PROF. MADNICK

A STUDY OF THE APPLICATION OF COMPUTER TECHNOLOGY IN RETAIL STORES

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ABSTRACT

In the last five years the use of Point of Sale Terminals has increased dramatically. The purpose of this thesis is to examine the implications of this trend for retail management.

Part A investigates the current state of the art. Topics covered include the types of systems currently available, the major costs and benefits, and the experiences of early users.

Part B presents a procedure that can be followed in analyzing the potential value of POS for a given retail organization and developing a POS design to meet the requirements of the organization.

Part C examines future trends in POS technology and related areas that are likely to have a significant impact on the retail industry.

The authors' conclusions regarding POS Systems are:

(1) POS Systems are cost effective in most medium to large size retail stores.
(2) The effective design and implementation of a POS System requires planning, coordination, and change management.
(3) Use of POS will expand rapidly in the next five years.

Thesis Supervisor: Stuart E. Madnick

Title: Assistant Professor of Management Science

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GLOSSARY

1. Area Checkout - arrangement of cash registers such that they are distributed throughout the store, each serving one area or department. Typical of department stores.
2. Barrier Checkout - arrangement of cash registers such that they all are located at the store exit and form a barrier through which consumers must pass. Typical of food and discount stores.
3. Check Digit - A check digit is an additional digit appended to the end of some string of digits which make up a code. The check digit is derived by some mathematical formula when the code is devised (for example: take the code 8472; derive a check digit as 2nd + 4th + 2[1st + 3rd] code digits divided by 6 -- [4 + 2 + 30]/6 = 6; the code then becomes 84726). Since this digit is mathematically derived, it can be recalculated when the code is input into a computer. If the computed digit and actual digit do not agree, the computer can signal that either an invalid code has been entered or an input error has occurred.
4. Data Base - the collection of computerized data used by an organization. Data Base System relates to a data organization and programming interface which allows separate applications programs to share common data and reference data without regard for its physical storage

requirements.

5. MIS - Management Information System; an integrated man/machine system for providing information to support the operations management and decision making functions in an organization.
6. Polling - a method of obtaining data from remote sites whereby a central computer makes telephone connection with a remote minicomputer, controller, or cassette recorder and directs it to transmit stored data back over the telephone line to the central location.
7. POS - Point of Sale; acronym for computerized information system for retailers characterized by data capture at the point of sale (ie - checkout station) via electronic cash registers.
8. Scanning - use of a peripheral device to read mechanically, optically, or magnetically encoded data from sales item packaging or tags. This data entry technique is used to bypass keyboard input.
9. UPC - Universal Product Code; ten digit bar code placed on food packaging by manufacturers (or retailers in the case of non-packaged or repackaged items). Read via optical scanner at the checkout to avoid keyboard data entry.

PART A -- STATE OF THE ART

CHAPTER 1 - INTRODUCTION

The objective of this thesis is to examine the current and potential impact of computer technology on the operations of retail companies. Both the technical and managerial problems associated with the use of computers in a retail environment will be discussed. The approach utilized is to examine the impact of the computer on the company as a whole. This emphasis on the total operation is particularly appropriate due to the high degree of functional interdependency required for rapid response to buying patterns in the retail market.

The choice of this topic resulted from the authors' interest in relatively recent developments in Point of Sale (POS) Terminals (Electronic Cash Registers). These developments have the potential to significantly alter the data collection capabilities of a retail store and, in doing so, to make previously uneconomical data processing activities feasible. The current situation can best be described by a quote from Irving Solomon,[1]

> Point of Sale equipment is now at the stage where the cost of not going ahead can be equal to or greater than the cost of testing and implementing the equipment.

]. "POS: Another Revolution in Retailing," Data Management, July 1974,26.

The changes resulting from the introduction of POS based systems will be critical to the success of retail organizations. With costs rising and margins shrinking, the large retailer cannot avoid the necessity to have better information on sales, inventories, and buying patterns. Yet at the same time, computer systems based on electronic terminal data acquisition are still in their infancy and have, therefore, generated well founded apprehension among many retail businessmen.

The basic reason that POS terminals represent an important advance in retail oriented data processing is due to the characteristics of the industry.[2] Individual item sales are generally of low dollar value while the total number of transactions is large. Therefore the use of more conventional data entry techniques for each transaction is uneconomical

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2. The retail industry may be subdivided into a number of segments; these segments being characterized in terms of sales item type and value, sales volume, item turnover, individual store size, number of stores, and checkout procedures (barrier or area checkout). Our analysis will focus on the larger stores, in terms of sales volume, store size, and number of stores. These are the establishments with both the greatest need for accurate data and the managerial and financial strength to support a POS System. This segment can be further subdivided into three basic areas:
   a. Food Stores - characterized by low item cost, high turnover, and barrier checkout.
   b. Discount Stores - characterized by low to intermediate item cost, medium to high turnover, and barrier checkout.
   c. Department and large Specialty Stores - characterized by low to high item cost, medium to low turnover, and area checkout.

In the course of our analysis, reference to the retail industry will be assumed to mean these larger retailers. Furthermore, our discussion will specify which of the three additional subdivisions of the industry are being addressed where differences between them are relevant.

and error prone. The result is that stock control and sales recording functions must be accomplished manually. Point of Sale terminals make large scale data collection feasible since the data collection process becomes a by-product of the normal checkout operation. The linkage of the POS terminals to a minicomputer additionally allows the automation of pricing and credit authorization functions.

The development of Point of Sale Systems is a direct result of the rapid and dramatic advances which have occurred in computer cost/performance ratios. The greatly reduced costs of electronic terminals allows the standard POS terminal to be price competitive with conventional cash registers.[3] Reliability of mini and micro computers (which provide the basis for Terminal Systems) has been increased sufficiently to allow day to day use of such devices in a retail store without a large amount of down time. The introduction of a microprocessor into the POS terminal has created a very flexible device able to support scanning devices and to operate independently of the store minicomputer when necessary. These first generation POS terminals have been tested by several stores. The newness of the product requires that the

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3. The standard POS terminal being one which can perform all of the functions of a mechanical register but which also is programmed to lead the operator through checkout procedures, accumulates sales totals internally, and is capable of interaction with other electronic recording and computer devices. Basic terminal price does not include scanning, recording, or computer devices.

results of the tests be evaluated very carefully. Further advances in terminal technology will undoubtedly lead to subsequent generations which will offer better performance and reduced costs. The authors will outline what future developments are likely to have a significant impact on terminal based systems.

The hardware requirements of a POS System will be examined in the thesis. These requirements can include such additional devices as optical or magnetic scanners, minicomputers to service the terminals, and machine readable ticket producers. The authors will discuss both the benefits which a retailer can expect to receive from the different hardware available and the costs of purchase and operation of the equipment. A clear understanding of the hardware available is an important input into the decision making process that a manager must undergo before adopting a POS System.

The managerial decisions which must be made can be roughly divided into three classes. The first class is whether or not to convert to some type of POS System. This type of decision is primarily based on the cost of conversion versus the potential savings in operations costs and the value of the data which can be gathered. The second class of decisions is related to the configuration of the system. These types of decisions are usually made on the basis of the type of retailing activity the organization is involved in. The third set of problems that a manager faces are related

to the suppliers of hardware and software components. Typical considerations are whether or not it is better to have the software produced internally or to purchase a turnkey system. Managers must evaluate a complex and interrelated set of criteria in deciding on the best course of action. These criteria will be examined more thoroughly in part B of the thesis.

In addition to the technical and managerial problems associated with the introduction of POS technology, there is the additional dimension of human factors. This dimension encompasses both employee and customer reactions to the new techniques and practices. Reported experiences of early users will be examined to highlight the problems encountered and to determine which approaches were most successful in overcoming these difficulties.

The sources for the thesis were primarily journal articles, manufacturers information, surveys, and interviews with managers in the retail industry. These sources were used because of the need to balance the theoretical and practical aspects of the examination.

The thesis itself will be divided into three parts. Part A will be a presentation of the current state of the art, including chapters on types of equipment and system configurations, potential system benefits, typical system costs, and a discussion of the results obtained by early users. Part B will provide a closer examination of the user

decisions which must be made concerning POS System design and presents a normative decision model for such design. Part C consists of the authors' projections concerning the future use of computers in the retail market. With this presentation the authors intend to first, inform the reader on the basics of POS technology; secondly, present a model of how computer systems design and implementation should be performed by retail businesses; and finally, identify significant trends and future developments in retail computer usage.

CHAPTER 2 - EQUIPMENT

A. Terminals -

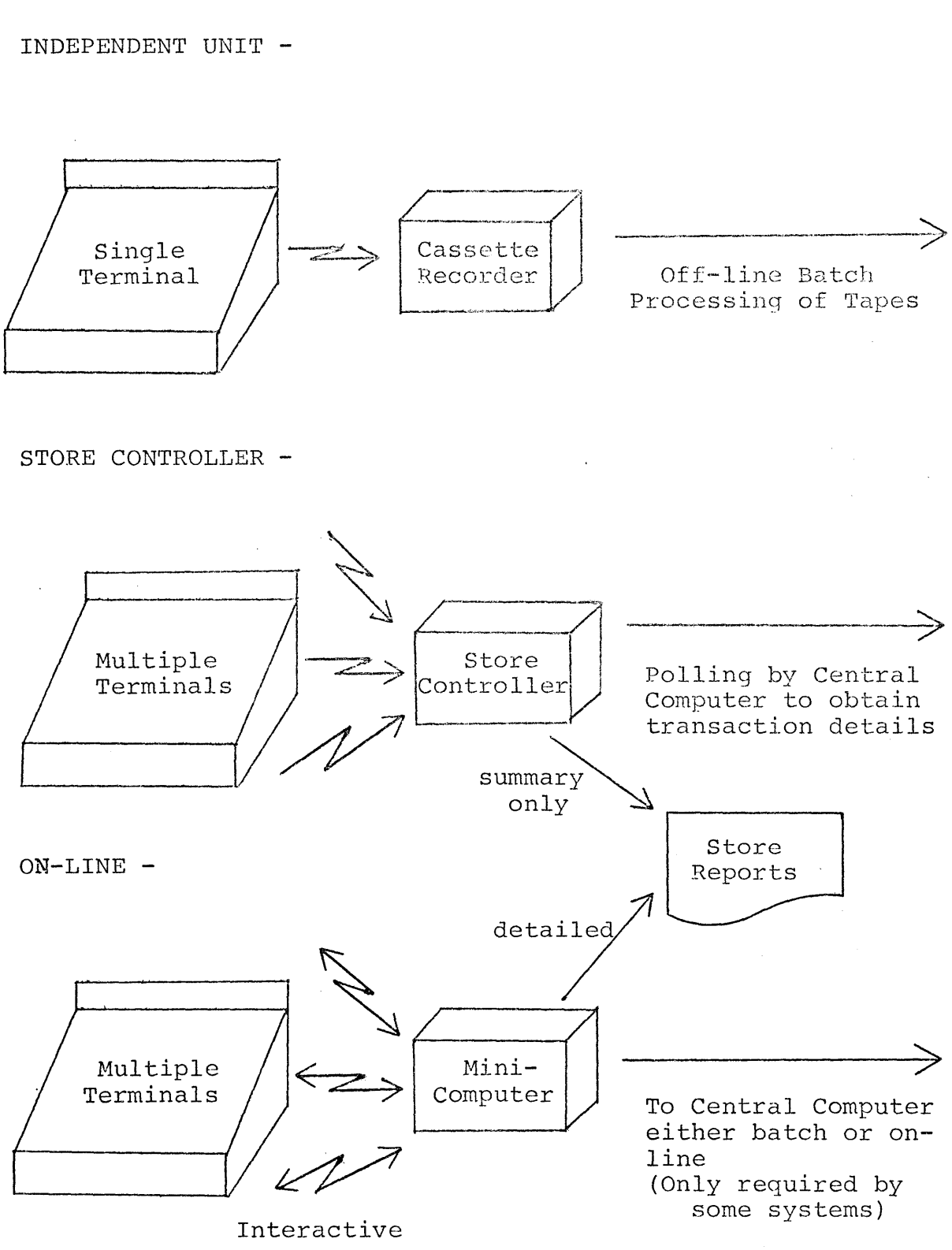
The Point of Sale terminal can best be described as a cross between an old style cash register and a microcomputer. The result is a device which has limited intelligence and can function as both a cash register and data entry point at the same time. In addition to the usual cash register functions, the typical terminal can also accumulate transaction data on magnetic tape and perform programmed calculations (such as calculating tax payable). The capabilities of the POS terminal can be expanded to include automatic pricing and credit card validation if the terminal is linked to a larger computer in a real-time mode. However, the ability of a POS terminal to continue to function if this central computer is down is an important factor in retail environments where transactions cannot be delayed in the event of a machine failure.

POS terminals have become practical in recent years as the result of the development of Large Scale Integration/Metal Oxide Semiconductor (LSI/MOS) components. For the first time the electronic terminal can be made cost competitive with the standard cash register and rugged enough to be dependable when installed in a sales area. The use of LSI/MOS technology also allows the terminal to be programmable, which both increases system flexibility and allows routine calculations (such as check digit verification) to be done automatically.

The primary advantage of the microcomputer approach has been the capability of direct data capture in an electronic mode. Since the terminal is programmable, it is possible for the terminal to be set up to allow transaction data to either be stored at the terminal on magnetic tape or to be transmitted directly to a central computer. The two basic advantages of the microprocessor within the terminal are the flexibility inherent in using programming rather than hard wiring to control the functioning of the unit and the capability of a microprocessor to handle input/output operations between the POS terminal and other computers or electronic scanning devices. The use of intelligent terminals in other closely related areas such as banking and remote data entry has been highly successful. The use of intelligent terminals has been justified on the basis of reduced data communication with the central computer and stand-alone operation in case of computer shutdown. These considerations are important in a retail environment since it is desirable to link a large number of terminals to a single minicomputer.

There are several modes in which a POS terminal can be operated depending primarily on the degree of independence desired (see figure 1). In most cases, the programmability of the unit allows the rapid change-over from one mode to another. The most basic configuration exists when the POS terminal operates as an independent unit. This mode of operation is useful as a backup procedure in larger systems

Figure 1 - System Configurations



and in smaller stores where the limited number of registers does not justify a minicomputer. The transaction data can be stored at the terminal on a magnetic tape cassette which can be further processed at a remote computer center. This system will support all standard cash register operations and in addition perform the following:

1. Check digit verification.
2. Tax and discount calculations.
3. Lead operators through entry sequence with lighting of panel or input buttons.

The major difference between this configuration and those using a minicomputer is the inability to perform credit validation or price retrieval. These operations require the ability to search and maintain direct access files, which is beyond the capabilities of the terminal processor.

The next major system class involves the use of a terminal controller to record the data captured by 10 - 30 of the POS terminals and to forward this data to a remote computer center. The additional benefit of this configuration is that the data storage function is handled centrally. This results in less data handling at the store and automatic polling by the central computer. The store controller may also be designed to perform limited processing of the data while it is being recorded. For example, the controller may retain running totals of sales by department or employee and thus be able to output limited operating statistics on demand. This

capability alone may be sufficient for certain users who do not require detailed transaction data or sophisticated data processing. However, even for those users who do, the controller can provide up to the minute summary data while more involved processing is performed in batch mode on a remote computer.

The third configuration, on-line, consists of a large number of POS terminals connected to a minicomputer. The minicomputer handles data storage and facilitates the POS terminals' access to the store's data base. The minicomputer, if equipped with disk peripherals, can store both item pricing and credit card data. This allows full credit checking since the POS terminal can request the minicomputer to access the appropriate file and respond with the stored credit rating or account balance. The automatic pricing is an important feature in food store operation since the price look-up eliminates the need for store personnel to price each item. Instead, each item is marked by the manufacturer with both a machine and human readable code (the Universal Product Code or UPC). This code is entered into the terminal at checkout time, either by an optical scanner or manually by the operator. The in-store computer then uses this code to access the appropriate item price in memory and transmit it back to the terminal. With this system, price changes become merely a matter of updating the computer memory and the shelf price, avoiding the necessity to re-mark each item.

In summary, the key characteristics of a POS terminal are:

1. Programmability - which allows the terminal to be adjusted to meet new situations (such as changes in the tax laws).
2. Limited Intelligence - in the form of a microprocessor which allows special calculations and data capture and transmission capabilities.

These characteristics are very important in the development of better data collection procedures for a retail store. The differences in specifications and design between a representative sample of currently available terminals will be given in appendix IV.

B. System Configuration Alternatives -

There are several devices available which can be used in conjunction with the POS terminals to create a computer system. The simplest of these devices consists of a data recorder which collects data from several terminals and stores the data on magnetic tape for further batch processing. The more complex systems, on the other hand, utilize in-store minicomputers which interact with the terminals as discussed and are capable of producing formatted reports for store management. Thus, a broad range of cost and capability trade-offs must be considered in determining which POS Terminal System is best suited to meet the requirements of a particular retailer.

The addition of a minicomputer (or store controller) results in a greater concentration of computing power and storage capacity. Different approaches to the use of additional hardware to support the operation of the Point of Sale terminals can best be illustrated by describing briefly four different systems.

The Singer Magnetic Tape Collection System is an example of a data gathering oriented system. This configuration consists of a Singer 4390 Interface Control Unit and a Singer 4391 Magnetic Data Recorder. The system will produce a magnetic tape of the POS transactions and will transmit data when polled by a remote computer. It should be noted that since the system does not allow POS terminal on-line access to stored data bases, on-line credit authorization is not supported. The major advantages of this system are simplicity and lower cost.

The NCR 255 Terminal System is an excellent example of a POS system that is designed to be self-contained. This system consists of 10 - 20 NCR 255 POS Terminals operating under the control of an NCR 726 Store Controller. The Store Controller can be programmed to provide support to the terminals as well as collecting statistical information in summary form. The NCR 255 System was designed to provide a single store with many of the benefits of larger POS systems without requiring the use of a central computer. Statistical reports can be output at any time through the use of any one of the

POS terminals in a report printer mode. The reports are printed on the regular cash register tapes. This configuration does not allow the collection of data on each transaction but rather accumulates transactions to provide summary statistics. The selection of the statistics to collect can be made by management. These statistics can include sales by department, sales of selected items, and checker accountability reports. The NCR 255 System provides the store owner with basic reports on the operating characteristics of his store and control reports which were previously produced manually. The drawbacks of this system are the reduced flexibility in report format and content, the loss of data on individual transactions, and the dependence of the terminals on the store controller for many of their capabilities.

The NCR 725 Retail Terminal Support System represents the next step in system complexity. This configuration is based on an NCR 725 minicomputer which can handle input from several groups of NCR 280 terminals. The result is a system which performs credit checks on-line, records transactions for further processing, and can produce formatted reports for store management. This system also has the ability to transmit data to a remote computer for further processing. The NCR 725 minicomputer is capable of interfacing with a combination of data concentrators (NCR 751, NCR 723) and can therefore be shared between several stores.

An example of a system which is dependent on a central

computer for many of its capabilities is the IBM 3650 Retail Store System. The IBM 3651 Store Controller has its own programmable storage and disk file. This minicomputer controls the POS terminals and maintains direct communication with an IBM System/370. This system depends on the IBM 370 to control the communications network and therefore is only practical for large retailers which can afford the large central computer. The IBM 3651 acts in a store and forward mode as well as acting as an intermediary between the IBM 3653 Point of Sale terminal and the central 370 computer's files when performing a credit check. The IBM 3650 System also supports a 3275 cathode ray tube display station and 3657 ticket unit to produce magnetic price tickets which can then be read by the POS terminals.

The short discussion of currently available systems clearly demonstrates the wide range of terminal support equipment. The decision of which system to use depends on the requirements of the particular retail environment as well as the cost/benefit trade-off between the simpler and more complex systems.

