greater concern to banks is their ability to comply with the requirements and regulations of the various governmental agencies which supervise their operations. For in no other business or industry is regulation and supervision by government as comprehensive and far-reaching as it is in banking.[1] Banking institutions are subject to both federal and state governments. All come under supervision of the Comptroller of the Currency, and member banks are subject to the Federal Reserve System and the Federal Deposit Insurance Corporation. State chartered and state member banks are also subject to state bank supervisory authorities.

Because of banking's economic and monetary importance, and because the public interest requires sound banking, "governments now must supervise all activities in which banks engage since these activities usually bear upon the deposit function."[2] Consider the following:

1. No other business creates money . . . .
2. No other business enterprise is charged with the responsibility of holding and protecting the people's money.
3. No other business assumes the obligation of paying on demand the debts it owes. The greater part of a commercial bank's debts are payable on demand, and the remainder are payable on brief notice.
4. In no other business is the ratio of capital to debt so low as it is in the banking business.

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[1]See Chapter XXI, "External Controls," Principles of Bank Operations, op. cit., pp. 321-334. See specifically p. 321.

[2]Ibid., p. 323.

In the case of banks, the capital ratio may be as low as ten per cent or less.

5. The economic well being of the country is closely, directly, and continuously dependent upon day-to-day operations of banks far more than on the activities of other businesses and industries . . . .[1]

In the light of the foregoing it is understandable why controls are imposed and examinations are required of our banking institutions. Questions remain, however. How flexible are control, record-keeping and examination requirements of regulatory agencies? Will some cost saving techniques made possible by electronic equipment be made unusable by these requirements? The answers seem to be that needed flexibility, if it does not exist, will be provided--with appropriate controls, of course, as state legislatures are clarifying doubtful points of issue through legislation. It also seems likely that such governmental agencies as the Federal Reserve System will become fully automated, and will, in turn, require that all checks processed through Federal Reserve banks be magnetic ink encoded, at least as to routing-transit number symbols and amounts. This will eventually "force" use of magnetic ink encoding on most banks, and could entail use of amount and account encoding equipment, a unit of an EDP system. As to cost savings, they may not be reduced, but neither may they be increased.

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[1] *Ibid*., p. 323.

Liability for Coding Error. Another legal question concerns the liability for wrong amount encoding, either for over or under the proper amount. For example, assume that an incorrectly coded amount causes an important check to be rejected because of alleged insufficient funds. The company issuing the check misses out on a large contract and sues for damages. Which bank, if any, is liable? Is it the bank originally receiving the check and encoding the amount, or the bank on which the check is drawn? It is generally agreed that the responsibility for the error rests with the bank making the coding mistake, but where the check has passed through a number of banks there still is the problem of identifying the bank doing the encoding.

Legal Questions in Sharing Facilities. With computer sharing, management is faced with additional legal questions. Three of these pertain to the validity of presentment at an off-premises processing center and have been listed by John Clarke as:

1. Because checks drawn on the bank or banks using the processing center would be sent directly to the processing center in order to save time, would valid presentment of the checks occur so as to form a basis for charging prior parties in the event of dishonor?
2. Insofar as member banks of the Federal Reserve System might seek to acquire proprietary interests in organizations owning or leasing equipment to be used by several banks, would the provisions of Section 5136 of the Revised Statutes and Section 9 of the Federal Reserve Act stand in the way of the acquisition?
3. Because, in the case of a processing center used by several banks, records relating to

> customers' accounts would necessarily be entrusted to a legal stranger, would a participating bank thereby be breaching any duty to its customers to maintain the confidentiality of those records?[1]

Answers to the first two questions are not entirely clear. Where states have jurisdiction, some have enacted legislation, or modified existing laws, to clarify the situation and permit full use of data processing facilities. It seems likely that the remainder of the states will do likewise. Where federal law is concerned, Mr. Clarke states:

> Section 5136 does not inhibit the right of national banks to participate with other banks in owning proprietary interests (other than by way of stock ownership) in organizations, other than partnerships, formed under local law for the purpose of operating cooperative processing centers.[2]

After further discussion of legalities involved, Mr. Clarke concludes:

> It will thus remain for the banks to select the appropriate format for such an enterprise, after counsel has, on the basis of local law and any applicable federal law, advised as to the range of choice that is available.[3]

The answer to the third question seems to be that "the problem of confidentiality does not constitute an appreciable obstacle to the use by any bank of the services of a cooperative processing center."[4]

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[1]Clarke, _op. cit._, pp. 532-533. Additional articles that have appeared in _The Business Lawyer_ are "Mechanized Check Collection," page 989, and "Automation, Forged Checks, and the N. I. L.," page 1008, of the July, 1959, issue, and "Computers in the Banking Industry," page 111 of the November, 1961, issue.

[2]_Ibid._, p. 544. [3]_Ibid._ [4]_Ibid._, p. 547.

Auditing

When electronic equipment was first applied to the data processing needs of business organizations, writers on the subject of auditing began theorizing as to what the effect would be on conventional control techniques and the customary "audit trail" which had been available for auditing purposes. Since experience was for the most part lacking, the views presented had to be predicated on auditing practices of the past as applied to existing machinery systems, and on knowledge obtained from EDP feasibility studies. These views were stated in general terms and usually coincided with or were between two divergent viewpoints. One view held that auditing would be revolutionized within a few years; the other, that computers would have no effect at all upon auditing problems.

Many problems associated with auditing were anticipated, as they were with the application of punched card systems to data processing needs. To date, most have not materialized to the extent nor in the magnitude and complexity that was feared. There are probably a number of reasons for this, but primarily, these are two. First, business managements have been cautious, perhaps to an extreme; they feared loss of control and loss of information through machine error, as well as loss of methods, familiar and dependable, which they had deemed indispensable. They wanted to move gradually into the new systems and techniques, and make sure that such losses did not occur. Bank managements were satisfied, generally, with the results from their older systems, but they were not satisfied with the time and effort necessary to produce them. Therefore, they wanted EDP to provide faster and more economical processing of routine work, and still provide information and reports grown customary with long use.

Auditing requirements have also had an effect on the transition process from one data processing machine system to another. Robert Swartz lists four consequences: (1) Improved internal control, (2) preservation of internal results, (3) self-checking circuits in business computers, and (4) acceptance of EDP by management.[1]

The first effect, improved internal control, emphasizes the importance that auditors have long placed on internal control as a generally accepted auditing standard relating to standards of field work. Auditors, both internal and independent offered encouragement and exerted pressure to see that internal control measures were strengthened and improved.

The second, preservation of internal results, stems directly from the auditors' requirements for an audit trail. Whether or not such internal results are necessary is problematical (with adequate control measures), but at the outset, auditors wanted to assure a continuity of traceable

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[1]Robert G. Swartz, "Now--The Effect of Auditing on EDP," N. A. A. Bulletin, XLIII (September, 1961), p. 16.

information. Auditors also insisted that computer systems incorporate their own internal controls, that self-checking circuits and other checks be made an integral part of data processing computers, the third effect listed by Swartz. Without such circuits, auditors could not satisfy themselves as to the results produced by the machines.

The fourth effect follows from the first three. As mentioned earlier, managements feared loss of control from utilization of EDP systems. Their fears were allayed somewhat when control requirements, insisted on by themselves and auditors, were incorporated within machine circuitry and data processing systems. Thus, the conversion to EDP did not represent an abrupt break from known controls and techniques, but a relatively smooth transition made possible by a series of insisted-upon controls and check measures.

