DATA PROCESSING SEMINAR

IN COOPERATION WITH THE

PENNSYLVANIA TECHNICAL ASSISTANCE PROGRAM

INSTITUTE OF REGIONAL AFFAIRS
WILKES COLLEGE
WILKES-BARRE, PENNSYLVANIA

DATA PROCESSING SEMINAR

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1970

Office of Science Research

and

Institute of Regional Affairs

Wilkes College

Wilkes-Barre, Pennsylvania

FOREWORD

Management today is purported to be an elusive alchemy of art and science. Concepts like management science and professionalism, and techniques like operations research and industrial psychology are taking outer stages. More traditional areas of study like finance and marketing seem to be moving grudgingly toward the wings.

Today's managers must deal with more and more information. They must learn to handle relationships with warry facts. Information is multi-dimensional, not just a conglomeration of individual facts in splendid isolation. These facts relate and merge. Therefore, information management systems must be designed to allow management to take full advantage and cognizance of this multi-dimensional aspect. Any effectible system must be capable of correlating, synthesizing, and merging data at various stages of the management decision-working process. The system must be general purpose as well - that is, capable of handling any kind of data that management works with. The system must allow management to use its imaginative and authoritive talents. There is truth in the beginning statement of the FORWARD, in that although managerial decision working is becomming more scientific, it is also akin to artistic inspiration.

One of the recent deviards in the business world has been for computer-based systems tailored to the needs of the generalist in management - that person without a formal background in system analysis programming. Such systems must provide this kind of general person both the opportunity and ability to structure his own data in his own way, using a language that is comfortable and easy to master.

It was with this general objective that a seminar of six sessions on the use of computers was offered to the business community in Northeastern Pennsylvania. The specific objectives of the series of sessions on the solution of management problems by the use of computers coincides with the recommendations of the Economic Development Council of Northeastern Pennsylvania, which gave whole-hearted support and encouragement to the program.

This educational program of technical assistance on the use of computers was not economically and readily available to industry in the region.

The computer seminar was financed and made available through Wilkes College and was well equiped to undertake the proposed program of computer seminars for business, commerce, and industry. The atmosphere which pervades the faculty and administration of Wilkes College has been and presently is one of maximum cooperation with the community for their mutual benefit. The modern science structure houses a Graduate and Research Center which, in addition to the usual major scientific equipment, includes a computer facility. The science departments at the College have participated in supplying local industry with services which have helped to upgrade the training of its employees. These departments have also acted as consultants to local industry in areas where technical know-how was necessary. The College has provided the community with services through The Institute of Regional Affairs since 1951. Because regional problems are a phenomenon spilling into many disciplines, the Institute has utilized resources including not only the College faculty in economics, psychology, government, and sociology, but also those expert in the region who could lend their talents to teaching, research and consultation.

The project supervisor for the Computer Seminar was Cromwell E. Thomas, a member of the Wilkes College Engineering Department for over twenty years, and is responsible for the operation of the Wilkes College Computer Center. He was ably assisted by Donald Chick, chemical engineering student, demonstrated remote terminal applications during the seminars.

The seminar sessions were conducted by Mr. Howard Fergueson, Vice President, Education Division, Management and Computer Services Corporation and Mr. Francis A. Schlegal, Jr., Management and Computer Services Corporation.

Appropriate consultants, who stressed the cost efficiencies inherent in introducing modern computing techniques into local operations, were engaged to conduct the seminar. Frank Mutalo, sales representative of Computer Services assisted in the afternoon demonstrations. George L. Johnson, Customer Applications Representative, and David J. Wells, Sales Respresentative, both of Computer Sharing, Inc., were available to discuss the application of the computer to participants whose work involved an unusual operation.

Both Mr. Thomas and Mr. Fergueson have undertaken to evaluate the effectiveness of the program by discussing with employers of the region the introduction of modern computing methods. Questionnaires were utilized to determine whether the employers had taken any action on installing computers as a result of the seminar. Mr. Thomas has continued to act as a laison between the employers and the management consultants who gave the seminar. Both men feel that the follow-up phase of this seminar program has been of immeasurable value to local employers.

Hugo V. Mailey, Director
Institute of Regional Affairs

TABLE OF CONTENTS

Forward ii

Program vi

Introduction by Cromwell E. Thomas 1

GENERAL BUSINESS APPLICATIONS
Introduction by Francis A. Schlegel, Jr. 3
Computer Applications to Business Practices by Howard Fergueson 8

TRANSPORTATION
Introduction by Cromwell E. Thomas 33
Options in a Computer Program by Francis A. Schlegel, Jr. 34
School Bus Scheduling by Howard Fergueson 37

RETAILING
Introduction by Betty L. Jahr 50
Retailing by Howard Fergueson 52

ENGINEERING
Introduction by Cromwell E. Thomas 70
Engineering by Howard Fergueson 72