C. Point of Sale Data Capture Scanners -

The problem of efficient and accurate data collection at the time of sale is very critical in most retail environments. Small margin industries such as food stores can attribute significant losses to cashier errors during checkout. Stock

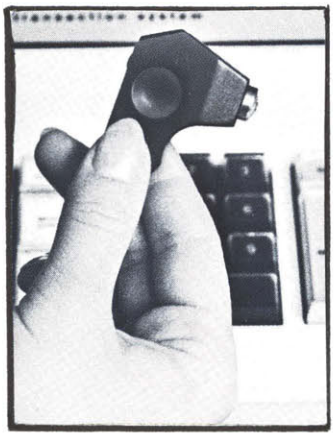
flow data is time consuming to obtain and prone to extensive errors. The increasing wage rates for cashiers result in continuing escalation of checkout cost. The development of the POS terminal has resulted in the parallel introduction of several new devices designed to facilitate the data entry process. All these devices are designed to mechanically or electrically read data from either the package (in the case of food stores) or from specially prepared tags attached to each item. This eliminates the need for keyboard entry by the operator providing both faster and more accurate data entry. The keyboard is not eliminated, however, to provide for both special transactions and to allow manual data entry when the coded information is unavailable.

The data readers can be classed into three general types (see figures 2 & 3). Merchandise ticket readers (such as the Singer Model 705) can read the Kimball Print/Punch tickets automatically. Magnetic wand units read information contained on a magnetic strip. These strips can be attached to either merchandise tags or credit cards. The third class of special input devices consists of an optical scanner which converts printed information into an electronic message. There has been a considerable controversy over which type of data coding should be adopted as a standard.

The merchandise ticket reader has the advantage of continuing a conventional practice since the tickets have been used previously for stock control in department stores.

Figure 2 - Types of Scanners

UPC Optical Bar Code and hand-held scanner



Magnetic Tag and Scanner

Kimball Ticket and Reader

Figure 3 - Food Store Optical Scanner

The main disadvantages of this approach are the cost of producing the tickets and slower checkout due to the mechanical nature of the reader.

The magnetic wand approach utilizes a hand held scanner which can read magnetically encoded strips. These strips can be placed on merchandise tags, credit cards, and employee badges. The magnetic strips can hold a considerable amount of data on one strip. The IBM 3657 Ticket Unit uses 37 characters per inch on a 1/4 inch wide magnetic strip. This capacity allows all the necessary data to be encoded on the strip when the merchandise is received. Therefore, a look-up of the information is not required during checkout. The advantages of this scheme are the high reliability of magnetic encoding and the large information storage capacity. The chief disadvantages are the cost of the tags, the need to override price changes manually, and the inability to place the code on item packaging. These disadvantages are important considerations in the food retailing industry where price changes are rapid, items prices are low, and a major objective of the conversion to POS systems is to avoid individual item marking.

The optical scanning approach is an alternative method which reduces the cost of labels by reading printed information. Since the direct recognition of alphanumeric printing requires comparatively expensive equipment, most of the common systems utilize a bar code. A representative

system is the NCR 785 Data Scanner. The scanner uses fiber optics to read a color-bar-coded merchandise tag. The color bar pattern is then converted into a binary representation by the built-in logic of the NCR 280 Terminal. The NCR 747 Tag Printer is a free standing programmable unit which can print the required tags automatically. Since the labels do not require a magnetic strip, their cost is considerably less than those used under a magnetic system. The optical scanner is, however, sensitive to errors in printing and is therefore more subject to reading failures if the printed labels do not meet rigid spacing and contrast requirements. The density of coding on most printed tags is less than 10 characters to the inch. The result is that the coded information density is much lower than under a magnetic system.

The magnetics versus optics controversy is based on differing opinions with regard to the trade-off between the cost of tagging and the complexity of the scanning system. The magnetic scanner is less complex but the cost of the tags is higher than the printing of a bar code on a label. In addition, the adoption of a standard optical code would allow items to be marked by the manufacturer. In the authors' opinion, the choice of approach depends on the particular retailing environment. The magnetic coding of information tends to be superior in situations where the data strip can be reused (i.e. credit cards) or when the

average unit price of items is relatively large (i.e. department stores). The use of an optical scanner is advisable in retail stores where the item costs are usually low and price changes are frequent. The food retail store is an excellent example of a situation where optical scanning combined with automatic price look-up is the better solution.

The recognition by a large number of food retail chains of the advantages of an optical scanning system has led to the adoption of the Universal Product Code in both Canada and the United States. Under this scheme the manufacturer will print on his label a ten digit numeric code (in both a bar code and numeric form) which will identify the manufacturer and the product. During the checkout operation, the numeric code can be read by an optical scanner (manual input is the backup in case of faulty input) and used as a key to obtain the item description and price information from a central mini-computer. The labor savings and error reduction potential are substantial. This development will be discussed more fully in the next chapter.

CHAPTER 3 - POTENTIAL ECONOMIC ADVANTAGES

The impetus for the adoption of the POS technology by retail stores is provided by the potential for cost reductions and improved management information. In this chapter the major areas of benefit will be examined in order to gain an insight into the impact of POS technology on the retail industry. The authors believe that a healthy skepticism must be maintained when evaluating manufacturer's claims and published reports. All reported savings have been cross-checked with other published reports in order to insure a higher reliability in data used.

The analysis of the economic impact of the introduction of POS technology on a retail company is complicated by the presence of both tangible and intangible savings. The tangible savings are the result of reductions in operating costs, such as number of personnel. Tangible savings can usually be estimated with a reasonable degree of accuracy. Intangible returns, such as better management information, are harder to quantify, but in many cases are far more significant.

There are essentially four classes of savings which can be associated with the introduction of POS terminals. Three of these classes fall into the area of tangible benefits. These are: increased employee productivity, reduction of checkout errors, and reduction of bad credit losses. The

fourth class, improved management information, is somewhat more difficult to specify. Each of these areas will be examined in turn. In the preparation of this material, the authors have made considerable use of a study entitled, "Potential Economic Advantages of Point of Sale Terminal Devices" prepared by Peat, Marwick, Mitchell & Co.

The assumptions under which this chapter was written include:

1. The POS Terminal System used as a model includes access to a minicomputer to allow interactive credit validation.
2. Each terminal has stand-alone intelligence equivalent to the Singer Model 902. This means that the terminal will continue to perform all checkout functions besides credit validation in the event of a computer failure. Detailed item sales information will then be lost, but the terminal will continue to keep running totals of: sales, tax, cash, and discounts.
3. The terminal has the capability to utilize at least one type of data scanning device (magnetic or optical).
4. The data captured by the POS System is used to produce management reports. This processing may be done either on-site or at a remote

computer.

A. Labor Productivity -

Retailing is a labor intensive industry. Given the recent trend of rapidly rising wage rates, the result is an increasing awareness among retail managers of the need to improve sales clerk efficiency. If a Point of Sale Terminal System can significantly increase sales force efficiency, then companies which acquire POS technology will have a distinct competitive advantage. This section will outline the areas in which significant savings can be made.

The general consensus of several reports is that the use of a POS terminal alone can reduce the time taken for each checkout operation by about 10% in the typical department store. (A further 10% decrease can be achieved through the use of a data scanning device). This savings results from the automatic functions, such as tax calculation, which were previously computed (or read from lists) by the sales clerk. The importance of this saving depends primarily on the proportion of time that is usually occupied by the checkout operation. A department store which uses a free-standing configuration would only achieve a 1% (or 2% with a scanner) reduction in clerical requirements (since only about 12% of a clerk's time is spent on checkout). A barrier checkout operation (approx. 50% of time in checkout) could save about 5% (or 10% with a scanner) of clerical requirements. Assuming that only one-half of the

the irritating delay while a credit check phone call is made.

Preparation of cash register reports and cash register close-out can be greatly facilitated. Assuming that cash register changeover occurs twice per day and average of 4 minutes per cash register is saved, the net result is a savings of 16 minutes per cash register. Most of this time savings can be realized since these activities usually occur during busy periods.

A savings specific to the food industry results from the use of the new UPC code and interactive price look-up by the terminal. This will allow the store manager to enter prices and price changes into the computer, thereby eliminating the pricing and repricing operations on each individual item. The resulting staff reduction would be (very conservatively) approximately one employee per one million dollars sales per year.[4]

Stock control is an important factor in the operations of most retail stores. The National Retail Merchants Association operating statistics indicate that about one-half of one percent of net sales is related to merchandise information

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4. Assuming a clerk can mark 1 item every two seconds at 40¢ per item - or about $5000 per day, then $1 million in sales means about 200 days of clerk time. If instead we assume a clerk only marks 1 item every 6 seconds - $1 million in sales is 600 days of clerk time or 2 to 3 full time clerks.

gathering and stock counting in department stores. The improved data capture resulting from POS terminals would reduce this cost by about one-half due to less frequent physical inventories. This advantage would be most applicable to department stores although some savings would occur in food stores.

The Labor Productivity improvements represent the most concrete area of potential savings and therefore may tend to be stressed heavily in cost justification studies.

B. Reduction in Checkout Errors -

The use of a POS terminal will greatly reduce the number of errors in pricing by the sales clerk if much of the data is captured automatically (via scanning). In addition, the POS terminal also captures sufficient information to allow the reconstruction of transactions in enough detail to trace cash shortages. Thus, in cases of continuing shortages, it would be possible to locate the problem; and the opportunity for dishonest manipulation by store employees is reduced.[5]

Food store operations involve considerably longer entry sequences which results in a much greater opportunity for errors to occur. Estimates indicate that losses through accidental under-rings are probably around .6% of sales. This loss could be cut by up to 80% if the store adopts a system which uses the UPC coding for data entry.

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5. Department stores which have adopted a POS Terminal System have averaged a net reduction of about $.45 per thousand dollars sales in cash register shortages.

POS terminals can also be programmed to include any special store charges into the bill automatically (for example, delivery charges). This feature will insure that store policy regarding special charges will be uniformly applied.

C. Credit and Check Authorization -

The large volume of sales which are paid for by credit or check create a serious problem for retail stores. The need for authorization must be balanced against the irritation of customers and the additional sales staff required. In most stores the policy is to verify all credit sales over a set dollar value. This policy is a compromise between potential losses and the costs of authorization. Since the store limit is usually easy to determine, a person attempting to use a stolen credit card could make a series of small purchases from different stores and escape detection. POS Terminal Systems provide facilities to allow fast and unobtrusive verification on all credit or check payments.

The level of authorization provided by a POS terminal depends on the level of support provided by the backroom computer. The lowest level of service is for the POS terminal to perform check digit verification on the credit card number and to automatically insure that store policy is followed (such as - checks must be for the amount of purchase or less). A negative verification can be performed if numbers of known stolen or lost credit cards (and bank accounts which have had checks bounce) are maintained on file. If

more storage is available, then it is possible to maintain a file of all credit cards and all customers who have check cashing privileges.[6] Since the look-up of credit information is performed automatically during each sale, opportunities for fraud are reduced while customer inconvenience is kept to a minimum.

The store security staff could be automatically alerted by the computer if a suspicious pattern of credit usage occurred. In addition, records of total credit extended to each customer could be kept up-to-date to prevent customers from overstepping their credit limits. The result would be better policing of credit and check sales. The resultant savings to each store depends on the current level of losses and the proportional reductions expected. Although food stores usually cash checks, the main beneficiary of improved control will be the department stores which extend consumer credit via their own credit cards. The following estimates were presented by Peat, Marwick, Mitchell, and Co. on the basis of a typical department store operation using automatic credit checking. Savings per sales dollar are based on

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6. For chain stores, two flavors of positive verification are offered. The first, selective, updates the credit files of the local computer immediately but only updates the files of other stores on a daily basis. The second alternative, full positive verification, requires dedicated communications lines between all local minicomputers and updates all files at the time of purchase. This system can also be implemented by linking all local minicomputers to a single, central credit file (as in the case of the IBM 3650 Retail Store System).

losses after an account is KNOWN to be bad.

Bad Debt Reduction (checks & cards)	= $.0006
Fraud (lost or stolen cards)	= .0004
	$.0010

or for a store with 100 million annual sales - $100,000/year.

These estimates do not include the deterrent effect that the presence of such a system has on a person contemplating the use of a stolen card or the reduction of customer irritation.

D. Management Information Systems -

The introduction of a POS terminal based system results in savings related to the entire corporate MIS in two ways. The first saving results from the reduction of back-office data preparation and entry operations. The second benefit is the availability of more timely and detailed information for use by managers in making decisions. The authors believe that this benefit may be more important than all the other advantages mentioned earlier, but recognize that the capability of management to use this information is the limiting factor.

The data gathered at the Point of Sale under conventional systems is usually recorded on cash register tapes or on special forms used by the sales clerks. The conversion of this data for input into a computer or into summary form for management use requires a large clerical workforce. The automatic capture of data in machine readable form by the POS terminal will greatly reduce the data preparation requirements. In addition, most POS systems can prepare store reports, such

as sales per department, which previously had to be done manually. The NCR 255 Terminal System can provide in-store information on store activity, movements of specific items, sales by cashier, and total sales information automatically at any time during the day. The manual preparation of this information at the end of the day would require several manhours for a large retail store. The time saved by the automatic production of in-store totals would be about one manhour per week for each cash register used in a food store.[7]

The recording of sales by merchandise item in a department store usually requires additional back-office staff. Many of these reports could be prepared by a remote computer using the data gathered by the POS terminal system. Potential savings for a large department store are based on a 60% reduction of personnel involved in the sales audit function. The estimates per sales dollar are:

Sales Audit Personnel	$.0006
EDP Input Personnel	.0002
Sales Report Preparation	.0002
	$.0010

or for a store with 100 million in sales - $100,000/yr.

These values are, of course, highly dependent on the amount of data currently collected by the organization. The values quoted are for a store which maintains sales records for only

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7. This is calculated assuming approximately 6 minutes per day-register to record register totals and 30 minutes per week-register to prepare formal reports.

about 10% of all items as well as reporting on sales by department.[8]

In addition to impacting sales data collection and preparation, a POS System can be used to improve the basic operational information and control process. In the retailing industry, this process consists of the merchandise processing cycle. This cycle might be pictured as:

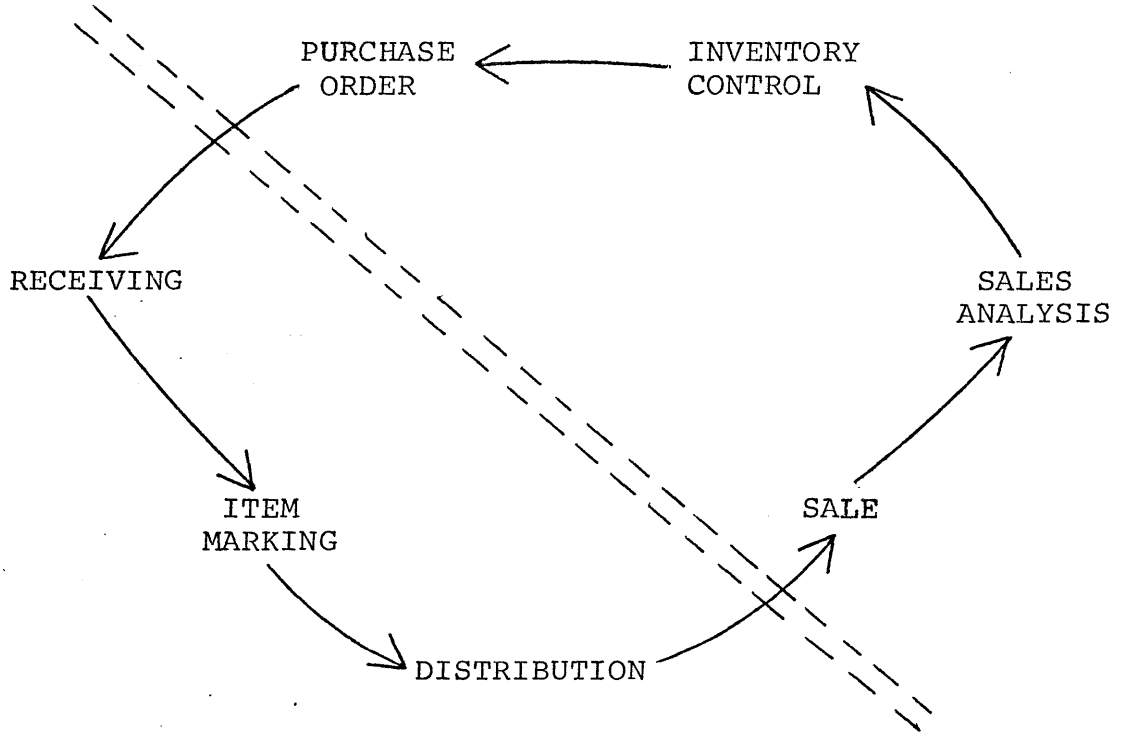

Figure 4 - Merchandise Processing Cycle

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8. It is conceivable, however, that the personnel savings may be offset by additional personnel required to handle the vastly increased amount of information output. In subsequent analysis of cost/benefit, the authors will state both gross increases and decreases of personnel to indicate clearly the changes occurring. The authors believe that in most cases the net result will be to decrease personnel.

Once improved sales data is available and a store level computer system is installed, it becomes feasible to utilize the computer for both company-wide and store level order entry and distribution.. In the figure, those functions to the left of the double line represent the most repetitive and simplistic aspects of merchandising. It is precisely here that the computer can be most easily utilized. By referencing the company data base on item characteristics and inventories, the system can automatically produce purchase orders, process item receipts to update inventory, produce price tags where applicable, and provide routing instructions within the company and/or store. (This is all most easily accomplished, however, with a fully interactive system utilizing CRT consoles at all receiving, warehousing, and distribution locations.) The benefits of such computerization include fewer ordering and distribution delays and vastly improved information on item inventories. In addition, the system will improve information accuracy at each step of the cycle and reduce clerical work loads.

The Marketing Department would be able to use POS data to investigate sales trends and to evaluate the sales performance of new products. This information could then be used to determine what merchandise should be dropped from or added to the product line. Rapid identification of poor selling items would help buyers to revise purchase plans in order to reduce the number of products which must be sold at

a markdown (or, in the case of supermarkets, thrown out). A twenty percent reduction in obsolescence losses for the typical retailer would be equivalent to all the concrete savings which were mentioned previously.

In a memo issued by a well known Canadian manufacturer to salesmen dealing with the food retailing industry, it was stated that salesman-buyer interaction would change dramatically as the use of POS terminals became more widespread. Among the changes predicted were the following:

1. New products will be test marketed for shorter periods and using POS terminals it will be possible to make statistical estimates of the product's performance. The retailer's buying committee will have more hard evidence to base their decisions on.
2. Products with poor performance trends will be detected earlier.
3. Centralized buying operations will be able to keep a closer watch on merchandise movement at the store level.

The conclusion was that the use of POS terminals would increase the application of analytic techniques in determining the marketing plans of the retailer.

Control over the level and composition of inventory is a crucial factor to the success of almost all retailers. In many cases the value of inventory held at any given time

exceeds the net profit of the retailer by a factor of five or ten. Therefore a small increase in the efficiency with which the inventory is managed can result in a significant increase in profits.

The POS System will provide the manager with faster and more accurate data on sales flow that will allow better control over inventory on hand and indicate trends in sales of individual items. The inventory records will be updated much more frequently than was possible under the previous system. The result will be that the level of safety stock can be reduced without lowering customer service levels. Significant changes in sales patterns can be identified. The buyer can then adjust the purchase orders of the company accordingly. Multi-store companies could also use the system to allow one store to make use of inventory on hand at another store.

Product movement data capture at the point of sale will also aid the store manager in determining losses due to pilferage. Identification of high loss items may result in improved tactics to discourage pilferage (such as changes in display techniques). Each department manager will also be made aware of the losses caused by pilferage and will be able to determine the success of protective measures.

The reporting of sales by department may be used to help in the reallocation of space, manpower planning, and diagnosis of possible problems in individual departments. Store sales distribution reports would provide the manager

with an additional tool with which he could diagnose potential problems. Sales floor activity levels can be determined through the examination of sales by time and department. Store management can use this information to plan personnel allocation and to develop standards for sales floor jobs. This important control tool has been expensive to use in the past since the level of activity could only be determined by manually counting customers during the day. POS Systems can clock each transaction and produce the needed data automatically. Better control over manpower allocation can result in significant clerical savings without imparing customer service.