The second reason why anticipated auditing problems have not materialized to the extent at first feared is that machinery systems design has been evolutionary, progressing from machinery systems of the past to those of the present in a step-by-step process. This does not mean that some of the machinery itself has not been revolutionary, but that full computer capacities have not been utilized, and that accounting systems development tended to require many of the same steps and controls associated with previously used systems.

Because of the mitigating effects produced by the evolutionary processes of machine systems and the requirement for extensive controls by managements and auditors, auditing of bank records where EDP systems are in use has been conducted in much the same manner as it was prior to computer use. Some familiarity with equipment and operations of EDP systems has been required of the auditor, and certain techniques have had to be modified slightly, or designed, to make them suitable. But, relying on equipment and internal controls and the printed reports which managements have insisted upon for their purposes, auditors have been able to employ techniques that have allowed them to reach satisfactory conclusions regarding operations and bank financial condition by either auditing "around" or "through" the computer.

Currently, computer systems seem to be entering a new phase. As experience has been gained and machinery reliability improved and known, greater confidence has been placed in the equipment by its users and they are now beginning to develop more highly integrated processing systems and are eliminating some of the detail previously provided by "hard copy" print outs. For example, note the following:

> . . . the computer's true potential for integration of data processing and automation of source data is just beginning to be tapped. As this trend accelerates, auditors are concerned that more and more hard copy will become unnecessary to the management information structure--or even disappear altogether. A handful of executives are already complaining that the record-keeping demands of their auditors and of state and

> federal agencies are hamstringing the efficiency of their data processing systems.[1]

Auditors now caution that requirements of the auditors are not their own, but those imposed by the valid interests of other groups. Companies still need records to report to these vested interests. For example, records are necessary to show customers that their accounts are accurate and to provide reference information concerning these accounts when it is requested. A second need for records stems from examination requirements of government supervisory agencies and revenue authorities. A third reason for adequate records is to show to stockholders that management is doing a creditable, honest, and responsible job. Nevertheless, as integration becomes more of an accomplishment, new challenges are likely to be encountered by both the internal and external auditor. Basically, these challenges seem to fall within two categories, those usually referred to as internal control and audit trail.

Internal Control

> Internal control comprises the plan of organization and all of the coordinate methods and measures adopted within a business to safeguard its assets, check the accuracy and reliability of its accounting data, promote

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[1]Axelson, "Management and the EDP Auditor," Management Controls, IX (April, 1962), p. 94.

> operational efficiency and encourage adherence to prescribed managerial policies.[1]

Defined thus, internal controls are established to accomplish three major objectives. First, it is intended to assure that the accounting function provides complete, reliable, accurate and current information. Second, it is intended to assure that management policies and directives for proper conduct of the operation are being complied with; and third, internal control is intended to act as a protection device against error, carelessness, inefficiency and fraud.

The use of electronic machinery for bank data processing has not changed the internal control requirements. But, the means employed to provide such control have had to be modified and changed, in some cases. For example, the basic concept of the division of duties and responsibilities as a measure of internal control has not been materially affected, but a change has been required in the manner in which this concept is applied.

First, with EDP, centralization of the accounting activities has taken place. The data processing activities of a bank using EDP are concentrated in a single area and may be separated entirely from the remainder of the banking activities. Therefore, a division of duties within the accounting activity does not exist to the same extent as it has previously. However, a division of duties and responsibilities

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[1]Committee on Auditing Procedure of American Institute of Certified Public Accountants, Statements on Auditing Procedure, No. 29 (October, 1958), p. 36.

is maintained, as the functions of the EDP center are not only separate from others of the bank, but also, duties of individuals within the center are divided. For example, the programmer should not also function as the console operator. Thus, the EDP center, functioning somewhat in the capacity of a service organization, becomes a processor of data, and not an originator, and an individual given the responsibility of "instructing" the machine on what to do with information introduced into it does not also function as the "introducer." Furthermore, transaction data does not originate with either the "instructor" or "introducer," but originates outside of the computer center.

By separating completely the origination and processing of entries, internal audit controls should be strengthened. The internal auditor will be in more of a position to audit the entire system and spend less time in checking detailed documents and figures, thus making his services amenable to management and the furthering of its objectives. However, vigilance will not be any less essential, but less time will need be spent on tracing individual transactions and more time spent on improving controls, refining procedures, and developing better techniques.

Second, there has been a shift of internal control procedures from people to machines as machines take over more of the actual data manipulation activities. The latter is made possible by effectively utilizing the controls built into the equipment by the manufacturer, as well as those incorporated into computer programs by systems design and programming.

C. E. Graese has divided the controls in electronic systems into four basic categories. They are: (1) built-in controls, (2) program controls, (3) input-output controls, and (4) operating controls.[1] Each of these is important in the internal control effectiveness of an EDP system. Some are provided as a part of the machinery construction, others come about as a result of systems design, programming and operating procedures. By providing timely assistance during installation and conversion activities, the auditor can assure adequate and effective control measures being built into the system.

Audit Trail

A major area of concern to bank-records auditing pertains to the possible reduction, and perhaps elimination, of an audit trail. Basically, the reason for this concern lies in the increasingly integrated systems banks are employing. Indicative of the challenges which may face an auditor is the use of sequential processing which eliminates many of the intermediate hard-copy journals previously available with other systems.

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[1] C. E. Graese, "Auditing Electronically Processed Data," Management Controls, IX (June, 1962), p. 98.

The use of a random access system provides a different kind of a challenge, as the original source data need not be arranged in any logical sequence for processing. Thus, even though a listing of information as introduced into the computer system is available, a specific transaction would be difficult to examine fully.

A third challenge to the auditor lies in the possibility of reduced hard-copy report preparations, with only exceptions data being printed out. Because of the nature of checking account and other financial activity requirements, this may not be of as great concern for banking firm auditors as it could be for those of other business organizations.

For example, Michigan National Bank's present procedures do not eliminate the audit trail. Reference to individual depositor account balances and transaction data is necessary. Therefore, daily journals are printed-out which provide not only reference information, but also a means of tracing individual transaction data from source to ledger accounts and final reports. Thus, account analysis and transaction tracing, although a little more difficult than previously, is still possible. However, as equipment integration increases, fewer hard-copy reports may be prepared--especially at intermediate processing stages.

A fourth challenge to a bank auditor lies in the use of wire transmission of data from local office or branch banks to a central processing center. Where collection points are scattered through the country, examination of sufficient competent, evidential material in support of the final summary report could be a problem. Once again, though, state banking laws may restrict the geographical area considerably more for banks than for other businesses.

Another area which may become of more concern in the future is the use of direct input equipment. As yet, new developments such as on-line connected teller and window-posting machines provide records of transactions that are subject to control and examination for accuracy and for audit.[1] But, as source documents are eliminated by data processing methods of other industries, banking may devise ways of providing even checkless banking. Who knows? Elimination of source documents could be a challenge to auditors in general business operations, but could it also become a similar challenge to bank auditors?

To date, loss of audit trail has not presented any unsurmountable problems for bank auditors. Where audit trail might become lost or obliterated, machine capabilities, supplemented by machine, program and system controls, have been utilized to provide assurance that transaction data has not been accidently or fraudulently changed or destroyed. Perhaps the paramount reason, though, is because bank managements have felt a continuing need for basic reports and

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[1]See pages 279 to 284 where these devices are discussed in greater detail.

records. Auditing staffs, too, both internal and independent, have stressed the importance of adequate record keeping for meeting the various reporting requirements of a banking institution, and have originated measures and methods to exploit the attributes of EDP equipment. Where intermediate records are eliminated, program checking methods provide assurance that "auditing around," or "auditing through" the computer, where coupled with input and output information, will give satisfactory evidence of a transaction's propriety. It appears, therefore, that in banking, at least for the present, the loss of audit trail does not present problems which the auditor cannot cope with. As to the future, it is certain that difficult problems will arise. They will present new challenges to the auditor and require new skills and ingenuity of him. By increased knowledge of and reliance on machine capabilities and control techniques, it is a valid assumption that competent, qualified auditing skills will be developed to meet these challenges.