This short list of potential benefits occurring as the result of better information flow clearly indicates that the potential of a POS system is far greater than the concrete savings mentioned previously. As was noted at the start of this section, it is almost impossible to quantify these savings without actual test data in the particular retail environment. It is the authors' opinion that if the installation of a POS Terminal System can be justified on the basis of the concrete savings alone, then the retailer would be well advised to install the system. Numerous companies have instituted test store programs which will help to determine the impact of POS terminals on store performance. The results of these tests will aid future decision makers in placing a value on the intangible benefits of a POS System.

In summary, the purpose of this chapter has been to highlight the economic advantages of a POS System. These advantages are:

1. Improved Labor Productivity - due to reduction in clerical work and more rapid data entry at checkout.
2. Reduction of Checkout Errors - through the use of machine readable price tags and/or price look-up.
3. Check and Credit Authorization - allowing zero floor limits, instantaneous credit file updating, and reduced consumer irritation when an on-line system is utilized.
4. Improved Management Information - due to reduced data preparation and input effort, installation or improvement of an order entry - distribution system, and availability of sales and inventory data for upper levels of management.

CHAPTER 4 - TYPICAL SYSTEM COSTS

In this chapter typical hardware and software costs for essential system components will be given. The systems offered by Singer will be used as examples since they comprise a significant proportion of those installed. In addition, some of the more subtle POS costs will be discussed.

The largest direct cost factor is the computer equipment. These costs are, of course, dependent on both the terminals selected and the support facilities required. The actual price of the equipment is usually the result of negotiations between the retail organization and the manufacturer. Representative price ranges for various components are listed below. In general, prices at the higher end of the spectrum are for more sophisticated models:

HARDWARE --

POS terminals	$3000 to 5000
Scanning devices	900 to 1300
Data Recording Unit (per terminal)	900 to 1200
Store Controller	7000 to 10000
Minicomputer (with disk)	
10 - 30 terminals	10000 to 25000
over 30 terminals	25000 to 100000
Ticket Producing Unit (magnetic)	20000 to 22000
Printer (40 cps)	4000 to 6000
Communications Controller	1000 to 4000

SOFTWARE --
(available for IBM 360/370 or Singer System Ten)

Polling ---------- $ 5000
Used to gather data over communications lines from either individual terminal cassette recorders or from an in-store controller.

Reformat and Edit ---------- $ 5000
Places data in proper format for further processing and checks for errors.

Sales Audit ---------- $15000
Balances media (cash, credit, checks) and data (inventory information) against each other and separates data into individual files for further processing - such as, General Ledger, Payroll, Receivables, Payables, and Inventory.

Fashion or Staple Merchandising --------- $25000
Accepts terminal sales information and incoming stock data to produce the following reports - Inventory, Item Performance, Sales by department, and On-hand vs Model Inventory.

By determining the configuration desired and adding the prices of equipment and software required, it is possible to estimate the required investment for a particular installation.[9] Historically the price of computer equipment has been dropping rapidly, thus, the prices listed above will probably be reduced in the near future.

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9. For example, in a food store with eight checkout lanes using optical scanning, the system cost might be:

Terminals	$24000 to 40000
Scanning	7200 to 10400
Minicomputer	10000 to 25000
Printer	4000 to 6000
	$45200 to 81400

Software -

Reformat and Edit	$ 5000
Sales Audit	15000
Merchandising	25000
	$45000

Total System = $90,000 to 126,000

The above does not include installation costs or the cost of any additional equipment for telecommunications.

Installation of a POS System is a cost that is highly variable since the expenses incurred depend on the store layout. A store which is in the process of construction can be altered to meet the wiring requirements of point of sale equipment for a cost of about $25 per terminal. Alteration of an existing building (especially an older building) to allow proper connections could cost hundreds of dollars per terminal. The new wiring required includes a 20 amp electrical power line for each group of up to three terminals and a high grade duplex communications cable. Neither of these wires are particularly expensive and good quality wire should be serviceable for at least ten years. The cost of wire in a large store would average about $20 per terminal. Provision of space for the minicomputer requires an area that does not experience either excessively high or low humidity in order to reduce the problems of electrical leakage and static electricity respectively. In an article in Canadian Grocer (June 1974), Dominion Stores reported that a corralled area at the front of the store provided a satisfactory environment. Since the space required by the in-store minicomputer is small and there will probably be a reduction of at least one cash register position in most stores, it is unlikely that the POS System will require any additional floor space. The cost of minicomputer installation in most cases will be small.

Program development for the POS System will be an important cost factor in most cases. The smaller retailer will usually

purchase the programming from the hardware manufacturer as part of the system. Larger retailers may decide to do part of the programming in-house in order to tailor the system to their own requirements. Programming includes both the terminal programs and the programs for the minicomputer.

Training of employees who are currently using cash registers should be helped considerably by the presence of visual aids on the POS terminal keyboard to indicate the next entry required. The reported training time required to familiarize a cashier with the system was from 8 to 16 hours. Since a high rate of speed is not required from a department store clerk, sufficient proficiency can usually be obtained in 3 to 5 hours. The training effort before the installation of the system will insure a smooth transition to the POS Terminal System with little or no loss of productivity at startup. Most users report that in a few weeks store productivity shows a marked improvement as the ability of employees to utilize system features is increased.

The last major setup cost associated with the introduction of POS terminals in a store is related to the need to explain the changes to both the employees and the customers. Good employee relations requires that management be careful to introduce the idea of the new technology to the staff. Whenever possible the store manager should try to encourage employee participation in the examination of how to best utilize the features available on the POS System. The net

result of such an approach will probably be a net gain, since the ideas put forth and the increased employee acceptance of the system may well be more valuable than the cost of management time. Customer education about the new system is required to avoid misunderstandings. Advertising posters and pamphlets can be used to explain the new procedures to the customers. This problem will be reduced in the future as more stores are equipped with POS terminals, resulting in increased public awareness of the system.[10]

The continuing costs associated with maintaining a POS System include maintenance of the equipment and programs and any operating staff costs. The POS terminals need a greater degree of maintenance than mechanical cash registers. Files and operating programs must be updated and checked for errors. There may be setup and maintenance costs associated with the

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10. One item of heated debate at the current time is consumer unrest over elimination of item pricing by food stores. The basic concern is over the accuracy of shelf prices, the accuracy of the price look-up feature of the POS System, and the inability of the consumer to verify prices himself at checkout. Therefore, certain consumer groups are lobbying some state governments to force food retailers to retain item pricing.

To overcome any discrepancies between shelf prices and computer memory prices, a system whereby shelf labels are immediately printed out when the computer is updated may be required. In addition, price changes will most likely have to be made only when the store is closed to shoppers to avoid a situation whereby the price of an item already chosen by a shopper is changed prior to that shopper's checkout.

One idea presented to promote consumer confidence was to supply grease pencils in the store so that shoppers could mark items themselves for comparison with the computer price. Steinbergs (Dorval Test Store) in Canada has reported favorable results with such a system.

operation of the in-store minicomputer. These costs must be considered by any retailer in determining the total cost of converting to a POS System. Operating staff costs are of primary importance at the corporate level where the added load on the central computer system and the increase in information output will be most significant. Individual stores can hopefully utilize existing clerical personnel to operate the system locally but could require a more highly skilled person in larger stores with more complex systems.

The preparation of magnetic tags is an important factor in any cost analysis of a department store using a magnetic wand scanning system. The tags can be prepared automatically by special equipment, but the cost of labor to operate the machine and the tag material cost must be added to the operating costs. Although food stores avoid a great deal of marking by using the Universal Product Code placed on packaging by the manufacturer, they must still place labels on all perishables (Meat and Produce - about 25% of sales).

The costs described in this chapter can be combined with the savings presented in the previous chapter to give a cost/benefit analysis of a POS System. The results of representative calculations are given in Appendix I.

CHAPTER 5 - RESULTS SO FAR

This examination of the state of the art in Point of Sale Technology will end with a brief summary of the published results. The majority opinion of the users has been that the introduction of POS terminals was successful. In most cases the published reports indicate that POS technology has increased productivity sufficiently to provide a high rate of return (20 to 50% per year) on the POS investment.

The currently available literature and the authors' discussions with POS System users has indicated that the introduction of the system has been smooth and relatively trouble-free. An important point is, however, the fact that the transition period was preceded by months of hard work by both management and systems analysts to design, test, and debug the POS System.[11] The key point of these results has been that the implementation of a POS System, if preceded by thorough development work, can be accomplished with a minimum of disruption of sales floor activities.

The available data on the operation of the POS Systems currently in use has also been favorable. Many of the potential benefits identified in Chapter 3 have been reported as obtainable

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11. An excellent example of the reports on system implementation was provided in an article entitled, "A Tool to Avoid Complexity and a Story of Success" by Frank Burnside (Computers and People, May 1974). This article described the experience of a large department store in the adoption of POS terminals (Sweda Model 720 with Datapen magnetic wand readers).

under actual operations. System reliability has been excellent in most cases with system downtime at surprisingly low levels. In general, the performance of POS Systems has been remarkable, considering that the computer industry has a history of pioneering disasters. This early success should be an important factor in encouraging other retail firms to investigate and to adopt POS Systems.[12]

The authors believe that in the next few years rapidly increasing manpower costs and increasing competition will make point of sale systems even more attractive to the retailer. Combined with new advances in computer technology that will increase the computing power per dollar invested, these developments will create a large increase in Point of Sale usage. Retail companies who ignore the potential of POS Systems may find themselves at a significant competitive disadvantage in the not too distant future.

In summary, the authors have attempted to provide in Part A the background required to undertake POS System specification and to understand POS System design and implementation. The major points to be emphasized are:

1. POS terminals are programmable and possess limited intelligence.

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12. A recent survey undertaken by the Food Council of Canada (1974) indicated that almost all the major food store chains are taking an active interest in POS Systems. At least five companies have setup test stores or plan to start test stores by early 1975. The general consensus in the entire food industry is that POS Systems will become common in the next few years.

2. Systems configurations vary from stand-alone terminals with tape cassettes to a fully interactive system which allows file look-up and update.
3. A major advantage in data entry speed and accuracy is available through the use of scanning devices.
4. The most easily quantified areas of cost reduction include increased employee productivity, reduction of checkout errors, and reduction of bad credit losses.
5. As related to the existing company MIS, a POS System can reduce manual data preparation and entry and can improve the quality of management information. At the lowest levels, the system makes possible full automation of the order entry - distribution system within a retail organization. The system also provides information for sales analysis and inventory control. In addition, decision support features for upper management can be implemented utilizing the data base maintained by the POS System.
6. System costs include hardware, software, physical installation, system design, employee training, and operating and maintenance expenses.

PART B -- MANAGERIAL IMPLICATIONS AND DECISIONS

The purpose of Part B is to present the authors' conclusions regarding the procedures that should be followed by managers in arriving at decision regarding Point of Sale Systems. These procedures are not simply a collection of what the pioneering companies have done, but rather an attempt to apply normative decision techniques to the problem at hand. Careful attention has, however, been maintained with regard to actual company practices in order to avoid a completely theoretical approach.

The authors' believe that a basically normative approach to the managerial decision process will help to provide new insights into the problem of adapting Point of Sale Systems to the needs of the retail industry. The authors recognize that a particular company will encounter specialized problems not covered by the normative viewpoint. The normative approach should, however, provide a framework or series of guideposts which may prove useful in evaluating POS Technology with regard to a particular retail environment.

Before proceeding to the next chapter, there is one definition that should be clarified. The Point of Sale System described consists of the electronic equipment, software, and procedures relating to the operation of this equipment. This definition is presented so that it will be clear to the reader that the physical equipment only constitutes one part

of the entire POS System. In order to be effective, the design, implementation, and control process must be carried out in a manner which recognizes the requirements of each subsystem involved in the entire POS System.

Our analysis will follow the flow chart presented on the next three pages.

Figure 5 - POS Design

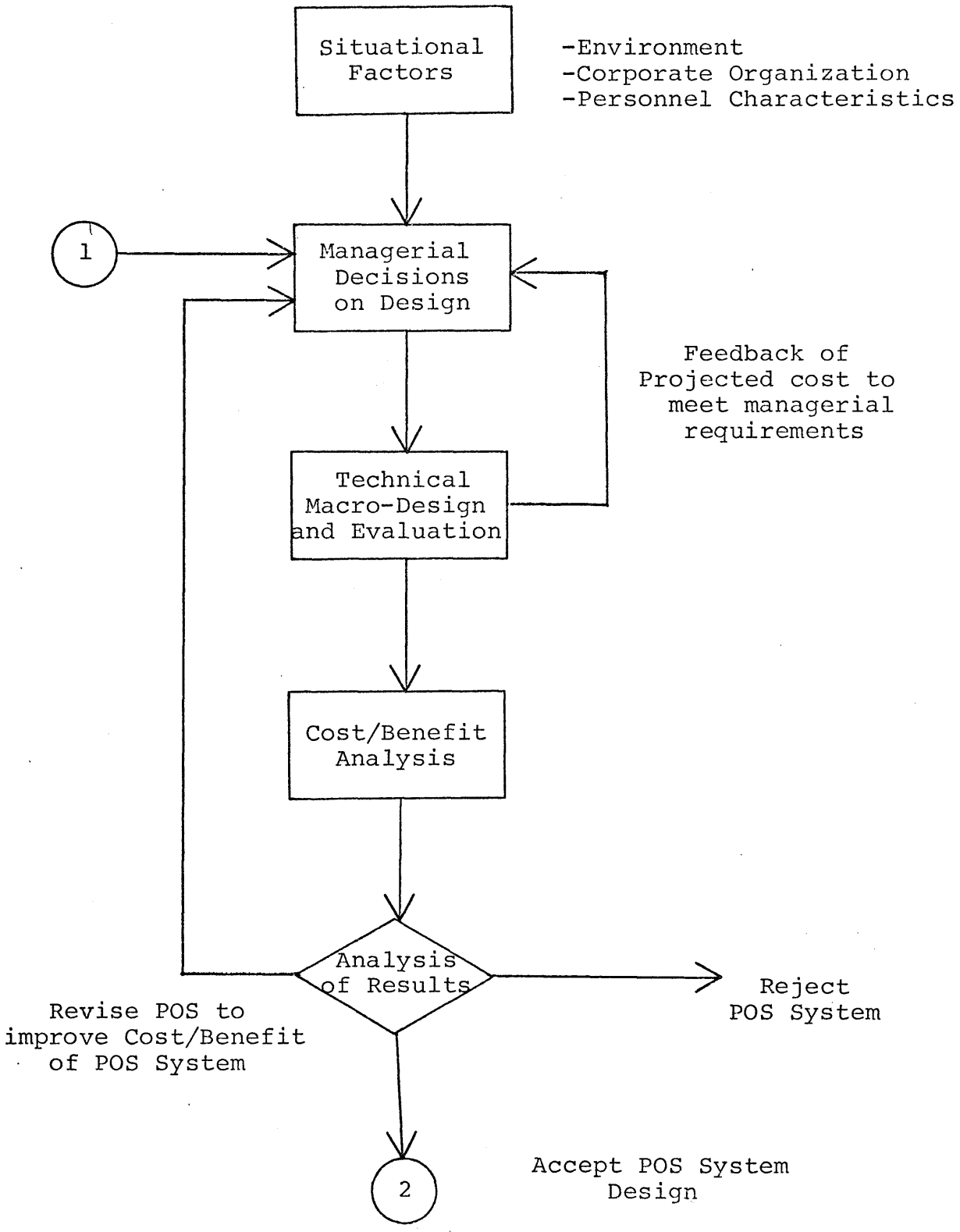


Figure 6 - POS Implementation

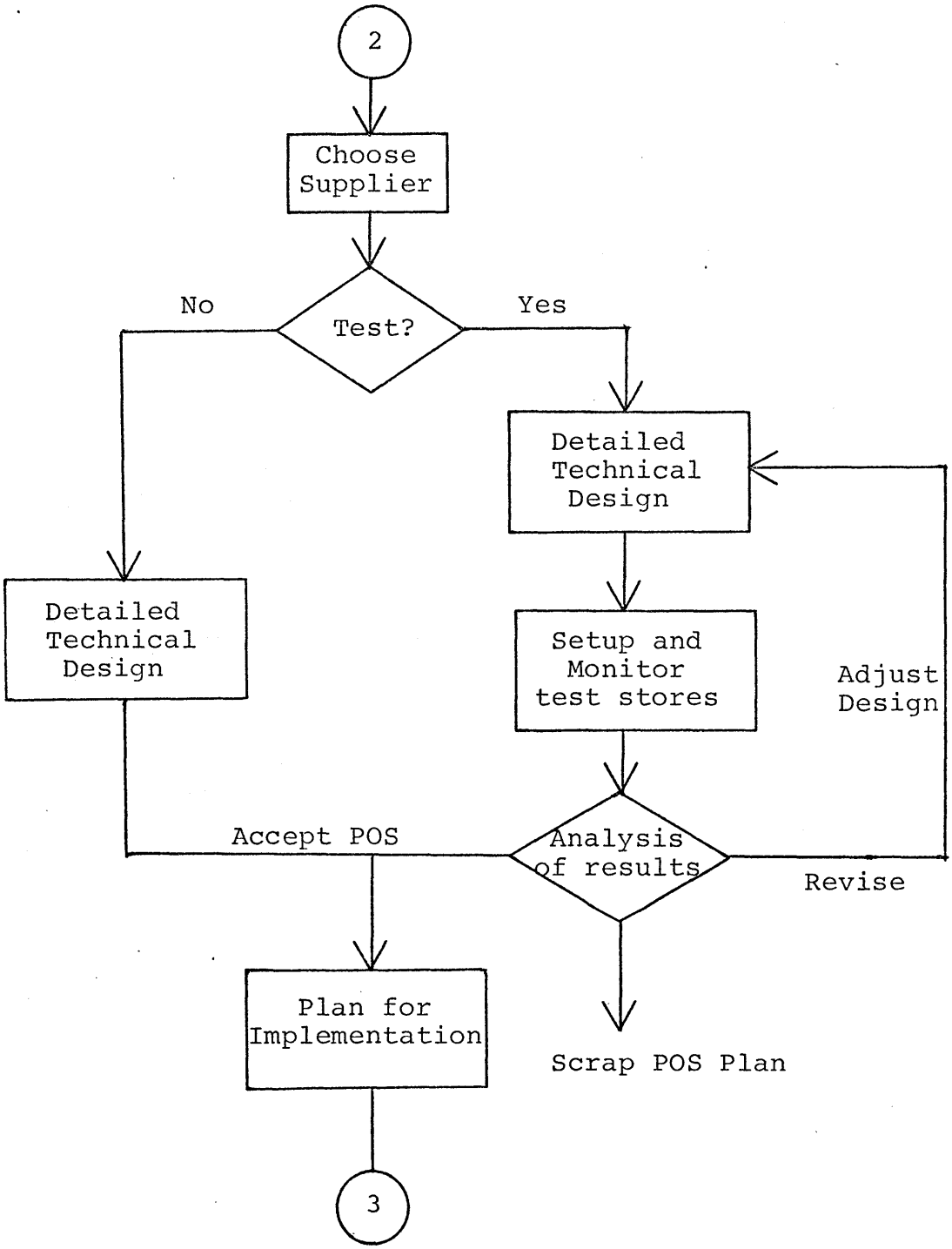
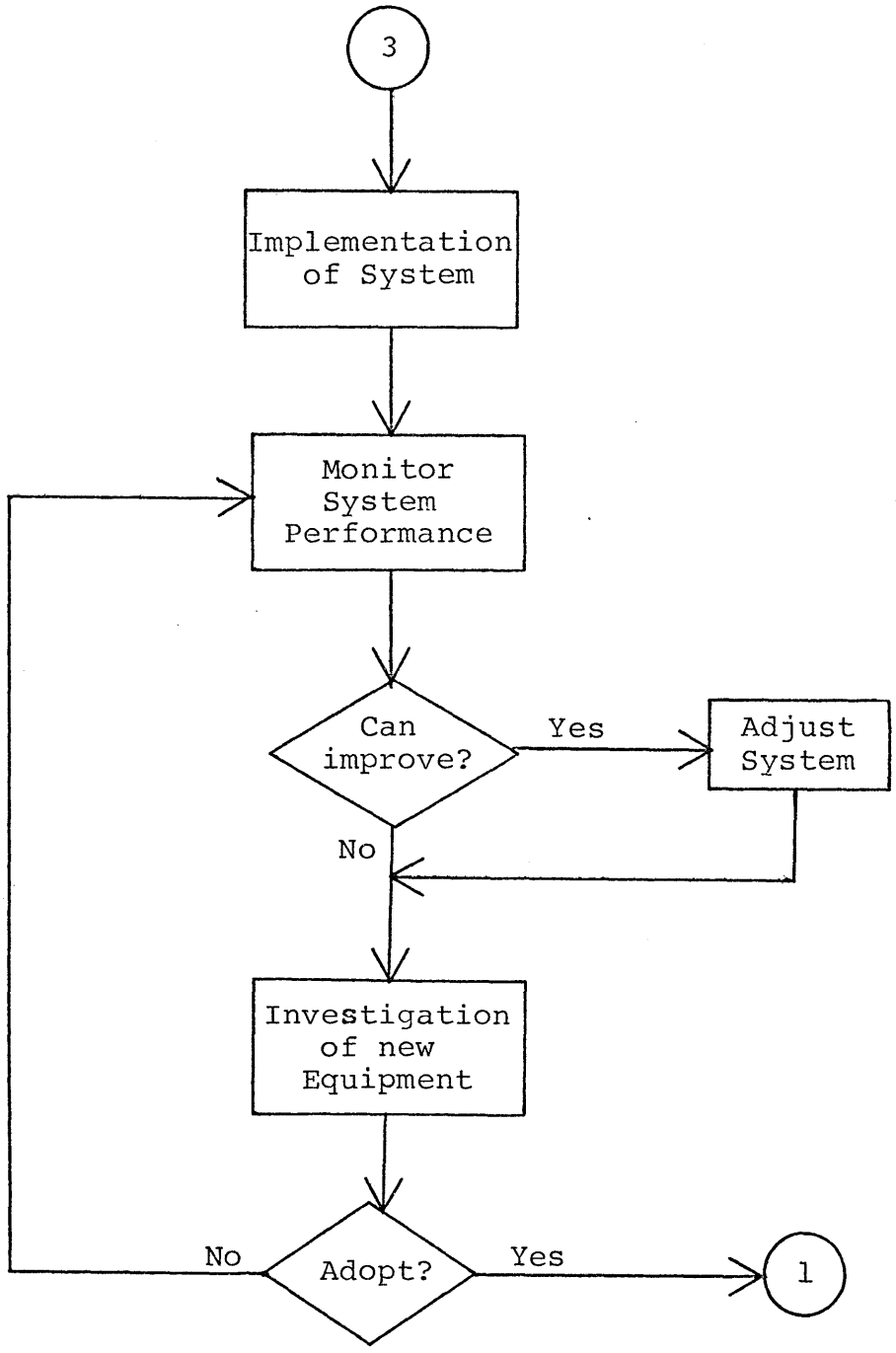
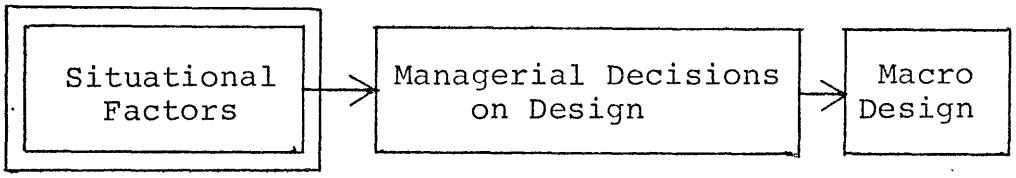


Figure 7 - POS Control





CHAPTER 6 - SITUATIONAL FACTORS

This chapter deals with the characteristics of a retail organization that are important inputs into the Point of Sale decision. Proper identification and evaluation of the key situational variables is an important first step in the design process and the decision as to whether or not to use Point of Sale Terminals. The authors will outline those factors which in their opinion are of significant value in the determination of the implications of the introduction of a POS System. These factors are important because a POS System must be designed and evaluated in terms of its impact on a particular retail organization. By first identifying and analyzing these key factors, the manager and systems designer will be better prepared to approach the investigation of POS Systems in terms of the organization's requirements. Without a clear understanding of the organization's needs, any design (or evaluation) process is in danger of producing a good system (in terms of efficient use of resources) which is not effective in terms of the particular company.

The situational factors which will be presented in this chapter are those which directly effect the POS decision process. Above these factors are the corporate goals and

objectives (either explicit or implicit) which top management uses to determine company strategies and policies. The linkage between corporate goals and the situational factors which currently exist in the organization is beyond the scope of this thesis. The corporate goals and objectives are, however, important to the extent to which these policies, if pursued, will result in future situational factors different from those presently in existence. Topic number one will address this problem.

This chapter corresponds to the activities occurring in box 1 of the procedural flow chart (see Figure 5). The presentation format will consist of a list of questions relating to a specific topic followed by a short explanation of the significance of the answers to these questions in the POS decision process.

(1) Corporate Goals and Objectives

(i) To what extent will present situational factors be altered in the future if corporate strategy is followed?

(ii) How many of these changes will occur within the projected lifetime of the proposed POS System?

The answers to these questions are critical to both the POS acquisition and design decisions. Candid answers to these questions will provide the best guidelines as to what require-

ments the company POS System must be capable of fulfilling in the future.

The adoption of a POS System by a retail organization is an important investment decision since it entails a large outlay of cash to acquire the hardware and software components as well as the cost of system design. Corporate plans for future growth will be very important in the estimation of the cash inflows that will result from this investment. Evaluation of the investment decision on the basis of the current characteristics of the company implicitly includes the assumption that the organization will not change significantly in the future. In the 1970's this assumption is not necessarily valid.

As an example, consider a retail company which currently has a mix of relatively large and small stores. An investment analysis of the POS System is likely to conclude that the System cannot be cost justified in the smaller stores. The knowledge that the corporate plan for the next few years is to close down the smaller stores and expand the number of large stores would certainly have an impact on how the investment analysis influenced the POS System acquisition decision.

The importance of future plans to the POS System design is in determining the flexibility which should be built into the System. If, as has been predicted, the current trend is toward lower sales force personnel in a store, (Retail Street,

September 1974), then any company which follows this trend will require a POS System to supplement the reduced work force.

(2) Management Control System

(i) What are the key variables used by higher management to monitor the operations of the company?

(ii) What information available at the point of sale is considered to be useful to top management but is too expensive (or takes too long to collect) to be provided on a regular basis?

(iii) To what extent are the store managers independent?

In order to make the best use of the data capture capabilities inherent in a POS System, the designer must be provided with a clear statement of what data the management control function requires. The data requirements can be broken down into two basic categories. The first category consists of data that is currently collected by some other means. The second category is data that is not now collected but would be of use to menegement in decision making.

The identification of the key variables (especially in the case of category two) depends on the manager's ability to identify the key success factors of his business. In order to do this the top managers must have a model of their organization. One key success factor in the retail trade is rate of response to consumer trends. Key variables relating

to this factor would be sales of new merchandise, sales by department, and excess inventory levels. This data could be obtained by use of a POS System that recorded sales by item number. The data collected could then be processed by a central computer to produce a report which highlights the required information. Similar analysis of other key success factors will result in the identification of what useful data can be provided by a POS System. The designer can then provide the system with the data sets and hardware required to produce these reports.[13]

A separate issue that must be considered is the level of autonomy that the individual store managers currently exercise. In the case of a company organized as a voluntary chain of franchised stores, the adoption of a POS System would depend on the agreement of enough of the store owners to convert to such a system. The emphasis on centralization of functions (such as logistics) would also be on a more voluntary basis. Even in stores which are run by employee managers, the psychological impact of the increased availability of store operations data at head office must be considered. Such de facto centralization may well be counter-productive. Thus, explicit consideration of such factors is essential during System design.

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13. Typical key control variables in the retail industry are: response to consumer trends, inventory turnover, effectiveness of promotions, pricing, staff productivity, and effectiveness of credit policies.

(3) Corporate Organization for Logistics

(i) How centralized is the control of logistics within the organization?

(ii) Will the introduction of a POS System have an impact on the degree of centralization?

A retailing company with a highly centralized logistical system would be able to use the "sales by item" data captured by a POS System to increase the distribution system efficiency. Tighter control over inventory would be possible since the sales data could be subtracted from stock on hand at the end of each day. Trends in sales of individual items could be monitored and unusual patterns could be rapidly isolated for management evaluation.

Inventory control is a particularly important factor in the profitability of most department and discount stores. These companies can usually be characterized by a low net profit per dollar of sales and a large inventory of goods for sale. Therefore even a small improvement in inventory control with a corresponding reduction in inventory holding expense would improve net profit substantially.

The second question is related to a trend toward centralization of the logistics function ("Computer Generations", HBR July-Aug. 1974). In analyzing the potential impact of a POS System on company operations, the manager must consider whether

or not this system will make it practical to handle logistical operations centrally. The rapid accumulation of sales data would provide the manager of the logistics function with timely information on current stock levels. This would make centralized control feasible because the major problem in this mode of operation has been incomplete and late data.

(4) Managerial Personnel

(i) Will store managers make use of the new information?

(ii) Will the head office personnel make use of the information?

The above questions are very closely related to the intangible benefits which a company can expect to receive from the introduction of a Point of Sale System. The advantage of providing the manager with better data depends on whether or not the new information has a beneficial impact on decisions made.

In evaluating the impact of POS Technology the background and present practice of the organization's management personnel must be considered. If the managers tend to be analytically oriented, then it is highly likely that the new data will be helpful.

Design of the POS System, especially with regard to programs preparing reports from the data collected at the terminals, must be based on an understanding of the managers

information requirements. Therefore, no reports should be designed without the active participation of the managers themselves. This participation, coupled with an educational program aimed at helping the managers to use the new data effectively, will undoubtedly increase the impact of POS Systems on management decision making.

(5) Product

(i) What is being sold?

(ii) What is the average cost per unit?

The answers to questions (i) and (ii) are important factors in isolating the benefits which can be derived from the installation of a POS Terminal System. At one extreme are food stores which sell a large number of low price items at a small margin of profit. The primary impact of Point of Sale Terminals in such an operation would be on the speed and accuracy of the checkout process and the elimination of item pricing if the UPC and scanning are used. A Department Store, on the other hand, sells items of a higher unit cost which in many cases have a limited life due to fashion or seasonal trends. In this case, the primary impact of POS Terminals will be concerned with the control of inventory and the accumulation of marketing data. Answers about the product are therefore an important indicator of what benefits can be expected from a Point of Sale System and the design

required to obtain these benefits.

(6) Store Volume

(i) What is the volume of transactions of the average store?

(ii) What are the size ranges of stores?

These questions are related to the fact that most of the benefits of a POS System increase proportionally to the volume of transactions while many of the cost factors tend to be only semi-variable. Therefore, in most cases, there exists a specific threshold of size required before installation of a POS System becomes economically viable. For instance, it is estimated that a food store must have a volume of at least $50,000 sales per week (in 1974$) to justify the required investment. (Canadian Grocer, June 1974 p. 16). In addition to the single store decision problem, a chain type operation must consider what actions should be taken if the 'average' store is above the critical volume but several of the smaller stores are below the cutoff volume. The manager must carefully consider the trade-off between equipping the smaller stores to achieve uniformity or only equipping the larger stores.

The size of the store also influences the design process. Larger stores make the installation of more on-site computer power practical while most smaller retail outlets should

operate in the store and forward mode. Another alternative that should be considered for smaller stores is to have several stores share the same minicomputer. Several of the manufacturers offer connectors which allow this type of connection through voice grade lines.

(7) Store Design

(i) How are the cash registers currently organized and how many are there?

This information can be used to determine whether or not the installation of POS Terminals will allow a reduction in the total number of cash register locations. Such reductions are usually only possible in stores which use a barrier checkout design (i.e. - most food and discount stores). Several reports have indicated that as much as a 40-50% reduction in the number of such checkout stations is possible in food stores using scanning and the UPC. Department stores using area checkout stations, on the other hand, cannot usually reduce the number of registers without adversely affecting customer service.

(8) Credit and Check Authorization

(i) Are credit cards accepted?

(ii) Are checks accepted?

(iii) What are the authorization procedures (time required,

floor limit)?

(iv) What are current losses due to fraud?

The answers to these questions will determine whether the use of automatic credit authorization is cost effective. The design of the POS System will therefore be clearly influenced by this process. Future trends should also be considered in answering this question. This proviso is particularly true with respect to food store operations since the current lack of credit card use may not continue (Retail Overview, Dec. 1968, p. 18). In fact, the availability of POS Systems may be an important factor in extending the use of credit cards.

The answers to questions (i) and (ii) as regards both current and future store policy will determine if any type of credit checking system is required. Question (iii) attempts to isolate the specific method of credit checking required. As described in Part A, these methods can be as simple as individual register check digits verification or as complex as full positive account look-up and update on each transaction. Question (iv) provides information useful both in the determination of which credit check method to use and in analyzing the potential benefits of such a system in relation to its cost.

(9) Personnel

(i) How will store employees react to a POS System?

(ii) What will the trend in employee wages be in the future?

The first question deals both with employee attitudes and their ability to adjust to new procedures. The extent of the problem is generally dependent on the previous experience of the store personnel, but can usually be overcome by providing for a few hours of training and by good communications with the employees during the introduction period. Stores which are unionized must also consider carefully the reactions of the Union to POS Systems.

Recent trends in the wages of store personnel have been sharply upward. If this trend continues, the introduction of POS terminals will become even more cost effective in the next few years.

(10) Customers

(i) How will they react to Point of Sale Systems?

This is a critical question since a retailing company depends on its customers for its survival. In most reported situations the customers have reacted favorably to the new equipment since checkout or credit operations are handled more rapidly (99% favorable reaction reported at Steinberg's test store, Canadian Grocer, Sept. 1974). There are, however, suspicions on the part of some customers that prices read

automatically may be wrong or different from the posted prices. Indeed, certain consumers groups are striving for legislation to force continuation of item pricing in the food industry. Such legislation could severely limit the cost savings of POS Systems to food retailers. However, as the use of POS terminals increases, the general public is likely to become more accustomed to the new systems.

It is important that the reaction of customers to the POS System be considered carefully and all necessary actions be taken to make the transition smooth. Most of the pioneers in the use of POS terminals have recognized the need to educate the public through advertising and to provide a channel of communication for consumer response. A strong effort must be made to sell the new system to the customer by indicating the benefits that this new system offers to the consumer.

(11) Corporate Data Processing

(i) How capable are the present data processing personnel and to what extent will they be able to maintain the POS System?

(ii) What will the impact of POS related computing be on the computer center? Is enough computer capacity available to handle this load?

(iii) What are the specifications of the POS output needed to ensure compatability with central system?

(iv) Future plans for expansion?

The answers to these questions will help the manager to determine the changes that will be required for adoption of a POS System. In determining these answers the manager will have to rely on technical advice that might best be provided by outside consultants.

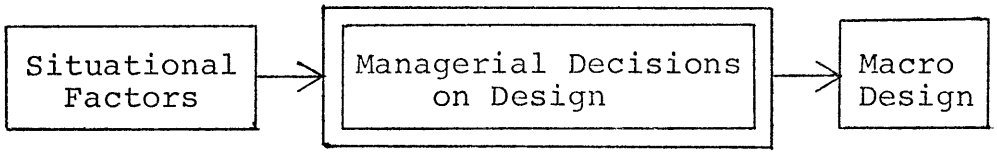
The investment decision must include as costs any additions to system components or staff personnel that are required to support a POS System. Savings might also occur if the POS System performs functions that are currently handled by the central computing systems.

Design decisions will be affected by the need to insure that the POS System can interface properly with the central computer. This is critical both from the standpoint of operational efficiency and system reliability.

Future plans for the acquisition of new computer equipment should also be considered. The same questions relating to capacity and compatibility that were answered regarding the present system should be considered in relation to proposed future systems.

The computer staff will play a key role in the design and implementation of a POS System. Their capacity, both in terms of background and time availability, should be considered. Computer analyst and programmer time should be added to the total cost of a new POS System.

In summary, the purpose of this chapter has been to make explicit the situational factors which are likely to have an effect on decisions regarding POS Systems. The first step in the decision process requires that these factors be examined. Subsequent chapters will demonstrate the use of these characteristics in both the design and investment decisions.



CHAPTER 7 - DESIGN - MANAGEMENT

This chapter will examine the decisions which corporate management must face during the design process of a Point of Sale System. These decisions will to a great extent determine the contribution that the new system will make to the organization. Chapter 8 will investigate the technical aspects of the design process.

The separation of management decisions into one chapter does not mean that the authors believe that this is an independent function. These decisions are highly dependent on the situational profile that was developed from the questions outlined in the previous chapter and on the technology available from the manufacturer. Although Corporate Management receives inputs from the technical systems designers and the equipment manufacturers in order to fully understand the system, the success of the POS System will depend primarily on the quality of the decisions made by management. The input of Corporate Management to the design phase is critical to the creation of an effective system that will support the activities of the organization.

Management must also be aware of the circular aspect of the process of the adoption of a POS System. In designing

the system, the effect of the POS System on corporate characteristics must also be considered. This effect requires that the system be flexible enough to allow in-place upgrading, so that the POS System can be revised to meet the changing requirements of the store environment.

The selection of the proper systems features should be made on the basis of a cost/benefit analysis. In order to determine the costs properly it is necessary to examine the decision process as a two stage approach. During the first stage, the decision regarding the basic configuration of the POS System is made. The second stage requires the manager to determine the subset of features available on the chosen configuration which are the most cost effective for this company.

Configurations

The basic system configurations are those explained in Part A. Their characteristics are reviewed below.

Configuration I consists primarily of the basic terminal and data accumulation equipment which services one or more terminals. The features provided by such a system are improved checkout speeds and the automatic preparation of data in machine readable form. The advantages of this configuration are the simplicity of its operation and the low equipment costs.

Configuration II improves the computer power of Configuration I by linking the terminals to a mini-computer or

store controller. This mini-computer controls the data collection process and also provides some in-store reporting capabilities. The primary distinction between this setup and Configuration III is that the mini-computer does not have the secondary storage or computer power to provide extensive on-line look-up facilities. Features available on this system are the features listed above for Configuration I plus negative credit authorization, automatic print-out of in-store totals, and automatic accumulation and transmission of transaction data. These systems are in the mid-range of both complexity and price.

Configuration III is a POS System which has extensive interactive facilities between the terminals and a computer equipped with direct access storage. The additional features provided by such a system are positive credit authorization and automatic price look-up. The cost of these new features is a more complex system and increased equipment requirements.[14]

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14. Management also has the option of choosing a terminal system designed to perform only a single function (such as credit verification). This option requires that the mechanical cash registers be retained and therefore cannot be considered a complete POS System. An example of this type of system is the TRW Model 4000. This system provides simple data entry terminals (12-15 keys or Touch Tone Telephone) which are linked to a mini-computer via data communications over telephone lines. Full positive credit authorization is possible through the use of disk data sets as peripherals to the mini-computer. If in management's opinion the usefulness of a POS System would be limited to one particular function, the use of a specialized system would be a viable alternative. The main advantage would be lower investment and operating costs as compared to a full scale POS System.

System Features

The most basic feature of any POS System is data collection. Management must determine what transaction data should be collected. Important technical inputs into this decision are the time constraints on the processing of data and the current (plus future planned) data processing capability of the company.