Auditing Objectives and Problem Areas

With the exception that internal auditing is concerned with appraisal of administrative and operating performance, internal and external audit objectives, generally speaking, are the same. The particular responsibility of auditors is to determine:

1. That all transactions of a business that are recorded on the books of account are legitimate transactions--that they have substance in fact, and
2. That these transactions have been posted correctly and properly summarized and interpreted so as to reflect the true operations and financial conditions of the company. This is essential as an aid to management planning and decision and to accurate reporting to directors, stockholders, creditors, and other interested parties.

The objectives of auditing thus defined will not change regardless of the type of accounting tools that are being or will be used.[1]

In the normal demand-deposit bookkeeping operations with a computer, checks and deposits are received from outside sources and original control totals established. Proofing operations must verify these totals, or correct them where tellers' errors have been made, and establish the validity of figures to which posting journals must prove. In addition, the daily or periodic trial balance figures must prove to the general ledger, which is controlled outside of the data processing center. This routine provides a system of checks and balances, not only on the information being fed into the machine, but also on the accuracy of machine processing and information being received from the machine system.

The principal areas of the processing center where the auditors' problem appears greatest are:[2]

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[1]Alexander S. Simmons, "The Electronic Computer and the Work of the Internal and the External Auditor," reprint of a talk given before the Motor City Chapter of the Systems and Procedures Association, p. 2.

[2]The principal areas presented here are from Edward T. Shipley, "The Auditor's New Tools," Auditgram, XXXVI (January, 1960), p. 5.

1. The input media--Input can be received by the computer from magnetic tape readers, paper tape readers, punched card readers, or the console keyboard. In some cases, from more than one of these at once. This area is probably most susceptible to error and requires the greatest degree of control, especially when it is recognized that the high speeds of computer operation compound errors at a tremendous rate.

2. Memory unit--Control of input media will control storage facilities.

3. Arithmetic or logical component--This area is subject to programming. Therefore, the auditor is concerned with the adequacy and accuracy of the programs introduced.

4. The output devices--Output can be in the form of magnetic tapes, punched paper tapes, punched cards or printed reports and schedules. The output record can be used to check the accuracy of the preceding steps.

5. The "control area"--This is not a component part of the machine, but an integral part of the system.

In summary, it may be said that auditing objectives do not change simply because of a change in data processing methods to an electronic computer system. Auditing techniques, however, may change, but in this change, control characteristics built into the machinery and the internal control concepts built into the data processing system become aids to the auditor. Where verifiable records are "lost" or the audit trail becomes dim, the auditor can place great reliance upon the machinery to perform without error, and where the basic records are in written form prior to input and after output, auditing techniques need not change as auditing around the computer is then possible.

Many of the modifications in practice have actually produced a more satisfactory audit than previously.[1] This may be due in part to the fact that, under automation, organization lines become blurred. As a result, the auditing function and all bank operating functions assume a closer relationship than ever before.

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[1]Graese, op. cit., p. 101.

CHAPTER IX

IMPLICATIONS OF FUTURE DEVELOPMENTS IN BANK DATA PROCESSING TECHNOLOGY

Previous discussions, for the most part, reflect some of the problems and practices which already exist or are currently taking place. Additional changes are bound to occur. But, inasmuch as electronic equipment costs are as high as they are, automation progress in banking should proceed at a deliberate, orderly pace. This should moderate the adjustments necessitated by conversion to electronic data processing systems and lessen their impact upon bank managements and personnel, and banking customers. Nevertheless, promises for the future are exciting, and adjustments will likely be constantly required.

A definite possibility for the future is greater integration of data processing activities. This merely means that source data will be more and more recorded in machine readable form as a by-product of original entry. All further processing will then be automatically handled without interruption of the continuous flow of data within the machine system, or without manual intervention. An example is furnished by savings account window-posting machines which are controlled by, and operated in-line with, an electronic computer.

Another possibility is the combining of different accounts for the same customer. Thus, savings, loan and deposit balances might be maintained in a three-way account with one monthly statement and with inter-transfer between each restricted only by credit line and savings balance limitations. Or, perhaps deposit and loan accounting may be combined into one "customer account."

There is still another aspect of demand deposit accounts which may change the basic approach to the entire area of bank check operations. This is the possible reduction, and perhaps eventual elimination, of the check handling burden for which present electronic check equipment was designed. Examples of this approach include the discontinuance of payroll checks in payment for services to employees of the Valley National Bank of Arizona. Instead of issuing a check, the employee's personal checking account is credited and an earnings report given to the employee. Many other examples of similar or slightly modified plans could be given. For instance, the Union National Bank, Wichita, Kansas, has a plan whereby employers arrange with the bank to credit payroll payments directly to the accounts of the recipients. This plan has proved mutually advantageous to the bank, which has gained deposits, and to the participating employers, who are spared the expense of issuing individual payroll checks and reconciling a payroll checking account. By permitting the employee one free deposit and one free withdrawal in each two-week period (a usual pay period), no additional expense accrues to him. Thus, he can withdraw the entire amount credited if he so desires.[1] Evidently such plans also have the sanction and approval of the American Bankers Association. The following originally appeared in Newsweek.

> If the American Bankers Association has its way, the weekly paycheck will become an anachronism. The ABA has unveiled a program which permits a company to meet its payroll with a single check to a single bank. The bank then credits the wages or salaries directly to each employee through an account in the bank of his choice.
>
> ABA figures the plan has something for everybody: For the employer, it reduces payroll-processing costs. For the employee, it is convenient, saves time and assures safe deposit of pay. (He has the option of not participating.) For the bank, it means first crack at a host of new depositors and borrowers.[2]

The plans mentioned above suggest an important payroll check elimination possibility for a number of institutions and firms. It involves direct posting to employee bank accounts without checks being issued. An example of how it might work can be illustrated by using Michigan State University as the employer, Michigan National Bank (an EDP user) as the bank, and Michigan State University's faculty

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[1]Hoey, op. cit., p. 110.

[2]"Painless Payday," from "News From the World of Business," Reader's Digest, LXXXI (July, 1962), p. 194.

and staff as employees.

In place of individual payroll checks, the employer would send the bank a magnetic tape containing names, bank account numbers, and deposit amounts of its employees. A transmittal document and a check for the total amount would accompany the tape. With its electronic computer the bank would up-date the individual account balances by posting from the magnetic tape. If desired, the one check could even be eliminated by designing the transmittal document as an authorization to transfer funds from the University's account.

On a larger scale, the same idea has been considered from time to time by the Social Security Board and other government agencies. Bank accounts in the vicinity of each beneficiary would be credited with payments rather than issuing millions of checks annually.[1]

Another plan which would further eliminate the use of checks involves the charge side of a person's bank account instead of the credit side. According to this plan, business organizations, the bank, and their mutual customers arrange for all purchases from the participating businesses by the customer to be charged to the bank. The bank, in turn, charges the person's bank account. At the end of the month,

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[1]Hoey, op. cit., p. 111. It is also stated that, according to the Social Security Bulletin of the U. S. Department of Health, Education, and Welfare, XXIV (January, 1961), p. 1, approximately 14 million checks are currently being issued each month to recipients of Social Security benefits.

or whenever during the month cycle-billed statements are mailed, a bank statement is mailed, accompanied by evidence of charges which have been paid by the bank to business organizations and charged to the individual's account. Thus, for a slight fee, all purchases, as well as payroll credits, appear on one monthly statement. The plan eliminates the need for personal "bookkeeping" (except for incidental cash items), and bank reconcilement (assuming no additional checks need be written). Through this medium, the banking industry can add another "convenience package," a mark of modern America, to the long list already available from the nation's numerous industries.