The provision of accurate and timely information on sales transactions was cited in many of our survey responses as the most important benefit of the POS System. The improved data collection at the store level cannot be fully exploited until the company upgrades its other systems so that the POS generated data is utilized. Therefore the limiting factor in the value of the data collected is often the capability of the company's operating and management control systems to make use of the data.

In-store reporting capability is the second major feature that management must consider. If the use of in-store reporting reduces the requirements for data transmission and/or central data processing, then the cost savings relating to this reduction should be considered by management.

Credit card and check authorization are important factors in most retail stores' profit margins. Management must consider the current losses due to fraudulent abuse of credit as well as the clerical time spent on credit authorization in accessing the need for on-line credit checking.

Negative credit checking provides the first level of protection by comparing the credit number to a list of known lost or stolen cards. Positive checking extends the process further by determining if the number is on file and what the current charges against that account total.

In a brochure prepared by TRW, the following reductions in credit related costs for clients using their systems are claimed (positive credit authorization).

(1) 95% reduction in purchases on bad debt accounts.

(2) 75% reduction in fraud purchases.

(3) 20% cost savings in authorization payroll.

(4) 33% reduction in telephone calls.

The savings that would result if these reductions occurred would be substantial for any retail store which had a sizeable percentage of credit card sales.

Magnetic or optical scanning of merchandise information is an important factor in improving both the speed and reliability of data capture. A full information tag can be provided with a magnetic system which eliminates the need for any look-up function. This system would be useful if the store operating policy was not to alter the prices too often on merchandise already in the store. Either optical or magnetic tags can be used in a system which utilizes price look-up. Since most of the information is maintained on a direct access device, changes in item data, including price, can be performed via a simple terminal entry.

Management must consider the savings in clerical time both in the checkout operation and in merchandise pricing when evaluating this feature. The authors' survey responses indicated that many managers in the retail food trade were convinced that the impact of automatic pricing on food store operations would be dramatic. In many cases the managers believed that this feature alone could justify the installation of POS Systems.

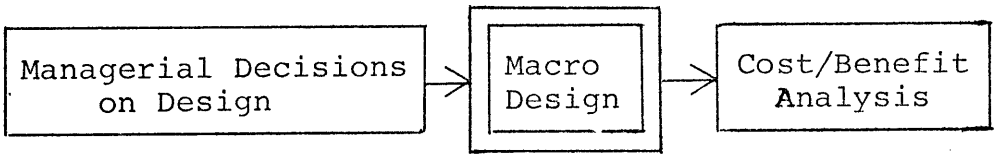
The use of an automatic look-up feature by POS Systems will likely increase as the costs of direct access devices and minicomputers decrease. Therefore management should consider very carefully whether or not the proposed system could be upgraded to an interactive system in the future if it is decided that the scanning feature should not be included now. One respondent in the survey admitted that failure to include this flexibility was the most serious mistake made in systems design.

As described previously, the process of deciding on what is the best system is a two stage procedure. The selection of the optimal configuration is followed by the choice of the optional features available on that configuration. In many cases the final decision can only be made after several iterations through this decision process as new facts relating to the configuration are uncovered during the second step. The preceding discussion regarding the major features and configurations will, hopefully, help to make

the decision process more structured by explicitly relating features and configuration types.

Another important decision by management is related to the make or buy decision regarding the software of the POS System. The manager must choose between purchasing the standard software packages and then making the necessary adjustments in company procedure to accommodate the software or having his own computer department develop customized programs. Except for large retailers,there is usually little choice since the required software would be too expensive to develop independently. The authors recommend that even if the software is purchased, management should instruct its own computer department to become sufficiently knowledgeable about the software provided so that changes where necessary can be made quickly.

In summary, a good Point of Sale System design requires the active participation of management because only managers have the broad perspective on the entire business that is needed to insure the effectiveness of a POS System. Too often the lack of guidance by management forces systems personnel to make decisions regarding system design that actually should have been made by someone with a more general management perspective.



CHAPTER 8 - MACRO-DESIGN

The previous chapter discussed the role of management in the POS design process and in doing so indicated that the system analysts were a major source of information for the managers. This chapter examines the role that the company's technical staff can fulfill in both the macro-design of the system and in evaluating the hardware/software packages offered by the various manufacturers. The responsibility of the system analysts is to create a POS System that will be as efficient as possible. If both management and analysts perform their respective duties properly, the resulting system will be both effective and efficient.

The system analysts should work closely with management personnel to lay out a macro-design of a POS System that is required by the company. The analysts should provide management with estimates of the costs (based on preliminary investigation of what equipment is available) that will be incurred when particular system features are added. Management should also be given guidance as to which features of the POS System can be performed efficiently on a particular configuration.

The completed macro-design should provide the system

analysts with a series of broad guidelines within which the equipment offered by various manufacturers can be evaluated. The key to a successful selection of equipment is a good general knowledge of what is required by the retail company.

The first question that must be answered in evaluating the POS equipment available is which companies offer a system that is similar to the macro-design that has been prepared. The answer to this question will provide the analysts with a short list of manufacturers who provide POS hardware that would meet the requirements of the company. The system analysts then face the task of identifying the technical strengths and weaknesses of each system so that this information can be made available to help management make the vendor decision.

The first step in this process is the selection of what equipment offered by each vendor would meet the requirements of the company. The system analysts working in conjunction with the manufacturers' representatives can perform a preliminary design of the system that the company would obtain from each of the different vendors. This design will be the one from which the cost/benefit analysis is developed.

The authors have not been able to find any mention in the literature of the use of simulation techniques to evaluate the performance of proposed POS Systems. In view of the extensive use of simulation in the evaluation of more conventional computer systems, the authors are of the opinion

that this approach would be useful. For example, a simulation of the behavior of a minicomputer when supporting different numbers of active terminals would be useful in evaluating the minicomputers offered by each manufacturer. Such a simulation would provide the system analysts with important data on how well the POS System would operate in different size stores.

There are several dimensions along which each potential POS System should be evaluated in order to provide management with a realistic comparison of each system. The most important dimensions are:

(1) Hardware capability

(2) Software availability

(3) System adaptability

(4) Upward compatibility with more powerful systems

(5) System obsolescence

(6) System reliability and backup

(7) Data security and recoverability

(8) System cost

Hardware capability is concerned with answers to questions such as "How many active terminals can be linked to one supporting device?". Using the data gathered, the system analysts can then determine what equipment will be required to support the company's POS design.

Software availability is important because in most cases in-house development of POS software would be prohibitively expensive. Therefore, the quality and type of programs

available from each manufacturer must be considered.

Most system packages allow the customer some flexibility in tailoring a system to the particular retail environment. The system analysts must provide management with an estimate as to what extent the POS system can be adjusted to fit the company's present procedures. The need to revise present procedures in related systems should be considered as a cost when comparing alternative vendors. One of the executives that the authors interviewed emphasized that the POS transition occurred most smoothly when the impact on related systems and procedures was minimized.

The option of being able to upgrade the POS System in the future should be considered. Survey responses have indicated that becoming locked into a low-power POS System is a very real problem. For example, the analysts should determine whether or not a proposed terminal for use in a non-interactive system could be easily converted for use in an interactive system in the future.

A closely related topic, and one of considerable importance to users, is fear of obsolescence. Having witnessed the dramatic changes in the computer industry and more recently in the pocket calculator market, retail managers are rightfully concerned that future technical developments may allow systems with radically improved performance and features yet similar or even reduced cost. This has caused some retailers to decide to wait until the market looks

more stable (after a couple of system generations have passed) before seriously investigating POS. The countervailing argument to this position is that early users will be farther along the learning curve as regards POS systems and thus more able to utilize advanced systems. In addition, by having utilized POS in its early years, they may have obtained a competitive advantage which is difficult to overcome. The critical point to all this is that regardless of when a retailer begins seriously considering POS, but especially for the early users, it is critical that system design recognize the certainty of POS evolution and include provisions for it. The basic consideration is whether or not the system manufacturer will be able to keep pace with the industry and whether or not his future systems, both hardware and software, will allow easy conversion from the present one.

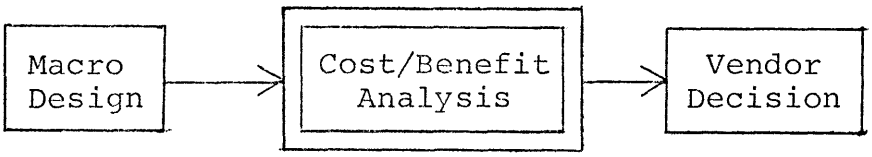
In a retail environment a total system failure would be costly in terms of lost sales data. The reliability of the system and available backup procedures are therefore very important. The analysts should determine to what extent the terminals are capable of independent operation (so that the terminals function during a computer failure).

Sales data in most retail stores is classified as proprietary information. The system design must include adequate safeguards to prevent unauthorized access. A second concern is that any lost or inaccurate data relating to credit sales would be costly for a retail store. The POS

System should contain sufficient backup facilities to insure that data can be recovered in the event of system failure or transmission errors.

The approximate cost of the hardware and software provided by each manufacturer can also be determined by comparing standard prices with the required system components. This is only an approximation since in many cases prices are subject to negotiation.

The report that will be prepared for management should include both an analysis along the various dimensions identified and the cost calculated for each system under consideration. This report will provide valuable inputs both for management's cost/benefit analysis and for vendor selection.



CHAPTER 9 - COST/BENEFIT ANALYSIS

This chapter deals with the Cost/Benefit analysis that management should perform at this point in the POS System design process. This analysis represents the first hurdle that the system proposal must pass. The preceding three chapters have been concerned with information gathering and narrowing down of design focus. Management must now re-evaluate the proposal to institute a POS System on the basis of the information gathered so far. Cost/benefit analysis represents the most objective method to determine if the proposed system is worthwhile. The options available to management are to redesign the system, to scrap the project, or to proceed with the design and implementation of a POS System.

The first step is for management to estimate the value of the various features available on the proposed POS System. In the case of one well known department store the following benefits were classed as important (configuration type II).

(1) Reduction of paper flow within organization

(2) Improving accuracy on customer accounts

(3) Accurate unit sales data reducing the need to do

inventory counts.

(4) Being able to reconstruct transactions.

(5) Negative credit check to reduce fraud and bad debt credit sales.

Management must determine the incremental benefits that could be obtained in their organizational operations. A particular feature is only valid to the extent that it can contribute to the operation of the retail company under consideration.

The benefits to be obtained from a system include several advantages (such as faster and more accurate information for management decisions) that are harder to quantify. The extent to which these benefits can be useful to the company should be considered at the time when the quantifiable benefits of the system are compared with the costs. (i.e. - Do these intangible benefits outweigh any excess of costs over the tangible benefits?)

The costs associated with the system consist of both the analysis/design/implementation costs and the incremental increases in investment in equipment and in operating costs that would result from the introduction of POS equipment. Although the largest and most obvious costs are the purchase of the required hardware/software from the manufacturer, management must also consider the costs of implementing and maintaining the system. Important implementation costs include software development, file creation, user training, and management time. Operating costs will include system

analyst and programmer time to revise and maintain the system, item marking costs, and computer operations costs. Considering all these factors management can estimate the cost of a POS System.

Management can then consider the costs vs the benefits in terms of:

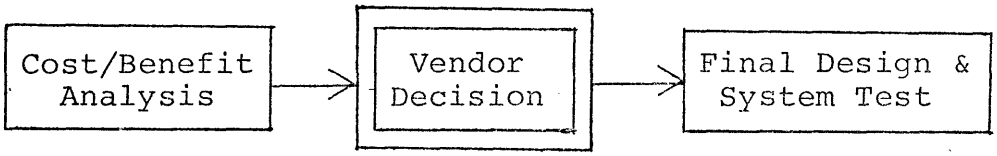
(1) What is the return on investment that will occur as the result of concrete savings?

(2) How important are the intangible benefits such as better and more accurate information?

(3) What are important non-cost items (such as employee morale and customer reaction) and will these factors be favorable to the introduction of a POS System?

Based on the answers to the above questions, management must decide if a POS System should be installed. If management decides not to proceed at this time, then the options are to scrap the project or to consider revised designs.

A more comprehensive list of costs and benefits relating to a POS System was presented in Part A. In Appendix I example calculations of this type are presented for both a hypothetical department store and food store.



CHAPTER 10 - VENDOR DECISION

The selection of a supplier for the Point of Sale equipment is an important decision which requires the perspective of top management. There are five key factors which should be considered by management:

(1) Does the manufacturer offer a system that will meet the specifications that have been developed during the preceding design steps?

(2) What is the overall cost/performance rating of the various systems under consideration?

(3) What level of support will the vendor provide?

(4) Will the vendor be in the business five years from now?

(5) Does the vendor have a good delivery record?

The acquisition of this information will be discussed and then the importance of each of these key factors to the vendor decision will be considered.

Information on the first two factors identified should have been prepared during the technical macro-design and evaluation phase. This information should be made available to management in a form that emphasizes the important characteristics of each system under consideration but avoids

the presentation of too much detail. (NOTE: As was mentioned in the chapter concerning macro-design, an important factor in technical screening of proposed POS systems is the compatibility of the equipment offered with the POS plan. The proposed POS systems passing this hurdle will still require some changes in current operating procedures. The extent and magnitude of these changes should be considered as a criterion by which to judge the vendors.)

Vendor support can be determined by consulting other retailers who have acquired the system. The evaluation of support provided includes the speed and quality of the maintenance service. Software support is another important vendor characteristic. Management can also evaluate the assistance that has been provided by each manufacturer during the earlier stages of the design process. The analysts should provide management with their evaluation of the availability and competence of the support provided by each manufacturer's representatives.

The manufacture of POS equipment is a new and rapidly expanding industry. The number of new firms entering this industry is therefore large. Unfortunately, if past patterns in the computer industry are any indication, many of these firms will withdraw within a few years. Management must consider carefully the financial and market position of each of the proposed vendors. The judgement of which vendors will survive will be critical to the selection decision.

The reliability of the vendor in meeting his delivery commitments should also be studied. Other customers of this vendor are an excellent source of data. The reasons for delay should be considered, since events beyond the vendor's control (ie - strikes, fires) may not be indicative of the vendor's true performance.

The objective of management is to select the vendor which provides the system closest to the company's requirements, offers the best cost/performance ratio, provides excellent maintenance and software support, and is going to be in the POS equipment business for a long time. Management in most cases will have to be satisfied with the best possible trade-off between these characteristics.

The first factor provides a clear cut screening mechanism since only the equipment which is compatible with the general system design should be considered. The first step will often reduce the number of potential vendors significantly.

The cost/performance factor is an important characteristic which managment must consider carefully. Any manufacturer whose equipment is not competitive on this basis should also be removed from consideration. Choice of the vendor cannot, however, be decided on this basis alone since vendor characteristics are also important.

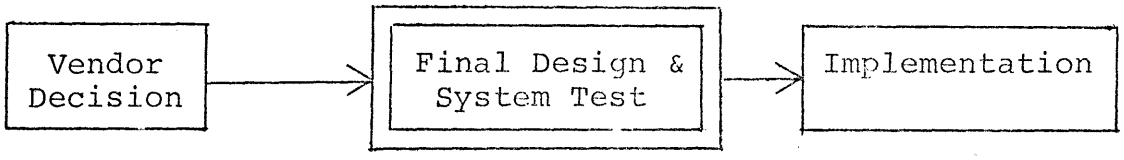
The level of support provided by the vendor is another important characteristic since smooth performance of the POS System will require good maintenance of both the hardware

and software components. Any vendor who has a poor record of past sale service should be eliminated from the list of potential suppliers.

Vendor stability is a particularly important factor in the POS System market because of the dependence of the users on the vendor for both hardware and software maintenance. If the manufacturer withdraws from the POS market, customers who have bought his equipment will be forced to maintain their own systems. The rapid development of new technology for use in the POS equipment will result in second generation machines being introduced in a few years. If the manufacturer is still in business, the chances that the retailer will be able to obtain a second generation system that is compatible with his first generation files and programs is increased considerably.

The vendor decision requires the exercise of managerial judgement since management must evaluate each vendor on the basis of the five factors identified and then decide which vendor represents the best combination of characteristics. A thorough examination of the characteristics of each vendor will provide the most useful information base for the decision. The choice will require management to evaluate the relative strengths and weaknesses of each supplier in terms of the requirements of their retail organization. This decision is non-programmable since the criteria upon which the decision must be made includes both technical data and subjective

evaluations of the reliability and stability of the vendor companies. This chapter has indicated the authors' opinions as to the most important criteria for vendor selection. A good decision by management will improve the chances of successful implementation and operation of the POS System considerably.



CHAPTER 11 - FINAL DESIGN AND SYSTEM TEST

For the large retailer, company-wide POS implementation is usually preceded by a system test in a single representative store. The benefits of such a test include:

(1) Detection and correction of system bugs prior to general installation.

(2) The ability to experiment with alternative POS features.

(3) A more reliable indication of system performance and benefits.

(4) A final opportunity to abort the project.

The primary cost of such testing is the opportunity cost of lost system savings resulting from the delay in general implementation. As POS systems come into wider use and the uncertainty of system performance is reduced, such system testing will probably decline in duration and frequency.

Regardless of whether or not a system test is to be included in system implementation, final detailed system design must take place (see figure 6). This detailed technical design occurs within the constraints of the decisions on macro-design and equipment selection that have been discussed previously. The goal of this design process is to create a POS System that will be efficient.

As an example of this process, the authors will use the development of an IBM 3650 Retail Store System. This represents the usual situation that will be faced by the systems analysts and programmers of the retail organization. The POS package supplied by IBM includes both equipment and special software routines that allow the Store Controller to be programmed for operation. The Subsystem Support Services (SSS) program (run on IBM 370 computer) uses parameters supplied by a company programmer to set up the Controller library and operating system. Special company routines are then written by the programmer and assembled into a form suitable for use by the controller by the IBM provided User Programming Support Package. The role of company analysts and programmers in developing software for the POS System is therefore rather limited.

The major task that the corporate computer staff must perform is to develop new programs and revise existing programs for the central computer so as to make use of the POS generated data. This is a long-term project that will be critical to achieving the intangible benefits cited previously. Unless the raw data is processed into compact and informative reports for management, the volume of data will overwhelm the individual manager and result in no effective use being made of the data.

The programs developed for the processing of POS generated data can be split into two general categories. The first

class is essentially an automation and extension of existing manual systems. In many cases this class of application will involve the use of a POS System to replace manual input procedures. The problems involved in these applications are relatively straight forward. The second class of processing concerns the use of POS data to aid management control and decision making. A relatively simple example is the use of sales statistics by time and department to help in staffing plans. A more complex example is the use of POS data to analyze sales trends for use in purchasing and distribution decisions.[15]

Once this technical system design is complete, the company can proceed with initial system testing. The value of testing results from the involvement of both customers and store personnel in the test. They can highlight any errors in design that have so far been undetected. The POS data generated can also be used to test new applications programs designed to operate under a full scale POS System.

An important test store characteristic is that to the extent possible the store(s) chosen represent the average company store. The key dimensions on which the term average should be applied include clientele, store size, sales volume,

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15. The availability of POS data will be an important factor in the adoption of Management Science techniques to aid management. Previously, many potentially useful applications of operations research techniques have been impractical because the required data was unobtainable. These applications must be re-evaluated in light of the plan to implement a POS System.

and location. Choosing a store that is not "average" can result in biased results.

The procedures mentioned here refer to a chain store operation. In the case of a company having only one or two large stores, a similar test can be set up using one or more departments in each store.

The detection and correction of hardware or software deficiencies in a test store environment can result in a smoother transition when the entire chain converts to POS terminals. The key to performing the detection process effectively is to have manual checks on system performance (ie - are the unit sales reported for a specific item realistic). Unless there are good manual checks on the POS System, many subtle errors may go undetected. A parallel test is the only way to insure a relatively error-free POS System.

The second level of design error possible concerns the physical layout of the terminal and surrounding fixtures. Test store personnel can indicate how the physical setup of the checkout area can be improved. Minor changes in design (such as enlarging the bagging surface area in a food store checkout) can result in an improvement in employee productivity.

A major concern of several retail food companies has been the reliability of the optical scanner under normal store operations. The results of Steinberg's test store operation at Dorval has indicated that the UPC symbol can be

read with a high percentage of reliability under normal operations (Canadian Grocer, Sept. 1974). Superficial damage to the UPC symbol does not prevent registration via the scanner. Only a test store environment can provide this type of critical data.

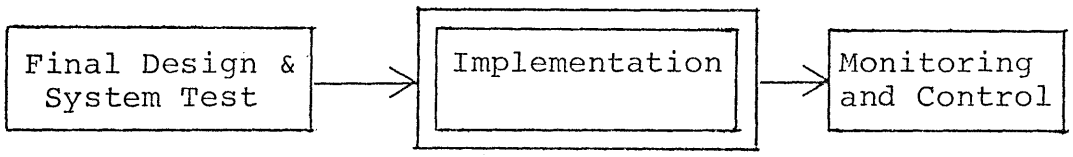
The second major advantage concerns the use of a test store to experiment with various features of the basic POS System. One potential test in a department store environment is to compare the value of the terminal with and without scanning devices. The results of this experiment could be an important factor in the final decision as to whether or not to include scanning in future POS installations.

The test store environment also represents the first time that the reaction of customers to the new POS System can be measured. An advertising campaign can be tested for its effectiveness in selling the POS System to the consumer. Problems or dislikes regarding the new equipment voiced by customers can provide useful insights into the key factors in customer acceptance of the POS System. In addition, retailers can determine if the system has any effect on sales volume. Early users have been concerned that consumer distrust might adversely affect sales (this is especially relevant in the food industry).

POS technology is relatively new and is only now becoming widespread throughout the retail industry. Therefore the early users of POS Systems were pioneers in an untried area

of retailing. Setting up test facilities was necessary to determine whether the cost estimates for installation of the system were realistic and if the benefits cited were obtainable. The large investment required to convert all stores to POS terminals required that the system be proven in the field. As this technology becomes more widespread and a retailer can use the example of other companies selling similar products, the requirement for this type of verification will decrease. This type of information will still be useful in the final go - no go decision, but the primary value of testing will be in design and experimentation.

In summary, a well planned test carried out in an average company store can provide information that will indicate required design changes. Detection of errors and defects in the basic implementation and design procedures will save the retailer both time and aggravation when the full scale POS System goes on-line. The knowledge gained about customer reaction to the POS terminals will allow a strong promotional and advertising campaign to be created to sell the POS concept to the consumer.



CHAPTER 12 - IMPLEMENTATION

The completion of the design phase and test store operations has provided management with the necessary data to prepare a plan for implementing the POS System. A good plan is required because of the need to coordinate a large number of interrelated projects connected with the POS System introduction. A few of the more important factors are:

(1) Purchase of required equipment.

(2) Installation of POS terminals and auxiliary equipment.

(3) Perparation of advertisements to introduce the new system to customers.

(4) Training of store personnel in using the terminals and consultation with any unions.

(5) Development of centralized computer systems to gather and use POS generated data.

(6) Financing the investment.

Unless all phases of the implementation plan are coordinated, the startup process will be chaotic.

The first four factors can be related to a specific store. A set of general procedures and the timing of those procedures should be developed. These procedures can then be adapted to the requirements of a particular store.

Standardization of these store level procedures will insure that no important factors are overlooked. Improvements to the implementation plan made at one store can be used by stores converting to POS terminals at a later date. This will avoid any duplication of effort. The mistakes made by other stores during conversion can be avoided, resulting in reduced implementation costs.

The basic software package used by each store should be standardized with minor modifications required by a particular store being made by the corporate computer staff. A standard set of shared software is necessary both to allow changes to be made uniformly and to reduce the software development costs for the company as a whole. The availability of a thoroughly tested software package should minimize the number of equipment problems encountered in each conversion.

As was noted previously, one of the major contributions of corporate computer staff is the development of new programs and the alteration of existing programs to use POS gathered data. A separate corporate MIS development project should be prepared detailing the nature and timing of the required changes. This plan should include changes required before the POS System is implemented as well as future projects that will make use of POS data.

Financing of the POS System will also be an important factor for consideration by management. POS hardware and software costs represent a large investment for most retail

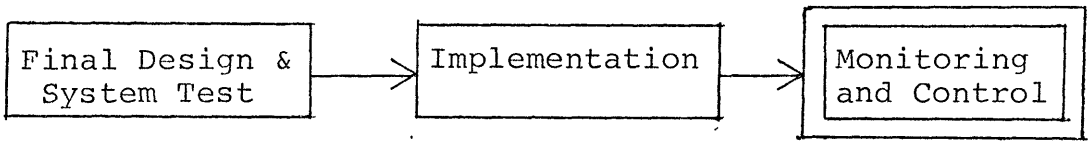
companies.

The description of the POS Implementation Plan has clearly indicated the need for the involvement of a large number of corporate departments as well as store personnel. This need for corporate assistance during conversion and financial considerations usually results in the implementation process being carried out over a number of years. Most large chain store organizations have adopted the policy of converting only one store (or a group of stores in a region) at a time. This policy eases the financial burden and reduces the manpower requirements at the head office. The primary drawback of this approach is the difficulty of instituting management reporting programs for the entire company which require POS data. In addition, there is an opportunity cost resulting from not using POS terminals in some stores for a long period. These benefits and costs should be considered by management when the timing of POS implementation is considered.

Many retail organizations have a policy of installing POS equipment in all new stores to take advantage of the economies involved in installation during construction and to enhance the "new" image of the store. Older stores are converted on a rotation basis according to some priority. Those stores that will be vacated in the next few years are not included in this plan. (Note: The physical installation of POS terminals and auxiliary equipment in older stores may present wiring difficulties. Careful pre-planning of the

physical installation is particularly important in these stores).

The process of actually implementing the POS System will undoubtedly result in problems being encountered at both the corporate and store levels. The objective of the design and implementation process is to minimize the number and severity of problems encountered. A good implementation plan will recognize the need to be flexible to deal with unforseen difficulties and to learn from previous mistakes so that errors are not repeated.



CHAPTER 13 - MONITORING AND CONTROL

The computer technology and the level of experience relating to POS usage are still in the early stages of development. It is reasonable to expect that future developments will open new opportunities for extension of and improvements in the current POS Systems. The Computer Services Department should maintain a close watch on the available technology to discover new trends in POS Systems. This function will insure that the company will maintain an up-to-date POS System. The decision to adopt new equipment or software should, however, be made on the basis of the net contribution the changes will make to the entire company.

The monitoring of the present system will be a useful tool in maintaining and improving efficiency. Considerable performance improvements can often be obtained through the "fine tuning" of a system that is currently operating. This type of activity will be particularly important with systems such as the IBM 3650 where the central computer interacts with the onsite controller.

Adjustments to improve system reliability and recovery capabilities represent another set of continuing reponsibilities. Situations causing system failure will have to be detected and

the appropriate actions taken to prevent their occurrence in the future. A systematic approach to the investigation and correction of problems encountered will make the POS System more reliable in the future.

The increase in use of POS generated data by central computer programs will also require changes to the system in the future. New uses for the POS data may require that changes be made in the type of data collected. The programmability of both the terminals and the minicomputer will reduce the effort required to effect these changes.

In summary, the POS System is not static but will evolve over time. This property of the system requires that careful consideration be given to developing procedures that will control this evolution.

CHAPTER 14 - PEOPLE

The discussion in Part B has centered around the flowchart for POS System design and implementation. The result has been to emphasize the technical aspects of the POS design process. This chapter will bring together some basic human factors that will be an important determinant of the success of the POS project.

The main participants in Part B have been: top management, computer staff personnel, employees, and customers. Each of these groups have an important role in this process. Certain requirements must be fulfilled in order that this role will be carried out properly.

The customer is the most important consideration of the retailer and is also the participant least controllable by management. The introduction of a POS System will change the traditional pattern of interaction between the customer and the store to some extent. Many consumers dislike change and are suspicious of any hidden (ie - price look-up) activities. A good advertising campaign is required to convince the public that this new technology will be of benefit to them. Customers should be encouraged to voice their likes and dislikes regarding the system. This information will provide valuable clues to how the system can be designed to satisfy the customer better.

The Steinberg test of the IBM Electronic Checkout System

at their Dorval Store is a good example of selling the change to the customer. Newspaper advertising and in-store displays were used to introduce the POS System to the consumer. The emphasis was on the benefits (such as faster checkout and a more detailed receipt) that the customer would receive from the system. Every effort was made to encourage customer feedback. Transitional aids, such as a store price list, were provided to help the shopper. Good change management is an important factor in reducing customer distrust of the new system. A proper approach to customer education can make the change an event that most customers regard as interesting rather than as something to be suspicious of.

The store personnel must be properly trained in the use of the POS terminals. They must also accept the new technology. Therefore the training of store personnel must consist of both how to operate the new terminals and why they should accept the new system. Whenever possible, any necessary personnel reductions should be made through the natural attrition rate. Employee resentment of the system can result in deliberate petty sabotage which will make the implementation process difficult. Convincing the clerical staff that they are an important factor in the success of the system (which they are) and getting them involved in the conversion process will improve the chances of success. Store personnel represent the front-line in terms of contact with the customer and their attitude towards the new system will be an important

influence on the customer attitude.

The vendors are usually represented by both sales staff and service personnel. In dealing with these people it is necessary to remember their objectives are not necessarily those of the retail organization. Internal expertise is useful in maintaining a careful surveillance on the vendor's activities and promises.

Computer staff personnel also have their own axe to grind. Their reaction to a POS System can range from delight at acquiring a new toy to resentment at the use of outside software. Top management must be aware of the prevailing attitude when evaluating the reports and plans issued by this group. The need for recognition of good work and perseverance in this difficult project by the computer staff must be appreciated by top management.

Finally, top management must look inward and consider their own biases. The pessimists concerning computer technology must consider the successes that have occurred in POS System usage. The optimists must consider the difficulties in obtaining these successes. A balanced viewpoint is needed to be able to judge the pro's and con's of POS technology realistically.

PART C - FUTURE DEVELOPMENTS

Parts A and B of this thesis have discussed the current state of the art and a framework for the design and implementation of a POS System. Up to this point the authors have focused on the present. Part C will focus on the immediate and long term consequences of this new technology. The authors will examine the impact that POS Systems can have on the development of new retail computer systems such as data base and electronic funds transfer as well as the major trends in the improvement of POS Systems in the future.

CHAPTER 15 - RETAIL DATA BASE

The installation of a POS System will provide the retail organization with previously unobtainable data on product movement, cash flows, and employee productivity. This data represents a potential for improving management control and decision making. However this potential will be realized only if the raw data can be converted into information for management. The purpose of this chapter is to describe how the data base approach and POS data collection can be combined to make the potential benefits of POS technology a reality.

The data base concept has developed as a result of the realization that the physical storage of data (ie - as bits on a magnetic tape) can be separated from the logical structure of the data (ie - how the computer program accesses data). This separation is achieved through the use of a data base management system. Under a typical data base system, data is stored in machine readable form on devices (such as disks or drums) which allow individual data elements to be accessed in a non-sequential mode. A data base language allows the programmer to specify how the record received by his program should be structured (ie - logical data structure). The data base package acts as an interface by creating the logical record from the data actually stored on the physical devices.

The data base approach has been used in many situations where a large amount of information is shared between different operating departments of a company. One example is the use of a data base as the data source for an order entry system. Individual transactions can be processed or revised in a few seconds. Management or customer inquiries can be answered immediately. Mathematical models can be used to investigate possible solutions to problems of production scheduling, etc. because the required data can be accessed quickly and inexpensively. All these benefits can be made available to a retail organization through the combination of POS and data base systems.

Use of a data base system provides several advantages in situations where a large amount of data must be stored and several applications programs share this data. Some of the more important advantages in the context of a retail organization using a POS System are:

(1) Data can be accessed in different ways by different programs.

(2) The data base software can reduce the amount of programming required by providing the file structure interfaces for the applications programs.

(3) The preparation of special reports for management use is aided by the special look-up facilities.

The following paragraphs will examine these advantages in greater detail.

The first advantage of this approach will be of significant benefit when a full scale POS System is implemented. The amount of data accumulated will increase dramatically (a factor of 10 would not be unreasonable). The data base structure allows this data to be stored once, but accessed in several different ways. Minimizing the amount of redundancy will be an important contribution to handling this increased volume of data.

POS data availability will result in an increase in central data processing activities focused on the use of this data to aid management and to control operations. The use of data base software to manage information retrieval will facilitate this expansion. Programming time will be reduced because file structure and access will be handled automatically. These savings are particularly important because the development staff at the central facilities will be stretched by requests for new programs to make use of POS data.

Flexibility in how the data is accessed will also be an important benefit. POS data represents a large jump in information availability for a retail organization; and, therefore, even the best MIS master plan will probably fail or include all profitable uses of this data. A data base approach will prevent the use of one type of file structure in a previous application from hindering new development efforts. The data processing center will not be locked out of new projects because of previous data structure decisions.

Program maintenance is a significant cost item in the budgets of most computer departments. Retail organizations using POS will experience a rapid increase in the number of active programs. An investment in data base during the development of the new programs would be a significant factor in reduction of maintenance costs. Changes in file structure for a program (or another program using the same file) could be handled easily without extensive reworking of the program's data structures. Reduction of maintenance effort would free more resources for development of new applications to aid the organization.

The POS data captured will contain information that management will need for specific decisions. In many cases, the exact nature and volume of data required will not be known until the particular decision situation occurs. (For example, management may want to know the sales performance of one or more products in different size stores when deciding whether or not to delist a product.) This type of report cannot be generated in an ordinary reporting cycle because the requirement for this report is unknown until the problem situation is identified. Data base technology can be used to make the POS data available to management in a form that facilitates the use of this data in solving the problem at hand. The inquiry oriented nature of the data base system will be an important factor in the contribution that POS data makes to management decision making.

One of the best examples of a potential application of a data base system is the logistics network of a retail company. As was described in Part A, one of the biggest payoff areas in most retail organizations is the improvement in control over goods flow. The integration of POS collected sales data into a data base containing receipts and warehouse data makes an integrated approach to the control of logistics practical for the first time. Some of the important benefits from this combination are briefly described in the following paragraphs.

Purchasing decisions can be improved through the immediate availability of information that indicates the amount of product in the distribution network and its outflow at the store level. POS data provides the information concerning the sales flow at the retail level. Integration of the existing warehouse and transport control data into the data base will complete the information requirements. Routine buying decisions could be handled automatically by a computer program utilizing the data base. Special reports for purchasing management would improve their ability to detect and react to sales trends. Excess stock held at one retail outlet could be transferred to another store requiring that type of merchandise. The result would be a lower inventory without reducing customer service (or better customer service at the same inventory level) and an increased ability to react to sales trends.

The logistics network of a chain store organization usually consists of two or more levels of inventory. For example, warehouses delivering to individual stores. An integrated approach to multi-level inventory control would avoid the problem of local sub-optimization. (It can be demonstrated that if each level of inventory management is handled independently the resulting system will fluctuate unnecessarily, and as a result will not operate efficiently.) A data base containing information collected by a POS System would be a useful tool in developing a computer system to aid management in coordinating the distribution network.

The important costs for a data base system include:

(1) Additional computer hardware required to operate in a data base mode.

(2) Purchase or rental of a data base software package.

(3) Conversion of existing files.

(4) Slower processing speeds resulting from greater overhead on data accesses.

(5) Collection of the necessary data.

The authors believe that an extrapolation of past trends clearly indicates that these costs will be less of a factor in the data base decision in the future. Costs (1) and (4) will become less important as faster and more flexible computers are developed. (Fourth generation computers will probably be able to use large amounts of data storage efficiently and at a much lower cost per byte than the

computers currently available.) Combining this with the previous industry pattern of rapidly increasing computer power at the same price indicates that these costs will be less important in the future. Cost (2) should decrease as better data base software packages become available and improved hardware takes over many of the functions currently handled by the data base software.

The major problem faced by most retail organizations has been cost (5). Without a POS System, the accumulation of the necessary sales data and its conversion into machine readable form was too costly because of the number of transactions occurring at the retail level. Even if costs (1) to (4) were eliminated, a retail organization could not adopt a data base approach using the current manual system. POS technology offers an approach that converts transaction data into machine readable form as a by-product of normal store operations. (In many cases POS terminals can also be used to record merchandise receipts at the store level.) Therefore, the use of a POS System makes the data base approach practical in many retail organizations.

In the near future, use of a data base system will be restricted to large retail organizations with considerable head office computer experience and large central or regional computer facilities. The costs of the required computer hardware, data base software, and systems support staff is too large to be cost justified by a small or medium size

retail company. The benefits of a data base system in the utilization of POS data are proportional to the total volume of sales handled by the retail organization. Therefore the primary market for data base systems will be retail companies with sales over $200,000,000 per year (1975 $). Smaller organizations can obtain many of the benefits of POS collected data using more conventional data management systems.

There is one point that should be clarified with regard to the impact of data base technology on retail operations. The data base approach will allow centralization of logistical control, but does not require this centralization to provide the benefits cited. The data base can be used as a central pool of data that will aid a manager in the field by providing him with a picture of the overall situation. This data will provide the manager with an indication of the impact his decisions will have on the entire organization and, in doing so, help him to make a better decision.

In summary, the data base approach represents an alternative that could be used to aid in the utilization of POS data for control and decision making. However, top management must carefully weigh the costs and benefits of this approach in light of their company's situational setting. The authors believe that a data base approach is one alternative that should be considered, and in many cases it will be the best alternative.

CHAPTER 16 - ELECTRONIC FUNDS TRANSFER

Electronic Funds Transfer or EFT involves the movement of funds between bank accounts via an electronic communications network . The interest in such a system has come about due to the massive problem of manually handling checks. This year almost 25 billion checks will be cleared at a cost of approximately 25¢ each.[16] By 1980, the number of checks written is expected to double. In order to combat this problem, the Federal Reserve System and certain larger city banks are experimenting with EFT. This chapter will examine the importance of the use of POS systems to the success of an EFT system and the possible impact of EFT systems on POS usage, particularly for small retail stores.

There are two levels at which EFT has been proposed. The first is a system for automating only periodic receipts and payments. Under this system, a bank patron signs legal documents allowing his employer to automatically deposit his earnings and permitting companies to whom he makes periodic payments (telephone, electricity, rent, etc.) to automatically withdraw funds from his bank account. This type of EFT network has <u>not</u> been particularly successful because the

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16. The current bank credit card system is of no help since although it consolidates check payments it also requires processing of each charge slip at a cost of approximately 45¢ each.

benefits to the consumer are only the elimination of a few periodic payments. The incentives for consumer participation are greater under the second more comprehensive scheme.

Under the second type of system, all local merchants (or a significant percentage) are tied to the banking system to allow immediate debit and credit of accounts at the time of a sale (or the customer can place his purchase on a charge account - in which case the bank still credits the merchant's account, but debits the patron's credit account rather than his cash account). This would eliminate the need for cash or checks by substituting a credit card and electronic transfer. It should be noted that this system is entirely dependent on the merchant's use of POS. It requires that the merchant's minicomputer be linked to a local subnetwork presumably controlled by a local bank's computer. If this system were to become national in scope, it would require a hierarchical system of regional networks and finally a national network whereby all transactions outside a given locality would be referred to successively higher networks until they were satisfied.

The EFT system proposed will be successful only if the three major participants (customers, merchants, and banks) have an incentive to use the system. The next three paragraphs will examine the advantages available to each group from using the system and show how these incentives are

related to the use of POS systems by merchants.

The primary advantages to banks are the reduction in the number of checks which must be processed and the profits received from the operation of an EFT service. Both these advantages are dependent on the achievement of a sufficient volume of transactions. Therefore, from the bank's viewpoint, an EFT system will be economically viable only if a large number of retail outlets are willing to participate and a large number of consumers use the system.