Other examples of modified check use were given in an editorial of the December 31, 1959, issue of the _American Banker_. Two examples were quoted from this editorial by Mr. Hoey; the first of these is as follows:

> It may one day become possible to collect checks by telepicture presentation, with the necessary routing, account number, and amount information being furnished instantaneously by teleprinter, to permit immediate collection of funds subject to later forwarding of the actual items. Presumably, the right of chargeback would provide ample protection to the banks concerned in the case of forgeries, etc.[1]

The dollar amount of items in the process of clearing and transit collection, called float, creates an additional source of expense to a bank. The above method of immediate collection of funds would practically eliminate this cost, as well as check "kiting."

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[1]_Ibid_., p. 112.

The second example speaks of further centralization and virtual elimination of check transit problems.

> Probably the ultimate . . . would be a single national records center where the checking accounts of all depositors in all banks would be maintained on giant computers, and to which immediate access could be had from any point in the nation. If positive identification of check cashers could be established from electronic credit cards or like devices, and accounting records, the risk presently inherent in cashing checks for unknown parties would be largely eliminated, and it might then not even be necessary for the paying banks to present checks to the drawees, or for the latter to return them to the issuers, except where specific items were required as proof of payment or for like purposes. This final step, if it could be achieved, would completely eliminate the growing physical burden of check collection as we know it today, all paid items simply being sorted and filed at the bank where payment was made. If desired, the data contained in depositors' statements might be expanded to show the account number or other identification number of the casher of the check, which information could readily be included in the telepicture presentation.[1]

Williams Kuhns expressed a possibility similar to the last one quoted. He said:

> It is even conceivable that banks, linked electronically across the country, could introduce some scheme for transmission that would drastically reduce the need for shuttling paper checks back and forth. Just as checks largely replaced currency 100 years ago, we may see checks being largely replaced by magnetic impulses within the next five to ten years.[2]

The quotations just given portray possibilities which are far from being realized at this time. They do illustrate, however, that progress which has been made up to now is only a stepping-stone to greater achievements in the future. Many innovations which foreshadow their coming are now being

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[1]<u>Ibid</u>., p. 113. [2]Kuhns, <u>op. cit</u>., p. 52.

developed; others are but in the minds of men. Research expenditures have been increased tremendously. In 1928, for instance, $100 million was spent for technological research. In 1962, the expenditure will reach $7 billion or more. Furthermore, these figures are only for research in new technologies, new products and new processes for the civilian economy.[1]

Computer technology is moving ahead rapidly. Where vacuum tubes were previously used, transistors are now common. Mentioned now as replacements for transistors are molectronics, elements of microscopic size. "The implication is that computers having these microscopic elements may become small and economical enough for usage in most any bank, except the very small."[2]

In a very interesting article dealing with computer development possibilities within the next ten to fifteen years George W. Dick has written:

> The coming generations of computer components will be smaller and smaller--and capable of greater and greater speeds.
>
> We used to talk in milliseconds for thousandths of a second; then in microseconds for millionths of a second. The speed ranges of existing developmental components today operate in thousandths of micro-seconds, or for convenience what has been labeled as the nanosecond range. A nanosecond is one bil-lionth of a second; . . . one nanosecond is in the

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[1]Charles B. Laing, "The Future of Electronics in the Office," <u>The Office</u>, LV (January, 1962), p. 80.

[2]"Molectronics and Computer Center Deemed Signifi-cant to Automation," <u>The American Banker</u> (August 26, 1959), p. 9.

same proportion to one second as one second is to 31 years, 8 months, and 14 days.[1]

D. A. Buck and K. R. Shoulders also write of advancements that may possibly be achieved in computer size. Consider the following summary as reported by Gregory and Van Horn:

> The era of assembling numerous individual parts in a computer is drawing to a close. An alternative is to make part or all of a computer in a single process. One suggested method is vacuum deposition of electrodes onto blocks of pure silicon or bermanium and subsequent diffusion into the block to form junctions. A second method is vacuum deposition of magnetic materials and conductors to form magnetic core memory planes. Vacuum deposition of superconductive switching and memory circuits is a third method that will make possible the printing of an entire computer. Vacuum deposition through a mask is expected to make circuit elements as small as 4 millionths of an inch wide. If achieved, cryotrons might be printed so small that 500 billion would occupy only one cubic inch. Much work remains to be done to make a shoebox size computer, but the chemical reactions tested here appear to work and are a step in the direction of microminiature work.[2]

With the circuit becoming the basic element for design, rather than the tube or transistor, power requirements will continue to be drastically reduced, thus permitting fewer and fewer circuits as well as increased speeds.[3] Storage components will also be reduced in size as this element of

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[1]George W. Dick, op. cit., p. 22.

[2]Gregory and Van Horn, op. cit., p. 621. The reference concerns Buck and Shoulders, "An Approach to Microminiature Printed Systems," in Proceedings of the Eastern Joint Computer Conference (New York: American Institute of Electrical Engineers, 1959), pp. 55-59.

[3]Postley, op. cit., p. 122.

computer technology is likely in its infancy. "Magnetic cores so small that 200 to 300 decimal numbers could be stored in the space occupied by an ordinary sewing thimble have been developed."[1] Thus, with continued developments in circuitry, storage, and so on, the suggestion is made that "computers may become small enough to hold in one hand and so inexpensive that they could be given away as souvenirs to every visitor to a processing installation."[2]

Each of the developments mentioned above would add impetus to utilization of electronic equipment by banking institutions. However, account posting is only one part of the clerical and paper handling task of banks. Therefore, if computers were almost costless, the problem of check handling, transporting, clearing, and so on, would remain. Unless, of course, the elimination of check transfer from one locality to another, as mentioned by Hoey and Kuhns, became a reality. When both possibilities become actualities, the largest clerical jobs which banks now have will have been eliminated.

Data processing progress should also see a trend to more condensed information summaries rather than lengthy reports. Thus, printing loads and storage space requirements for volumes of paper will be continuously reduced. Printing devices will continue to be improved and printing

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[1] Ibid., p. 125.

[2] Gregory and Van Horn, op. cit., p. 614.

speeds will be pushed up and up as needed. For example, electrostatic, chemical and magnetic processes, possibly combined with photographic recording mechanisms, may enable printing copy at the phenomenal rate of 10,000 lines per minute or more.[1]

Another area receiving attention by experimenters is that of audio-speech recognition by machinery. As yet, however, there have not been "any successful (in the sense of being useful) examples of equipment in action with the capability automatically to recognize audible speech."[2]

An idea of the present status of computer technology compared to what it can and probably will become, is expressed in the views of George Dick. He says:

> In computer methodology, we are on a plateau of advancement comparable to that reached by the automotive industry when cars began to achieve general acceptance.
>
> Up until now, and with only certain reservations, the electronic computer has been a tool to be brought into play only after the basic groundwork has been done by pencil-pushing, by manual effort. The data processing system is fed facts and figures collected and compiled with little help from the computer itself.
>
> By coupling the computer with advanced equipment for data acquisition, data gathering, data collection, data and information communications, display and control or guidance, we will create a "turnpike" network for the flow of data traffic.[3]

The quotations cited above provide an insight into the number of changes, the extent, and the rapidity with

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[1]Postley, _op. cit._, p. 136. [2]_Ibid._, p. 137.

[3]George W. Dick, _op. cit._, p. 3.

which changes in computer technology are taking place. Certainly, changes now envisioned will not take place overnight. Yet, as innovations are introduced, benefits will be realized. Aggressive, far-sighted managements will be quick to exploit new device capabilities to the benefit of their institutions. However, with each change will come adjustments and need for further changes. The implication for bank managements, therefore, is that change is not only essential for progress, as such, but that change to newer methods and techniques is essential for survival. This does not imply that there is only one suitable data processing system and that all banks must adopt it, but it does imply that whatever system is used, it must be amenable to developing requirements of bank operations and bank management information needs; it must recognize that yesterday's concepts and methods will not serve the needs of today, nor today's of tomorrow.

Probably one of the most important requirements of the present is that the data processing system be able to furnish information regarding possible alternative courses of future action for decision-making purposes. The processing of bank data and documents by high-speed electronic equipment is now an established fact. By one method or another, more and more banks are utilizing semi-automatic and automatic machine systems. As equipment improvements continue, the evolutionary process of expansion, growth and development will present new and challenging situations. Sufficient quantities of timely, accurate, pertinent and easily understandable information must be available if decisions leading to improved operations and profits are to be made.

CHAPTER X

SUMMARY AND CONCLUSIONS

Modern equipment now being utilized by banking institutions is a far cry from primitive instruments and methods employed by bankers of old. The evolutionary process from the one to the other is interesting and replete with examples of man's ingenuity in devising machines and systems to aid in the performance of his tasks. Notable among these are the efforts of such men as Babbage, and the principles developed by him, principles which later played an important part in electronic computer development; Jacquard and his use of punched cards, and the utilization of this principle by Hollerith to produce punched-card tabulating machines; Burroughs and others, in producing the adding machine, in consequence of which many innovations and devices have been produced to aid man in his computing and paper handling endeavors. Bank data processing machinery currently in use--conventional bookkeeping machines, electronic bookkeeping machines, punched-card tabulating machinery systems, and electronic computers--incorporate many of the basic ideas generated by these and other pioneers.

The eventual use of electronic data processing machinery by banking institutions has required additional pioneering efforts. The basic unit, and the first to be produced was the electronic computer, a remarkable feat of engineering accomplishment. Primarily because of anxiety over a mounting flood of checks and rising costs, shortly after the modern computer became a reality, the banking industry began to explore the possibilities of electronic data processing for the check handling and demand deposit bookkeeping activities of banking. A few banks made the pioneering efforts by experimenting individually, or utilizing the services of qualified research institutes. Initial steps were taken to determine the feasibility of EDP equipment for bank data processing, and eventually, pioneer installations were made. The real impetus, however, was given the program by the American Bankers Association through its special committees. Their work eventually led to finalization of magnetic ink character recognition (MICR).

MICR provided a uniform method of check imprinting for subsequent machine handling; it made possible a single machine-sensing approach to document reading. This was a giant step forward. Equipment manufacturers, agreeing to the MICR program and a single approach to check processing, devised special check handling equipment capable of reading magnetically encoded documents, converting the coded information to machine language, and recording it in a form suitable for computer input. To properly encode checks, check printers were required to revamp check imprinting tolerance requirements. To speed up transfer of checks through the banking system, virtually all banks are being required to pre-encode checks with transit-routing symbol numbers.

Additional computer peripheral equipment has been developed, and less costly computer systems have been designed and introduced to provide computer facilities for a wider range of banks. Some data processing systems used by banks are semi-automatic in their operation, but even these provide a measure of automation which allows even the smaller banks to cope with the challenge of a growing volume of checks. Thus, regardless of the equipment which a bank might use, the efficiency of check handling and data processing has been accelerated.

As computer technology has been advanced, additional banks have made feasibility studies and then started the conversion process to an electronic system. Since operating circumstances vary widely, each computer system installed must be organized to meet the requirements demanded by operations and bank management. Specialized equipment has been developed to meet these system demands. However, each system is composed of the same basic equipment groups, generally classified as input, central processor, and output units.

Fundamental to the input group is a document sorter-reader-converter; the computer is the basic unit of the central processor, while a high-speed printer is the central unit of the output group. Operated in conjunction with these basic machines are a number of other pieces of equipment, each with its specific job to do.

Systems design may require on-line or off-line operation, or perhaps a combination of both, with individual machines operated either on-line or off-line, according to work requirements. To show equipment versatility and adaptability of machinery combinations, a representative number of machinery systems were discussed in the course of this study.

Individual EDP systems have been limited to a relatively few banks, principally larger ones. A much larger group, the smaller banks of the country, do not find individual installations economically feasible. Therefore, they are exploring joint computer facility sharing as a means of achieving the benefits and advantages of EDP. There are a number of difficulties and problems in joint usage--some economic, some legal, and some psychological--which must be overcome or reconciled before successful computer sharing installations are a reality. Nevertheless, some method of joint facility utilization now holds promise for smaller banks.

Bank utilization of electronic equipment will have a particularly profound effect on the people involved--management, personnel, auditors, and banking customers. For management there are many implications, but the major implication is that management thinking must be geared to a continuously developing stream of new concepts and innovations. Change will be the over-riding characteristic, and managements must be alert to receive the optimum benefit from progressive developments as they occur. To assist them in their function, electronic equipment will be used more and more to provide accurate, up-to-the-minute and projected future information. As top-level management relies increasingly on machine systems for information on which to base decisions, and as policies and procedures become increasingly formulated in machine programs, middle management will decline in importance and in numbers.

Bank personnel must also be viable to change, as transfer will likely result for a number of clerical employees. As shifts are made, new skills must be developed for new job assignments. For any not re-assignable, or where a decline in total personnel requirements takes place, unemployment may result. However, this possibility seems remote; skills possessed by employees of departments being reduced or eliminated are readily usable elsewhere. Furthermore, normal clerical employee turnover is high. It appears more likely, therefore, that getting a sufficient quantity of competent personnel will continue to be a problem, rather than the reverse. As normal attrition takes place, and as operations grow and services are expanded, opportunities for clerical and data processing personnel should increase.

For staffing the computer center, data handling specialists are required. Thus, personnel problems will center on obtaining staffs for new systems and adjusting clerical forces to new equipment and new data processing methods.

Auditors, both those on a bank's internal audit staff and those on the staffs of independent accounting firms auditing bank records, must become familiar with EDP systems and equipment. They need to know what the machines can do and what they can not do, so that proper machinery controls can be incorporated into an effective system of internal control. They must adopt measures and methods which will assist in safeguarding the assets of banks and reducing the possibility of manipulation and error. The internal auditor must insitute procedures which will promote operational efficiency and encourage adherence to prescribed managerial policies. The independent auditor must also insist that sufficient evidential material is made available to permit examinations and thus to furnish reports and opinions regarding those reports to the vested interests concerned. Both must work hand-in-hand to effectuate systems and controls which will permit full utilization of computer capabilities, and at the same time, provide satisfactory controls and an adequate record system.

Banking's customers will largely be influenced by EDP through the services which they receive from their banks. The variety and number of services should increase, and as volumes increase, customer service charges should not rise measurably, if at all, but should remain relatively constant. Thus, "more for less" could well be the contribution of EDP to banking's customers and to the economy as a whole.