The customer would benefit from the use of an EFT card which would be more convenient than paying by check, safer than carrying cash, and would avoid the problems of buying on credit. (The benefits of EFT over using credit cards would be increased if the customer was given a discount to compensate for the loss of float.) Again, the key to success for this type of EFT system is the acceptance of this card by a sufficient number of retailers to make the card useful to the average consumer.

The acceptance of an EFT system by both store customers and banks has been linked to the use of this system by a large number of retail outlets. There are three basic benefits that a retailer would receive. The first is the elimination of bad debt problems on all EFT sales because the money would be credited to the store's account at the time of purchase. The second advantage is that the funds received are immediately available for use by the retailer. Finally,

this system eliminates the need to handle large amounts of cash.

The retailer will be more receptive to an EFT system if he has confidence in electronic systems and the cost of additional EFT equipment is small. A POS system will both provide the retailer with experience in the use of an electronic system and allow the EFT hookup to be accomplished at little or no cost to the store owner. Rapid expansion in the number of POS systems could therefore be an important factor in the creation of a true EFT network. Under a POS system the EFT transaction could be handled in a manner similar to a credit card sale as part of the normal transaction procedure.

There are, however, a number of serious problems in the development of an integrated system for EFT which should be considered.

(1) Requires most retailers to use POS - small retailers who cannot afford the necessary communications equipment and minicomputers would probably have to be supported by a system offered as a bank service. One could imagine a bank offering a system to link the store with the EFT system and simultaneously produce reports from the POS data for some charge (perhaps a percentage of sales as is now done with bank credit cards). (This process could itself be an important factor in the expansion of POS equip-

ment into smaller retail outlets. A small store linked to a bank POS system could enjoy many of the benefits of such a system without large equipment or system development costs.)

(2) Large retail chains would be required to give up store credit cards and provide sales information to outsiders (in this case a bank or bank agency). All major department stores appear to be opposed to releasing any sales data and refuse to give up the profits available in offering consumer credit. (Popular acceptance of an EFT system could put pressure on a retail chain to offer this service to their customers. Sufficient safeguards could be included in the system to protect the proprietary nature of a store's sales data.)

(3) Lack of proof of payment - most customers are reluctant to give up the cancelled check that can be used as a proof of payment. Instead, store receipts and bank balance statements will have to be used.

(4) Legal objections - for one thing, it is still unclear whether a stored electronic message can legally be considered an instrument of payment. In addition, there are problems of bank liability for the consequences of any errors made. For example, liability for an automobile accident if through some system or programming error an insurance premium payment

request was dishonored. (These problems are no more serious than those experienced when credit cards were first introduced.)

This list of problems to be resolved and some partial solutions is indicative of the difficulties which must be overcome before Electronic Funds Transfer becomes an important factor in retailing.

Although the EFT systems as currently conceived have a number of problems, it is generally recognized that some sort of EFT system will have to be established to reduce the check clearing burden. Clearly the introduction of POS systems provides the critical first step in the development of a viable EFT system by both providing the needed hardware at the store level and acclimating the consumer to computerized transaction processing.

CHAPTER 17 - FUTURE DEVELOPMENTS IN POINT OF SALE SYSTEMS

This chapter will attempt to predict the growth and development of POS systems through extrapolation of past trends. The current state-of-the-art in early 1975 will be used as the starting point. The authors recognize that predictions of this sort are subject to large errors, but believe that it is possible to isolate certain major trends critical to the future development of POS.

POS technology has changed rapidly in the past ten years. A key factor in the success of POS at present has been the increase in computing power of the basic terminal. An 'intelligent' POS terminal capable of limited stand-alone operation and allowing more flexibility in system configuration represents a significant improvement over earlier controller oriented systems.[17] The development of intelligent POS terminals has been the direct result of advances in microprocessor production resulting in less expensive and more reliable terminal electronics. This trend will probably continue, with the terminals' computing capabilities being expanded to minimize the load on central computers and transmission facilities as well as increasing the capabilities of the

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17. Representative of the controller oriented systems (and date introduced) were: Uni-tote 101 (1965), Registron (1967), and Tardar (1967).

terminals to handle scanning devices or other auxiliary equipment.[18]

A second major factor in the current success of POS systems has been the increasing reliability of both the terminal and minicomputer equipment. In systems where the terminals are dependent on the central controller (or must have access to disk storage for price look-up when using a UPC type code), a dual processor setup is often used to insure continuous system operation. A retail store system must be able to function at all times during the selling period. The new POS systems are designed to maintain operation either through the terminals microprocessor or a dual processor on the controller. The availability of POS systems that provide dependable service is an important factor in the adoption of these systems by retail companies.

The trend toward even more reliable systems will continue. Better backup features (particularly with regard to continuing access to disk data files) and system capability to handle component failures automatically will probably be one of the key advances in POS equipment and software in the next few years.

The use of minicomputers to provide the POS system with

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18. Both Singer and NCR terminals are examples of MOS/LSI microprocessor units that have considerable stand-alone power.

data retrieval and storage capabilities will increase. The trend will be to use more sophisticated POS systems providing all the special features such as price look-up, credit authorization, and scanning. On-line communication between the store minicomputer and the host computer for the purposes of data transfer will be more prevalent, but the increasing power and flexibility of the in-store minicomputers will result in increased opportunities to use minicomputers to perform functions currently performed by central computers. Better disc storage peripherals for minicomputers will result in the storage and usage of more data at the store level for the preparation of in-store reports.

Continuation of the trend of more decentralization of the transaction processing functions will be paralleled by increasing effort at the central computer to make use of POS data. The creation of data bases and the development of electronic funds transfer systems are examples of potential extensions at the central computer. Better equipment for mass storage and data communications in fourth generation computers will make these new applications practical and cost effective for many retailers.

Scanning devices will be a part of almost all POS systems in general retailing operations. The costs of scanning will decrease rapidly as the result of improvements in the micro and mini processor equipment. Labor costs will continue to increase. The result is that scanning will become more cost

effective in the future.

The magnetics vs. optics scanning trade-off seems to favor optical scanning in the long run. As more department stores become POS users, a product coding system similar to the UPC will probably be developed. A UPC type code only requires 10 - 12 digits and is therefore suitable for optical coding because each store will maintain its own price and description data separately. In addition, a printed code is cheaper to use since it can be put on boxes or tags without requiring the use of a special magnetic strip. Better scanning equipment supported by terminals with more computing power will improve the reliability of optical scanning and reduce the cost differential between magnetic and optical scanning devices.

Cost/effectiveness of POS systems will probably increase in the future. While the overall cost of POS systems hardware is unlikely to decrease in the future (any decreases in electronics equipment costs will be offset by assembly and non-electronic parts cost increases), its cost will decline relative to conventional cash registers. The cost difference between using POS terminals in new stores (or to replace old cash registers) and installing conventional cash registers will decline. (In many cases, the stand-alone capabilities of a single terminal will justify the incremental cost of POS over a conventional cash register.) Rising labor costs will provide more incentive to use the POS system to improve

labor productivity both directly, through operational support, and indirectly, as the result of management control.

Robot retailing is another trend that is closely related to POS systems. The POS terminal could be extended to include a merchandise dispensing function. A customer would enter his credit card and the required item numbers. His account would be debitted for the cost of the items. The products would then be delivered mechanically at the terminal. Several banks in both Canada and the United States have installed automatic tellers which are forerunners of robot retailing. Retail companies selling a limited number of convenience products may be forced to use robot retailing to overcome the high cost and shortage of sales staff. POS type systems would be required in a robot retailing situation because the customer could not be expected to know the transaction sequence or do tax calculations. He or she would have to be guided and supported by an intelligent terminal that performed all the necessary transaction procedures automatically. The programmability of POS terminals would allow an interface with the computer controlling the movement of goods to the customer.

There are three basic factors that are retarding the growth in the use of POS systems. The first factor is the potential for loss if the POS system fails and must be scrapped. Secondly, many retail organizations are unwilling or unable to make the required investment in equipment and development

costs. Thirdly, there is the belief that the POS equipment available one or two years from now will make the currently available systems obsolete. To some extent all three of these reasons are valid, however, some counter arguments do exist. These arguments will be presented in the next three paragraphs.

Enough successful systems are in the operation to indicate that a POS system will be a success if the design and implementation are thoroughly planned and controlled. There is a lead time of one to two years to develop a POS system for a specific retail company. Much of this lead time can be eliminated if the company management starts the design process now. If it is decided that the actual implementation should be deferred, the lead time for a future system will be reduced because much of the necessary background data has been collected.

The delay of conversion because of the investment required has major pitfalls. First, many retail companies are opening new outlets (or renovating old stores). If new mechanical cash registers are installed, then the cost to convert to POS in the future will be increased by the cost of scrapping these registers. In addition, the deferment of investment in a POS system results in a significant loss of the operational savings available to the user of POS equipment. (As demonstrated in Appendix I these savings could represent a 50% return on investment per year.) Therefore

the lost opportunity costs should be considered when deciding whether or not to defer the POS investment.

Future POS equipment will probably have many advantages (some of which were cited previously in this chapter) over the current equipment, but equipment is only one part of a successful POS system. Costs of programming new applications packages to use POS data, installing the POS system, and personnel training are all labor intensive activities and are therefore likely to have large cost increases in the future. Organizational experience with an earlier POS system will reduce the conversion problems when a more advanced POS equipment is installed. Therefore conversion to a POS system should not be delayed solely because it is believed that future equipment will be superior or cheaper.

Consideration of future trends is, however, an important factor in developing long range plan for the effective use of POS technology. Design of a POS system should include sufficient flexibility to allow the integration of new features into the existing system. For example, a department store should consider the capability of the planned POS system to use a UPC type code if such a code was adopted in the next 5 years.

The use of POS systems will increase dramatically in the future both as the result of better and relatively less expensive equipment and due to the 'demonstration' effect of seeing POS systems being successfully used by other companies.

Therefore, successful installation and operation of POS systems by pioneering retailers will be an important factor in selling POS to the industry. Realization of the advantages of POS will provide a competitive edge to those retailers who have installed a system and increase the incentives for other retailers to develop their own systems.

CHAPTER 18 - CONCLUSIONS

In the course of studying Point-of-Sale Systems, the authors have developed some conclusions regarding its impact on retail organizations. As a short summary to the thesis these conclusions will be presented.

The development and use of a POS System will have a profound effect on the entire information system of a retail company. Information concerning sales trends, inventory levels, and personnel productivity that was too expensive or time-consuming to collect is available as a by-product of the sales transaction. Management can use this information to better understand and control the activities on the sales floor. (This is critical to a retail organization because many of the key success factors are based on successful operation on the sales floor.) Raw data for computer applications will be available in machine readable form allowing more extensive use of quantitative and analytical techniques to help management in considering alternative solutions to logistical and purchasing decisions.

The POS equipment currently available can be cost justified (on the basis of improved clerical productivity and credit control) for most of the large to medium size food and department stores. There are also many potential savings that could result from management control based on POS collected data. The authors believe that POS Systems

will become even more cost effective as clerical wages increase in the future.

The basic design and functions of POS Systems are the same for both food and department stores. There are, however, differences in emphasis on certain functions that results from the different characteristics of these two retail operations.

A successful POS System requires that the design and implementation process be well planned. Careful analysis of a store's requirements is a necessary input to the design process to insure that the POS System is effective. Good change management is required to sell the system to both store employees and customers. The Head Office computer group must be prepared to make use of the new data or many of the potential benefits on the new system will not be realized. The introduction of a POS System into a retail organization is a large project requiring managerial and technical expertise from many groups within the organization.

Finally, the authors believe that the growth in the use of POS Systems will be rapid. Within the next five years a majority of the terminals in use will be electronic. In addition, there will be an increase in the computing power of these systems resulting in a greater use of the look-up and scanning facilities. The computer will assume a much greater role in the operations of most retail companies both on and off the sales floor.

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MANUFACTURERS DATA -

1. Addressograph-Multigraph Corp.
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   29100 Aurora Road
   Solon, Ohio 44139

2. Datatrol, Inc.
   Kane Industrial Drive
   Hudson, Mass. 01749

3. IBM Corp.
   P.O. Box 12195
   Research Triangle Park
   North Carolina 27709

4. Image Systems, Inc.
   11244 Playa Court
   Culver City, Calif. 90230

5. NCR
   Main & K Streets
   Dayton, Ohio 45479

6. Pitney Bowes
   Monarch Marking Systems
   P.O. Box 608
   Dayton, Ohio 95401

7. Singer Business Machines
   1480 Soldiers Field Road
   P.O. Box 188
   Brighton, Mass. 02135

8. Threshold Technology, Inc.
   Route 130 & Union Landing Road
   Cinnaminson, N.J. 08077

9. Tranti Systems Incorporated
   540 Main Street
   Tewksbury, Mass. 01876

10. TRW Data Systems
    12911 Simms Ave.
    Hawthorne, Calif. 90250

11. Wavetek
    9045 Balboa Ave.
    San Diego, Calif. 92123

BANKING RESPONDENTS -

1. Bank of America
   Box 37000
   San Francisco, Calif. 94137

2. Telephone Computing Service, Inc.
   1115 Eastlack Ave East
   Seattle, Washington 98109

   responding for: Seattle - First National Bank

3. The National Bank of Georgia
   Atlanta, Georgia 30301

APPENDIX I - SAMPLE CALCULATIONS OF SAVINGS AND COSTS

The purpose of this appendix is to provide a general indication of the costs and benefits inherent in the installation of a POS System. The calculations are based on scenarios representing 'average' stores and are not intended to be applied directly to a particular situation. These calculations do, however, fairly represent the costs and benefits obtainable under the situations described. (Note: Equipment costs cited are based on the averages of manufacturers quoted prices for that type of equipment.)

FOOD STORE -

Annual Sales Volume	$4,000,000 (1975 $)
Cash Registers	10
Cashiers	15 (Part time = 1/2)
Total Store Staff	40

Assumptions -

(1) POS System used will support scanning of UPC.
(2) The Universal Product Code is printed on 80% of all packaged items. Meats and produce do not use UPC codes.
(3) The hourly rate of cashiers is $4/hr including fringes.

Benefits -

I. Quantifiable -

(a) Improved Checkout Efficiency - A 33% increase in cashier productivity would allow the number of checkouts to be reduced from 10 to 8 with a corresponding reduction in personnel of 3.

$4/hr x 2000hr/yr x 3persons = $24,000

(b) Bagging - Fewer checkouts and the freeing of the cashiers hands for bagging will result in a 50% reduction in the number of hours allocated to bagging. (Currently - 3 persons full time).

$4/hr x 2000hr/yr x 1.5baggers = $12,000

(c) Item Pricing - Most packaged products will have the UPC printed by the manufacturer. Therefore approximately 75% of the price marking operations will be eliminated.

$4/hr x 2000hr/yr x 3persons = $24,000

(d) Faster Register Changeover and Reporting - These reports will be produced automatically by the terminal thereby eliminating the time required to perform these tasks. At 15 minutes per day per machine, the total savings is:

$4/hr x 1/4hr x 360days/yr x 10registers =

$3,600/yr

Total Quantifiable Saving = $63,600/yr

II. Qualitative Savings at Store Level -

(a) Store Door Delivery Control - The POS System can be used to record merchandise deliveries to the store. Control could include verification that items delivered are on the stores approved list.

(b) Reduction in Store Ordering Time - Use of the UPC and entry of delivery data will allow automatic re-ordering of most merchandise that is scanned.

(c) Better Control over Store Inventory - Close monitoring of the inventory level of many of the packaged items in the store will reduce the occurence of stockouts and identify slow moving items which are in excess supply. The result is better service to the customer and more effective use of the inventory investment.

(d) Manpower Scheduling - The POS data can be used to determine the number of personnel required to operate the store during particular periods during the day or week. More effective use of manpower in this labor intensive industry has a significant potential for cost savings.

(e) Pilferage Control - The food retailer often incurs significant losses from pilferage and other fraudulent activities. POS data can be combined with inventory receipts data to determine the level of loss and the high risk items. This data will be useful to store management in combating this problem. Many POS Systems include the ability to monitor the activities of a terminal from the master terminal. Dishonest cashiers who deliberately mis-enter data for friends or relatives can be caught using this monitoring facility.

(f) Improved Accuracy - Scanning and simple input checks built into the terminal programs will help to eliminate many of the checkout errors. One test run by NCR indicated a NET loss of 0.6% resulting from cash register errors. The potential savings are considerable but depend on the current accuracy of the cashiers.

III. Contribution to Better Management and Control -

(a) Logistics Control - The capture of unit data at the point of sale would allow tighter control to be maintained over the entire distribution network. The network could be viewed in its entirety, resulting in a more global data base from which decisions could be made. The availability of POS data would make the use of mathematical models to help guide the optimization of the logistics network feasible.

(b) Merchandising Awareness - The key to the success of any retail organization is its ability to sell goods at the store level. Therefore many of the key variables of the retail industry are related to point of sale statistics. The adoption of a POS System allows these variables to be monitored and reported faster and more accurately.

(c) Purchasing Control - Most food store operations consist of many individual stores supported by centralized services such as purchasing and distribution. In many cases it is desirable to insure that only those products that have received approval are carried in a food store. POS terminals can help management to insure that its policies with regard to items for sale are observed.

(d) Central Computer Services - The use of POS data will eliminate the need to keypunch data received from the stores.

Costs -

I. Equipment in Stores -

(a) Terminals (8) - Each terminal costs approximately $5000 (including scanning equipment).

Total = $40,000

(b) Minicomputer - A minicomputer with associated disk storage and capable of supporting 8 terminals would cost approximately $20,000 (including a dual CPU for backup).

(c) Miscellaneous - Includes a modem for transmission of data over telephone lines and special equipment to protect against power surges on electrical lines. Total cost is approximately $7000.

Total Equipment Cost = $67,000

II. Installation and Training -

(a) Installation - The major task is the installation of the power and communications lines. This cost is highly variable with a small incremental cost if the wire is laid during store construction. Installation cost can, however, be significant if the store is old and does not have adequate wiring.

(b) Training - The cashiers will have to be trained in the operation of the POS terminals. It is estimated that each cashier will require a period of 8 hours of training before she is prepared sufficiently to use the system in actual operations.

20cashiers x 8hr x $4/hr = $640

(c) Support Personnel - Specialists from the food store chain head office are usually assigned to help with training and system setup.

(d) Advertising - In-store advertising and brochures to explain the new system to the customer.

The total cost of installation and training in a relatively modern food store of this size with adequate power supplies and duct access would be about $15,000.

III. Maintenance -

The POS System requires a higher degree of maintenance than most conventional cash registers. This maintenance cost is about $4000 per year.

IV. Centralized Costs -

(a) Hardware - Many POS Systems require the use of a central computer to process the data collected. In addition to the use of time on a central computer, a communications adapter is required to handle the interface with store minicomputers. The approximate cost is $8000.

(b) Software Utilities - Most manufacturers offer utility programs to handle activities such as polling. The average cost of each utility package is about $5000.

(c) Software Development - Old programs must be revised to use the new POS data. New applications programs are required to convert the POS data into information for management use or operational control. The cost is in most cases discretionary, but is necessary to allow full advantage to be obtained from data collected.

(d) Information Analysis - The effective use of POS data to support corporate operations will require the effort of management personnel. Demands on current managers time as well as new personnel hired to analyze the data should be considered part of system costs.

(e) Program and File Maintenance - There will be a continuing need to revise both terminal and applications programs as circumstances change. Files will also need to be maintained both at the store and corporate levels.

Summary -

The major benefits cited were -

(a) Quntitative improvements in store operations resulting in savings (mostly through decreased staff) of about $63,000.

(b) Qualitative savings in store operations were primarily in the areas of error reduction, inventory control, and manpower scheduling. A 0.5% improvement in gross margin is a very conservative estimate of the value of these benefits = $20,000/yr

(c) Improvements in corporate operations realized depends on the extent to which management is able to use POS data to guide decision making. The potential for savings is considerable, particularly in large chain store companies.