At the outset of an EDP installation, costs of experimentation, change, innovation, adaptation, and so forth, prevent the realization of any large savings or cost reductions. The conversion periods are long and the equipment capacities are not fully usable. However, some large banks, notably the Bank of America, the original pioneer bank in the use of EDP, now indicate that their lengthy efforts are paying off. Future costs can be controlled. Even with increased services and anticipated check volume increases, the challenge of the bank's paper problem can be met, service charges to customers can be held within reasonable limits, and profits can be earned for bank stockholders. But, as present challenges are reduced in their seeming enormity, new challenges arise. Innovations now envisioned will give impetus to new and important developments and changes in banking methods. With these will come new pioneers, and the course of progress will continue on and on into the future.

Regardless of what the future may hold, a transition is now taking place which promises to lead eventually to electronic computer use, through some method or another, by all banks. This does not imply that all banks will employ the same data processing system, for it does not appear that there is a single system which can be uniformly applied to the banking needs of each and every bank. Operating circumstances of the more than 15,000 banks of the nation are too varied. Accordingly, data processing systems will continue to be designed to meet the particular record-keeping needs and management requirements of each banking institution. As a consequence, large banks will continue to convert to, and utilize, individual computer installations. Machinery system innovations and progress will make individual installations economically feasible for a growing number of banks. For the smaller banks, methods now advocated for joint computer facility sharing will be explored further. Therefore, as refinements and modifications are made, co-owner- and cooperative-use problems will be resolved. When all computer sharing problems for the smaller bank are finally resolved, electronic equipment will become adaptable for the use of all banks.

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APPENDIX A[1]

A. B. A. Numerical System

Approximately forty years ago the American Bankers Association developed a plan for the numbering of all banks in the country so that each bank would have a specific identifying number. The plan, as developed, provided for a hyphenated number (for example, 1-45 or 90-567). The digit (or digits) preceding the hyphen, called the prefix number, designates the city or state in which the bank is located; the number after the hyphen, termed the suffix number, refers specifically to one bank in that given area. Under this plan, prefix numbers from 1 to 49 are assigned to cities which are normally large centers of economic activity (1 for New York, 2 for Chicago, 3 for Philadelphia, etc.); numbers from 50 through 99 are assigned to states (50 for New York, 90 for California, etc.). At this time the number 89 is not assigned, and the number 59 is used for the territories of Hawaii, Alaska, and Puerto Rico. The remainder of the numbers cover the 48 states. The numbers of all banks are listed in the Key to the Numerical System and in various bank directories under authority of the American Bankers Association, and the listing is revised periodically to reflect current changes.[2]

Check Routing Symbol

To facilitate the handling and routing of transit items through banks throughout the United States, a check routing symbol plan was developed by the American Bankers Association and the Federal Reserve System during the 1940's. The check routing symbol is the denominator of a fraction, the numerator of which is the A.B.A. transit number assigned to the drawee bank. The entire fraction is located in the upper right corner of the check above the figure amount line. The check routing symbol, for example

$$\frac{1\text{-}45}{210} \quad \text{or} \quad \frac{97\text{-}18}{1243},$$

is composed of three elements.

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[1]American Institute of Banking, Section American Bankers Association, <u>Principles of Bank Operations</u>, American Institute of Banking, 1956, Appendix, pp. 359-360.

[2]Current changes to reflect the 49th and 50th states of Hawaii and Alaska are as follows: In 1959, number 59 was assigned to Hawaii, 89 to Alaska, and 101 to territories and dependencies.

1. The first digit of a three-digit number (or the first two digits of a four-digit number) designates the Federal Reserve district. Thus the 2 in 210 indicates the Second Federal Reserve District and the 12 in 1243 indicates the Twelfth Federal Reserve District.

2. The next-to-the-last digit designates the Federal Reserve bank or branch serving the territory in which the drawee bank is located. The head office is indicated by figure I. Branches, if any, arranged alphabetically are indicated by figures 2 to 5. Figures 6 to 9 are used (or reserved) to designate special collection arrangements. For example: The 1 in 210 indicates that the bank is served by the head office; the 4 in 1243 indicates that the bank is served by the Salt Lake City Branch. In the Twelfth Federal Reserve District, figure I stands for the head office in San Francisco; the Los Angeles branch is 2, the Portland branch is 3, the Salt Lake City branch is 4, and the Seattle branch is 5.

3. The final digit serves two purposes: first, it facilitates the separation of items which are receivable for immediate credit from those which are receivable for deferred credit (without respect to the number of days of deferred availability), and second, it facilitates the sorting of items by states in any case when that is convenient.

If the number is 0, it indicates that an immediate credit will be given upon receipt of the check by the Federal Reserve bank or branch in time for that day's clearings; any other digit means a deferred credit without indicating whether it is deferred one or two days. This information is most helpful in separating city and country items. The final digit also indicates, in alphabetical progression, the state in which the drawee bank is located. Thus, in the number 1243, the 3 stands for Utah, 1 being used for Idaho banks served by the Salt Lake City Branch of the Federal Reserve Bank of San Francisco, and 2 for Nevada.

APPENDIX B

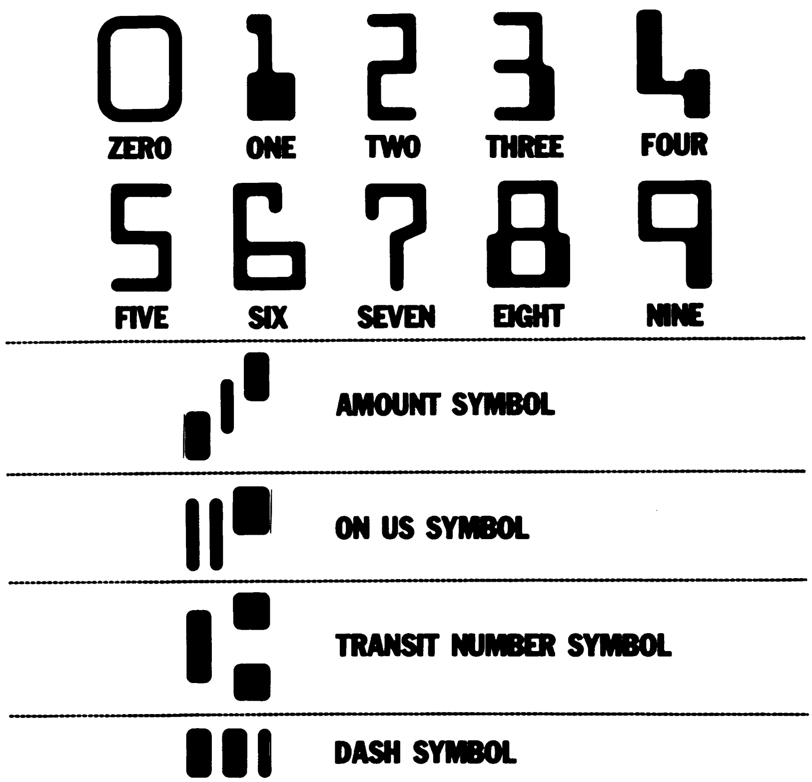
BANKINGS' NEWEST NEIGHBORHOOD

MICR Encoding Locations

PROPERTY OF

Burroughs Corporation

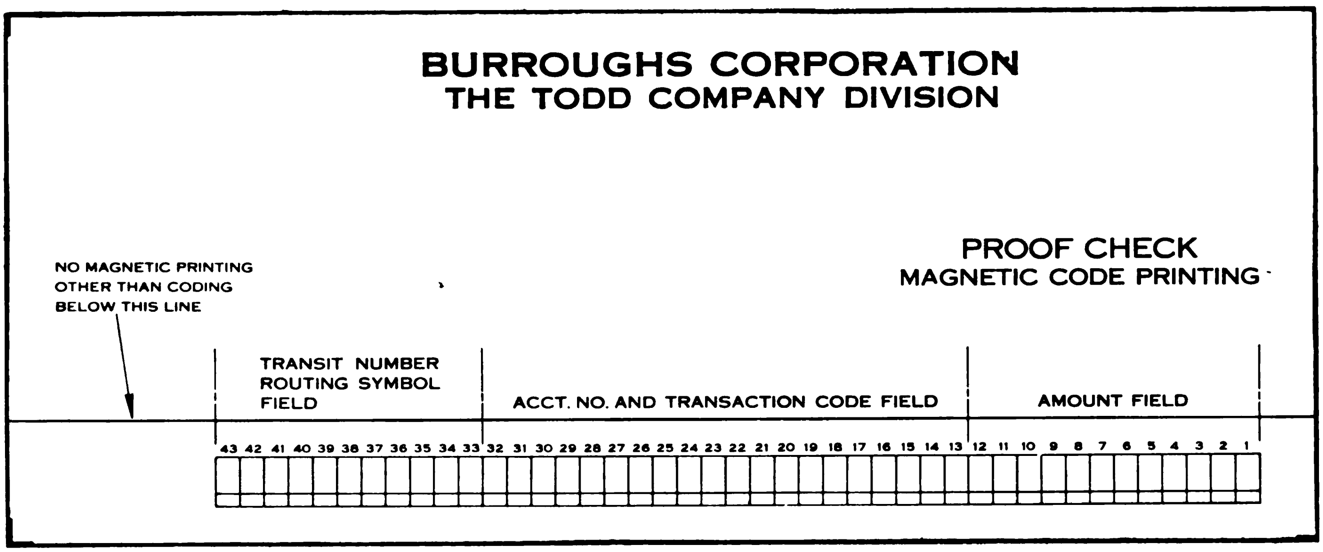
IN CANADA: BURROUGHS ADDING MACHINE OF CANADA, LIMITED


ZERO
ONE
TWO
THREE
FOUR
FIVE
SIX
SEVEN
EIGHT
NINE
AMOUNT SYMBOL
ON US SYMBOL
TRANSIT NUMBER SYMBOL
DASH SYMBOL

BANKING'S NEWEST NEIGHBORHOOD

A new neighborhood, consisting of forty-three 1/8 inch blocks, is starting to appear across the bottom of the documents of the banking industry. Four "families" live in this neighborhood. The story of these four families, and of their neighborhood, is the story of the new dimension of data processing in the banking industry - the magnetic character - and its desire to be read, to be recognized, and to serve the banking community.

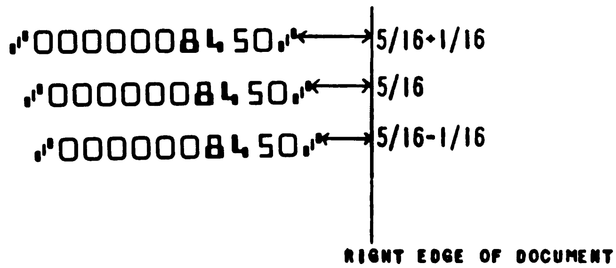
To understand this neighborhood, with all its problems (especially over property lines,) is not a simple task. Each family, and its individual members have particular goals, and particular limitations. So, first let us visit with each of the families, meet its members, hear of its property line problems, and try to understand what it takes to make a neighborhood such as this successful.



Here is banking's newest neighborhood, complete with property lines, showing the forty-three 1/8 inch squares it occupies.

THE AMOUNT FAMILY

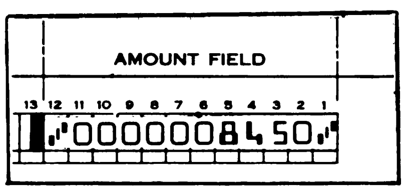
At the right end of the neighborhood, living in twelve 1/8 inch blocks, is the Amount family. Although made up of late arrivals to the neighborhood (post-printed) the Amount family is always on the document and all members are always present. The neighborhood is tolerant about their "tardiness", and has set up a code for all such late arrivals. When they arrive they can locate their family from a starting position adjacent to a line 5/16 inch from the right border of the document; or if their arrival is a bit shaky, 1/16 inch to the left or to the right of that line. Any further deviation would be illegal.



This picture of the Amount family illustrates their property line, and allowable deviation.

Since the neighborhood is based on forty-three squares, adjacent to the 5/16 inch border line, it can be seen that the Amount family always takes up squares 1 through 12, and can be expected to take up half of square 13 at times. Since nobody wants property they can't count on, the neighbors have granted half of square 13 to the Amount family.

Lets meet the members of the family. First of all there are the twins, Start ⑈ and Finish ⑈ . They live in squares 1 and 12 respectively. Between them lives the rest of the family, the digits, 0 through 9 (in any combination.) They occupy squares 2 to 11 in the family unit.



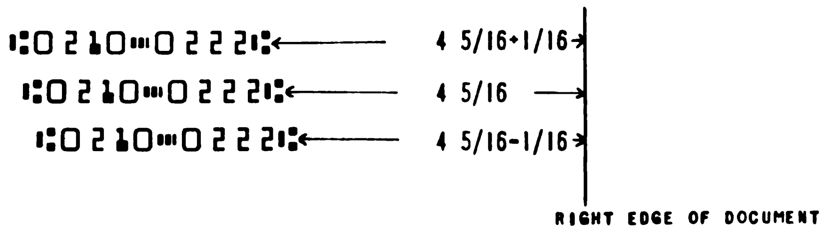
Here's the Amount family portrait.

The Amount family digits vary on almost every document, but together the family represents untold wealth, and is the most respected family in the neighborhood.

THE TRANSIT NUMBER FAMILY

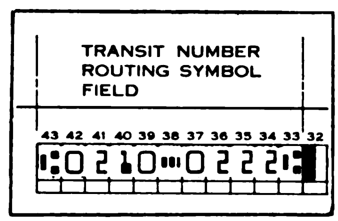
On the left end of the neighborhood, living in eleven 1/8 inch blocks, is the original founder of the neighborhood, the Transit Number family. Being a "first family" in the neighborhood (pre-printed), it is looked upon as a pillar in the community, and as such is expected to abide by the same rigid set of property line restrictions as does the Amount family.

The starting position for the Transit Number family is adjacent to a line 4-5/16 inches from the right-hand border of the document. Again the neighborhood is tolerant of slight irregularities in property lines, and the Transit Number family is allowed 1/16 inch to either side of their starting position. The family lives, therefore, in blocks 33 through 43, with half of block 32 reserved for the possibility of a shifting property line.



This picture of the Transit Number family illustrates their property line, and allowable deviation.

Let's meet the members of the Transit Number family. The twins, Start ⑆ and Finish ⑆ ; the Dash ⑉ ; and the eight digits 0 through 9, here again in any combination.

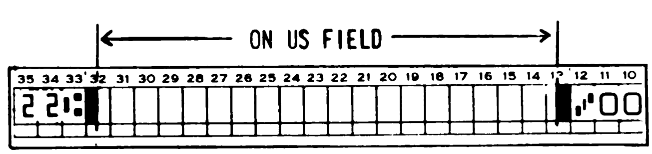


Here's the Transit Number family portrait.

The Transit Number family's contribution to the neighborhood is one of guidance and identification. The family represents the bank's "coat of arms" throughout the country, and serves to insure the most rapid and direct return to the bank from any remote origin. To accomplish this, family members addresses 39,40,41, and 42 represent the Routing Symbol and identify the Federal Reserve District, and members 34,35,36, and 37 identify the number of the individual paying bank, as assigned by the ABA.