The major costs identified were -

(a) Equipment - $67,000 initial investment per store (Most POS equipment is sold rather than leased).

(b) Installation = $15,000 per store.

(c) Maintenance = $4000 per year per store. (Manufacturer contract).

(d) Central costs - These costs are closely related to the extent to which the improvements in corporate operations are pursued. A strong program to make use of the POS data would require a sizeable investment in system hardware and applications programs. The optimal investment is primarily a function of the number and size of stores owned by the chain organization.

The estimated savings for the food store described is $83,000 per year. In addition, the POS data would be available for use by corporate management. The value of this data would depend on the trade-off between benefit type (c) and cost type (d) cited above. The initial cost to setup the POS System would be $82,000 with a continuing yearly cost of $4000 for maintenance. This analysis clearly demonstrates that a POS System would be cost effective in the type of store described. On the basis of in-store costs and savings, the rate of return on investment would exceed 50% based on a system life

of three years.

DEPARTMENT STORE -

Annual Sales Volume	$20,000,000 (1975 $)
Cash registers	30
Clerical Personnel	240

Assumptions -

(1) Approximately 5 clerks share one cash register on one shift and the store operates on a 60 hour week.

(2) A magnetic scanning system is used with tags on most items sold for more than $5.

(3) System includes full positive credit authorization.

(4) Average item price is $10 and on the average two items are sold per sales transaction.

(5) The hourly rate of clerical employees is $4 including fringe benefits.

Benefits -

I. Savings in Operating Personnel -

(a) Increase in Sales Staff Efficiency - The use of POS terminals will reduce the time required to handle the checkout and credit authorization procedures. Assuming an average of one minute saved per transaction and that one-half of that time could be realized in either staff reduction or other duties, the savings are:

$$\frac{\$20{,}000{,}000 \text{ sales}}{\$20 \text{ avg sale size}} \times \frac{1}{2} \times \frac{\$4 \text{ hourly rate}}{60 \text{ min/hour}}$$

$$= \$33{,}000/\text{yr}$$

(b) Stock Control Clerical Savings - Capture of item sales data at the point of sale will reduce the stock taking and manual reporting (including key-punching) required. Based on a reported cost of 0.75% on sales and assuming a net reduction of 1/2

in the current cost, the result is a saving of:

$$\$20,000,000 \times 0.0075 \times .5 = \$75,000$$

(c) In-store Reporting (Sales Audit and Sales by Dept.) - In many cases reports used by store management can be produced using POS data. Therefore the costs of manual preparation can be included as a savings resulting from a POS System. The authors estimate that $32,000 per year could be saved in this manner through a reduction in clerical staff of 4 people.

II. Store Operational Improvements -

(a) Reduction of Cash Register Shortages - The reported savings resulting from reduced cash register shortages has been approximately $.45 per thousand dollars sales. Here about $9000.

(b) Better Credit Card and Check Authorization - The use of a positive authorization file allows the customers credit rating to be checked quickly and unobtrusively. The POS System helps to reduce fraudulent and bad credit risk sales because each transaction is checked against an up to date customer credit file. The potential value of this system depends on the store's past history of credit losses. (A store experiencing average losses could expect a net saving of about $20,000 per year in bad debt reduction and another $20,000 per year in reduced back-office authorization personnel.)

(c) Personnel Scheduling - The use of POS data to determine personnel requirements (on the basis of transaction loads) represents an important tool for store management. Rising wage expense will make this function more important in the future.

(d) Inventory Control - The availability of sales data in a regular and timely manner will result in a significant improvement in inventory control. (The potential value is considerable, since a 2% reduction in total inventory would save approximately $10,000 in reduced carrying costs per year - using a 12% carrying charge and inventory turnover of 5).

(e) Purchasing Decisions - The availability of sales data should provide the store buyer with a better

basis from which to arrive at purchasing decisions. This will help to reduce the amount of obsolete stock that must be sold at reduced prices. Rapid detection of sales trends will allow the buyer to react quickly, resulting in fewer stockouts. (A reduction in markdowns by 10% is worth approximately $200,000 per year.)

III. Corporate Operations -

Most department stores are part of a larger corporate organization. (over 90% of department store sales were made by multi-unit chains according to the 1967 Census of Business.) There are considerable benefits that could be obtained from the use of POS data by corporate management to improve control over centralized buying and logistics functions. The value of these benefits depends on the size of corporate operations.

Costs -

I. Equipment -

(a) Terminals (30) - A terminal with a magnetic scanning wand would cost approximately $4000. The total cost of terminals is therefore = $120,000.

(b) Minicomputer - A minicomputer with the necessary disk storage for data collection and positive credit authorization would cost $30,000.

(c) Ticket Producing Unit - A unit would be required to code the magnetic tags - $15,000.

(d) Miscellaneous - Teletypewriter and communications adapters would cost about $5000.

II. Installation and Testing -

(a) Physical Installation - As in the case of a food store, the major cost of installation would be the wiring requirements. This cost will vary depending on the building characteristics.

(b) Training of Employees - Assuming an average of four hours of training per sales clerk and a staff of approximately 400 (includes parttime staff).

400 people x 4 hours x $4/hr = $8400

(c) Conversion Assistance - A team of experts is required to aid store management in implementing a POS System. This team could consist of either store executives relieved from other duties or outside consultants.

(d) Advertising - There will be a need to use in-store advertising to introduce the new system to customers.

III. Continuing Costs -

(a) Equipment Maintenance - $8000/yr
(Based on manufacturer contract price.)

(b) Tag Preparation - $50,000/yr
(Based on an additional cost of 5¢ per magnetic tag over normal tags on 1,000,000 tags.)

IV. Central Office Costs -

(a) Hardware - Full utilization of POS data requires the use of a computer to produce reports and accumulate historical data. This cost can be shared between all stores in a corporate chain or can be obtained from a service bureau. For companies already using a computer, the incremental costs of handling the POS data is the key factor.

(b) Software Development and Maintenance - New applications programs must be developed and old programs altered to use POS data. This cost is likely to be large if many of the management decision benefits are to be achieved.

(c) Analysis - The management time and effort expended in the analysis of the reports generated by the above programs is another important factor. The cost of clerical and staff personnel assigned to analysis-related work should also be considered.

Summary -

The major benefits cited were:

(a) Savings in operating personnel of $140,000 per year.

(b) Improvements in store operations worth over $ 60,000 per year for most department stores of this size (very conservative).

(c) POS data is available in machine readable form for use by corporate operations. The value of this data is dependent on factors not related to store operations.

The major cost factors were:

(a) Equipment = $170,000 initial investment per store

(b) Installation = $30,000 per store (modern store)

(c) Continuing costs of maintenance and tag preparation = $58,000 per store per year.

(d) Central Office Costs - These costs are related to the benefits obtainable from the use of POS data by corporate headquarters.

The net savings per year of operation was $142,000 per year. The total investment required to install a POS System was $200,000. Therefore the estimated return on investment is greater than 45% per year based on a system life of 3 years. (Note: The above calculations exclude the cost and value of using POS data for controlling corporate operations.)

APPENDIX II - TECHNOLOGY OF TERMINALS

In this appendix the authors will discuss both the conceptual and physical structure of POS terminals.

Conceptually, a POS terminal is said to possess intelligence. This intelligence is manifested in the ability to store and process data as well as serving as an input/output terminal. These characteristics are provided physically by the inclusion of a microprocessor and either core or semiconductor memory in the terminal. The microprocessor is essentially a simplified and miniaturized computer constructed from one or more MOS/LSI chips. Each chip contains the registers and arithmetic logic necessary to process data. (Typically, each chip processes 4 parallel bits, thus 4 chips are required to handle 16 bits in parallel.) When a semiconductor memory is used, it typically contains both the system control logic and the storage for programs and intermediate results. A microprocessor constructed from these chips typically possesses an instruction set similar to that of many general purpose minicomputers. The major limitations of a microprocessor as compared to a minicomputer are slower execution and limited capabilities as regards programming and I/O devices.

In order to communicate with its environment, the terminal also possesses a keyboard, lighted display, and printer. When not functioning in a stand-alone mode, the

terminal requires a communications interface between the microprocessor and an external modem used for telephone data transmission. In addition, an interface is required for any non-standard I/O devices such as scanners or tape cassettes. Finally, the terminal must also contain the more mundane items such as a power supply, display and printer drivers, etc.[1]

In discussing the operational characteristics of POS terminals, the Singer 909 terminal will be used as a standard. The use of a microprocessor and storage in this terminal permits it to perform the following functions without aid from any other device.

(1) The terminal can be programmed to maintain 31 to 62 distribution totals based on any combination of department, merchandise, non-merchandise, sales personnel, cash, charge, or other breakdowns.

(2) The terminal automatically keeps four totals: cash, sales, tax, and discounts.

(3) It also keeps six transaction counts: cash sales, charge sales, other entries, total transactions, voids, and total taxable items.

(4) To prevent input data loss when the operator proceeds faster than the terminal printer, the

---

1. The above mentioned elements are critical to the design of any and all POS terminals. As an example, all Singer terminals contain 4 modules, each on a separate circuit board. They are: microprocessor, memory, communications interface, and scanner interface.

terminal buffers up to 256 characters and 12 keystrokes.

(5) It will perform the following computations:

- item extensions (multiplication)
- addition
- subtraction
- discounts
- tax table look-up
- change

(6) The terminal will also provide a printed record of all transactions to serve as backup to any recorded or transmitted data.

Although other terminals may offer slightly different options, those mentioned provide a representative list of the "intelligent" features provided by most POS terminals.

APPENDIX III - SURVEY RESULTS

In order to investigate the reaction of retail managers to POS Systems, a short questionaire was prepared. Fourteen responses were received from a total of forty surveys mailed. Although the small sample size limits the use of statistical analysis, the reponses do provide some useful insights into the subject.

I. Characteristics of Respondents -

a. Type of Business - 8 department stores
4 food stores
2 fast-food

b. Size - The average weekly sales in stores owned by the respondents exceeded $50,000 per week.

All respondent firms owned more than one store.

c. Credit Authorization - All department stores used credit cards, with an average of 50% of sales paid for by credit card.

Food stores did not use credit cards, but did cash checks for regular customers.

II. Operational Factors -

a. Key problem areas associated with sales information and collection were given as:

- Lack of knowledge about inventory levels (64%)
- Errors made in checkout (64%)
- Inability to handle peak loads a checkouts (57%)
- Losses due to bad credit purchases
(63% of firms using credit cards)

b. POS Usage - 8 companies were using POS in one or more stores. 3 companies were investigating POS Systems. Of the 8 users, 6 reported little or no problems with the system and 2 did not have enough experience to comment.

III. Characteristics of Point of Sale Terminals -

a. Benefits - All responses but one indicated that POS terminals were better than manual terminals along the five dimensions listed. The following percentages were determined from the responses in each category.

	POS Superior		Pos Slightly Better		About the Same	
	User	Non-User	User	Non-User	User	Non-User
Credit Card Validation	67	50	33	25	-	25
Inventory Control	100	71	-	29	-	-
Report Preparation*	100	86	-	-	-	-
Checkout Speed**	33	57	33	29	33	14
Checkout Errors	50	86	33	-	17	14

* One response by non-user indicated manual system was superior.

** Note: Checkout speed was a more critical factor in food store operations.

User responses indicated a greater emphasis on the intangible benefits of management control and tended to de-emphasize the operational aspects of checkout speed and errors. The non-users tended to be more impressed by operational factors.

b. Factors Restricting POS Use - This question asked the respondents to choose those factors that restricted the use of POS Systems. Again, the responses of Users and Non-users showed interesting differences.

(see chart on next page)

	Users	Non-Users	All
Cost of Terminals	50%	75	66
Lack of Central Computer to Process Data	75	-	25
Limited Value of More Information*	-	-	-
Lack of Computer Expertise and Experience	50	-	17
Current Investment in Manual Cash Registers	75	50	58
Waiting for Price Reductions in POS Equipment	50	38	42
Believe present POS Terminals will be Obsolete in a few years	50	25	33

* None of the repondents believed that a manual system captured all the important information concerning sales floor activities.

Non-users were concerned primarily with system cost and obsolescence. They were not, as the users felt they might be, concerned with lack of experience in the use of computers.

c. Impact on the Organization - 11 out of 12 respondents believed that a POS System could make a worthwhile contribution to the organization. 93% of the respondents believed that a POS System would provide data useful to the central computer facility.

IV. Respondent Comments -

There were several interesting comments, a few of which are summarized below.

- Other store reporting and control systems were not sophisticated enough to use all POS data.
- Information was processed more rapidly using POS.
- Data overwhelmed main frame computer.

- Lack of system applications to make use of available information.

- Need a sound Administration System to support POS.

- Scanning makes it worthwhile (Food Store respondent).

V. Summary

a. The survey responses indicated a high degree of interest and enthusiasm for POS Systems, particularly among Users.

b. An important role for POS Systems was seen in the improvement of both store operations and management control.

c. Many retail firms have made a strong commitment to the development and use of a POS System.

APPENDIX IV - SYSTEMS AVAILABLE

Identity	Input	Output	Configuration
FOOD STORES -			
Anker Data Systems	Keyboard; Hand held or slot optical scanner	Display; Printer; Magnetic tape or Disk	Can be obtained as a stand-alone unit (ECR) or as part of a controller driven system
Bunker Ramo ESIS	Keyboard; (Optical Scanning is under develop-ment for UPC); Electronic Scale	Display; Printer	Uses 3 Nuclear Data ND812 minicomputers to support up to 18 registers. Terminals dependent on network of mini-computers. One fixed head disk available for data storage.
IBM 3660 Supermarket System	Keyboard; Fixed optical scanner for UPC	3 Station printer; Display; Disk attached to store controller	Similar to IBM 3650. System requires VS/370 host computer for initialization and polling functions. 24 terminals per controller
MSI Data Astros Supermarket System	Keyboard; UPC Scanner; Electronic Scale	Printer; Display; In-store reports via teletype; Disk holds data for polling by central computer	Uses dual processors and dual disk drives to support up to 14 terminals. Dual system provides backup to computer dependent terminals.

Identity	Input	Output	Configuration
NCR 250/255 Supermarket System	Keyboard; (Scanner for UPC under development); Electronic Scale	Up to 3 printers; Display; Magnetic tape, disk, or cassette depending on configuration	250 - stand-alone electronic cash register. 255 - minicomputer driven. Up to 48 terminals supported by one NCR 726 with disk data storage.
National Semiconductor Datachecker	Keyboard; UPC Scanner; Electronic Scale	Printer; Display; In-store totals printed by terminal. Polling by central computer	Dual processor system supporting from 6 to 24 terminals. Primarily an in-store system, although polling by host is permitted. Uses a disk file to store transaction and price data. Terminal can operate as a cash register if system fails. (Stand-alone terminal is being developed).
Sweda Superegister	Keyboard; Electronic Scale; (UPC scanner under development)	Dual Printer; Display	Possible configurations are: stand-alone, dual minicomputer system with 16 terminals, or on-line with host computer
American Regitel	Keyboard; Magnetic and Optical Scanners	Display; Printer; Magnetic tape	Terminals are dependent on minicomputer. System is only suitable for large stores. Credit authorization can be negative or full positive.

Identity	Input	Output	Configuration
DEPARTMENT STORES			
Anker Data Systems	Keyboard; Hand held or slot optical scanner	Display; Printer; Magnetic tape or disk	Can obtain a stand-alone (ECR) or controller driven terminal (MTS). Full positive credit verification on MTS system.
Datatrol System 6000	Keyboard; Any scanner type	Display; printer	POS terminal computer dependent on a store controller. The terminal controller must be on-line to a 2 or 3 minicomputer network (PDP-8's). Data recording, data look-up, and report printing performed at central location. System designed to support a large number of terminals.
IBM 3650 Retail Store System	Keyboard; Magnetic scanner (Reads tags produced by ticket unit)	3 station printer; display; Data on disk until polled by host 370	Entire system requires a System 370 computer and operates only on-line. Store controller can support up to 191 terminals and acts as major communications link with 370. Terminal can operate as a cash register if controller fails.

Identity	Input	Output	Condiguration
NCR 280/725 Retail Support System	Keyboard; Optical scanner (wand, NCR code)	3 station printer; Display; Magnetic tape, Cassette, or disk	Four possible configurations ranging from stand-alone to on-line with host computer. Controller can handle 48 terminals.
Singer Friden MDTS	Keyboard; Punched tag; magnetic or optical scanner	3 printers; Display; Magnetic tape, Cassette, or Disk	Five possible configurations ranging from stand-alone to on-line with full positive credit authorization. Up to 180 terminals supported in on-line mode.
Sweda Series 7000	Keyboard; Magnetic scanner	Display; Printer(30 col.); Magnetic tape, Cassette, or Disk	Both independent and controller driven terminals available. No interactive communication with host computer.
Unitote Series 300	Keyboard; Optical or Magnetic scanner	3 Printers; Display; Magnetic tape; Reports produced on teletype or CRT.	Terminal can operate in stand-alone, controller driven, and on-line modes. Central controller can use disk file for positive credit authorization in on-line mode. Up to 160 terminals per store controller.

Identity	Input	Output	Configuration
SPECIAL SYSTEMS			
Addressograph Multigraph Documentor	One key for each sales item. Used in fast food stores. Will also accept mark sense cards.	Printer; Display	Primarily stand-alone but can communicate with central computer.
AMF Electrosystems	50 item keyboard; Used in fast food stores.	Display; Receipt printer; tape cassette	MINEX terminals are stand-alone units. MANEX terminals depend on a minicomputer.
Datatrol CS-1400 & CS-1500	Touch-Tone telephone or calculator like terminal. Used for credit authorization.	Voice response or terminal display; Magnetic tape.	Uses a minicomputer and disk storage. Responds over telephone lines to terminal entries. CRT's can be added for use by credit specialists in an on-line mode.
TRW	Touch-Tone Telephone or calculator like terminal. Used for credit authorization.	Voice reponse or terminal display.	Uses a minicomputer and disk files to provide positive credit authorization. CRT's also supported.

APPENDIX V - RETAIL INDUSTRY SUMMARY

The economic feasibility of most POS Systems depends on the sales volume of the store and the number of stores owned by a firm. This appendix will briefly describe the structure of the industry along these dimensions.

Department Stores - (Standard Industrial Classification 531)

The total sales volume for department stores in 1973 was $52,965,000,000. On the basis of the latest available figures, the sales by stores with over 100 paid employees represent about 66% of this total. The average sales volume for department stores with over 100 employees is approximately $12,000,000 per year. This group of about 3000 establishments represents a key market for POS Systems.

There is also a significant number of companies who own more than one department store. According to the 1967 census, firms having more than 5 retail stores accounted for 84% of the sales volume.

These statistics clearly indicate the existence of a large number of retail outlets and multi-unit firms that could justify the use of a POS System in terms of a cost/benefit trade-off. Current estimates indicate a potential market for the large department stores (sales greater than 50 million) of 60,000 terminals. In addition, the market for terminals in smaller stores is approximately 180,000.

Grocery Stores - (Standard Industrial Classification 541)

The total sales volume for food stores in 1973 was $113 billion, of which $94 billion (83%) was sold by supermarkets. The 1967 Census data indicated that there were 3636 stores employing over 50 paid workers. This group of stores represents the prime market for POS Systems.

A survey taken in 1970 identified 21 major chain store companies which control over 40% of all food sales. The average store size in this group was about $2,000,000 in sales per year.

The trend in the last few years has been to increase average store size as smaller stores have been phased out and most new construction has been for large stores. Therefore the 1967 data presented tends to underestimate the number of stores where POS terminals are a viable alternative. The number of stores with more the 50 paid employees is probably closer to 7000 at this time.

Sources -

1967 Census of Business.
1970 Distribution of Food Store Sales in 281 Cities.
1974 Survey of Buying Power, Part 1 - Sales Management.
Guide to Retail Point of Sale Systems - Auerbach.