THE "ON US" PROPERTY

Between the Amount and Transit Number families there is a field of nineteen 1/8 inch squares. This property, called the On Us Field, depends on its two surrounding neighbors to keep their property within the specified tolerance limitations. At times the neighbors are lenient, and leave their 1/16 inch tolerance for the On Us Field to use. Sometimes they leave even more. This cannot be depended upon, however, and so the On Us Field contains itself within squares 14 through 31, and half of squares 13 and 32.



This picture of the On Us Field illustrates the property lines and available deviation.

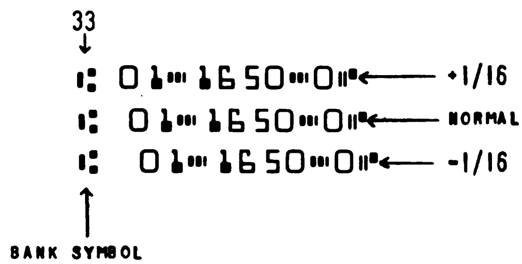
The On Us Field is dedicated to the paying bank. Its property cannot be violated by other banks, and its very existence depends on this inviolable right.

The On Us Field is made up of two family units; the Account Number family and the Transaction Code family. Because they have as their common interest the betterment of the bank, they exist in complete harmony. The result is a give-and-take relationship which has made their common boundary flexible and variable according to the needs of each.

Let us meet the two families, and study their contribution to the neighborhood.

THE ACCOUNT NUMBER FAMILY

The Account Number family is the most "personal" family in the neighborhood. It prides itself on being meaningful to people, and even is memorized by some who appreciate quick service at the bank. The family occupies the left side of the On Us Field and although it is another "first family" (pre-printed) in the neighborhood, it demands its rights to tolerance of 1/16 inch to either side of its home base for those occasions when it is tardy.



This picture of the Account Number family illustrates their property line, and allowable deviation.

The Account Number family has property lines just as all other families in the neighborhood, and must abide by them. Its right boundary is set by the bank, however, and not by the neighborhood. Whatever its size, or established right boundary, it still cannot extend into the Transit Number family's half of square 32 except in the event that it arrives (pre-printed) with the Transit Number family, in which case the two fields can occupy adjacent squares in complete harmony.

The membership of the Account Number family varies. Start Symbol ⑈ is always present, but the rest of the family can be made up of the digits 0 through 9, and the dash ⑉ , or even by phantom blank spaces.

⑆0123⑉4567⑆62⑉0118⑉1⑈

Here is a typical family portrait of the Account Number family with its next door neighbors, the Transit Number Family. Since the two families arrived together in the same pre-printing operation, they share a common property boundary as previously described.

⑆0123⑉4567⑆ 62⑉0118⑉1⑈

Here again is a portrait of the same two families. This time, however, they did not arrive together, but in separate operations, and consequently arranged for the necessary tolerance between boundaries.

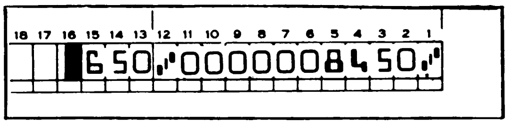
THE TRANSACTION CODE FAMILY

Next door to the Account Number family, occupying the remainder of the On Us Field, lives a strangely organized "phantom" family, the Transaction Code. "Phantom", that is, because its importance to the community is always felt, whether the members of the family are present or not! Most of the time, in fact, the family squares are vacant, but this tells the neighborhood that the document is a check, drawn against an account, and is a debit in the banking community.

When members of the Transaction Code family are present, they tell the neighborhood other things. Sometimes they tell of deposits made (and the number of checks in the deposit,) of debit memos or credit memos, of service charges and a vast variety of other transactions (hence the name.) Each is significant to the bank which the neighborhood calls home base.

The membership of the family consists of the digits 0 through 9, and at times the dash ⑉ . The symbols which are associated with the family usually belong to the neighbors. The phantom blank space, previously mentioned, is also a very important member of the family.

The Transaction Code family sticks pretty close to the Amount family in most such neighborhoods. They are usually seen together, and normally arrive together in the neighborhood. When they do arrive together, they share a common property line just as the Account Number family does when it arrives together with the Transit Number family.



Here are the two family units arriving together. Note that squares 13,14, and 15 are taken up by the Transaction Code family in this example, and that the 1/16 inch tolerance takes up half of square 16.

THE NEIGHBORHOOD CHARTER

Some concern had been registered by the families over property rights when the neighborhood was first formed. The Amount and Transit Number families were content with their property arrangements, but the Account and Transaction families made several complaints over poorly defined property lines. To correct these problems, a neighborhood charter was written and each family's rights clarified. The Charter reads as follows:

THE AMOUNT FAMILY

1. Twelve 1/8 inch squares of property, 1-12, with tolerance of half of square 13.

2. Rightmost square's right border adjacent to a property line 5/16", plus or minus 1/16 inch, from the right edge of the document.

THE TRANSIT NUMBER FAMILY

1. Eleven 1/8 inch squares of property, 33-43, with tolerance of half of square 32.

2. Rightmost square's right border adjacent to a property line 4-5/16", plus or minus 1/16 inch, from the right edge of the document.

THE ON US FIELD

1. Eighteen 1/8 inch squares of property, 14-31, and half of 13 and 32 for a total of 19 squares.

THE ACCOUNT NUMBER FAMILY

1. Subject to 1/16 inch tolerance on either side of field to allow for post printing in a separate operation. When arrival is simultaneous with the Transit Number family, a common property line can be used.

THE TRANSACTION CODE FAMILY

1. Subject to 1/16 inch tolerance on either side to allow for post-printing in a separate operation. When arrival is simultaneous with the Amount family, a common property line can be used.

APPENDIX C

LETTER TO NON-CONTROLLED ACCOUNT CUSTOMERS EXPLAINING PLANS

MICHIGAN NATIONAL BANK

Early in 1960, we will be using an electronic computer and magnetically encoded checks in our bookkeeping system.

To aid us in our planning, we would appreciate completion of the enclosed questionnaire, to be returned with the requested samples in the postage-paid envelope.

For a thorough analysis, it is important that the samples submitted be exactly as they are received from your check supplier, with related accounting forms attached.

The information and samples you furnish will enable us to plan for the easy transition of your account to this new electronic system.

We thank you for your cooperation.

(Signed) Eugene M. Wanger
Senior Vice-President

APPENDIX D

ELECTRONIC CHECK HANDLING SURVEY QUESTIONNAIRE

Title of Account:

1. Approximately how many checks do you use on <u>this account</u> each year? . . . . ______
2. How many checks do you presently have on hand? . . ______
3. Approximately when do you expect to re-order checks? . . . . ______
4. How many checks do you normally order? . . . . ______
5. Who is your check supplier? ____________________
6. Is the check part of a system or accounting machine operation? _____ Yes. _____ No.

   If the answer is <u>Yes</u>, please check one of the following:

a) Burroughs	______	e) McBee	______
b) N.C.R.	______	f) Hand-Posted System	______
c) Remington Rand	______	g) Typewriter	______
d) IBM	______	h) Other	______

7. Do you contemplate making any changes in the design or style of this check on your next order?

   Yes ______
   No ______

8. Are checks mailed in window envelopes?

   Yes ______
   No ______

9. Who in your organization is responsible for determining the style and type of check used by your company?

   Name ____________________

   Title ____________________

Would you please complete and return this questionnaire together with two samples of the check, related accounting forms, and window envelope, if used, in the attached postage-paid envelope.

Note: _____ Please check here if you desire a receipt for the enclosed checks.