MANUFACTURING
Introduction by Cromwell E. Thomas 89
Manufacturing by Howard Fergueson 91

Participants

Glossary

SEMINAR ON DATA PROCESSING

WILKES COLLEGE

PENNSYLVANIA TECHNICAL ASSISTANCE PROGRAM

PROGRAM

April 22, 1969	General Business Applications
May 6, 1969	Transportation
May 20, 1969	Retailing
June 3, 1969	Engineering
June 17, 1969	Manufacturing
June 18, 1969	Manufacturing

INTRODUCTION

by

Cromwell E. Thomas
Assistant Professer in Engineering
Wilkes College

Our interest in instituting a computer seminar for business, commerce and industry in Northeastern Pennsylvania really began with the publication of an analysis of the manpower problem by The Economic Development Council of Northeastern Pennsylvania. This Study, entitled "Manpower Dilemma in Northeastern Pennsylvania" and published in April, 1967, pointed up some of the complex employment problems that beset the region. A few excerpts from the report will serve to illustrate the seriousness of a new problem for the area-A MANPOWER SHORTAGE.

"The present manpower shortage will become more acute, and consequently the competition among employees for scarce labor will greatly intensify. Partly as a result of competition and partly as a result of pressures by organized labor, wage rates are likely to rise very sharply.

"Most managers are aware that capital may be substituted for manpower and vice-versa. When the cost of manpower moves upward, there is a strong tendency toward mechanization.

"In Northeastern Pennsylvania, until quite recently, the pressure upon managers to mechanize was below normal. Wage rates in the district were generally lower and plants using less modern equipment and turning out less on a per employee basis could compete in national markets because the price paid for labor was lower. With unemployment dwindling rapidly, upward pressures on wage rates are likely to create a situation where very large amounts of capital investment will be called for if the district's industry is to remain competitive.

"The lack of capital investment has caused the district to suffer greatly from outmigration of its young, best-educated talent. This phenomenon is related to the limited opportunities for college-trained "Middle Management" people."

The Council went on to state in the report that there was need for an action program, if Northeastern Pennsylvania is going to continue to compete successfully in national markets. The Economic Development Council, therefore, proposed a three-fold action program, one of which was management consulting assistance. A pilot program conducted by the Council and designed to provide modern analytic tools to manufacturers with problems in financing, marketing, production control, and cost controls, demonstrated that this type of management service effort can achieve marked improvements with a small outlay of resources. Such consulting service should include:

a. professional consulting services on specific plant problems;
b. seminars on management problems and effective solutions;
c. educational television, either district-wide or closed-circuit for industrial groups, and
d. expanded in-plant training for existing personnel.

The objective of these seminars coincides with the recommendations of the Economic Development Council of Northeastern Pennsylvania. Consultants participated in all seminar sessions. The program included sessions from Management and Computer Services, Inc. of Philadelphia. Computer Sharing, Inc. demonstrated the use of remote terminals for those participants interested in this type of system.

It is the hope of those who arranged the seminar as well as those who were invited as consultants that the sessions provided a needed impetus to explore the advantages of modern techniques. It is further hoped that management costs may be reduced for many employers of the region, thus improving their competitive posture on the state and national business scene.

GENERAL BUSINESS APPLICATIONS

a. Introduction

by

Francis A. Schlegel, Jr.
Management and Computer Services Corporation
Philadelphia, Pennsylvania

Our company is designed into four areas, one of which is education. We've contracted to conduct a series of seminars in the area of education for businessmen, engineers, and others who may have an interest in data processing. We will explain to you in terminology familiar to you what a computer is, and what it can do for you.

Part of the Penntap program, in addition to this seminar, is to provide a consulting service to you. Members of our firm and those on the college staff will visit each of your organizations to discuss with you your problems and possibly suggest how they might be solved through the use of data processing equipment.

Data processing is nothing new. It is merely a systematic processing of data as it is entered into a system. The system does not necessarily mean that it must be an electronic data processing system, however, electronic equipment and hardware has been used to process data faster than we are able to process it manually.

The three primary elements of the data processing system are: the ability to read data, to process the data, and to prepare the data in some output format.

What can computers do? I think that all of us are just waiting for sometime in July when two of the three astronauts place their feet on the surface of the moon. It is a fantastic feat and I am sure that we could not put those men there without the aid of computers. Computers are also being used in business, today, in the processing of telephone bills, in the controlling of inventories, in accounts receivable, in revolving charge plans, and in other ways. Nearly every one of your banks has data processing equipment which is used for the processing of checks and the maintenance of bank balances.

What we want to talk about today is how the computer, which has three basic elements: input, processing, and output, allows you, to use this computer as an extension of your mind.

The earliest form of data processing was really on the fingers. I am sure you have seen a picture of the abacus. It is just another tool that was used in counting. In the early 1800's, a person named Babbage attempted to develop what he callen the "analytic engine". Had it not been for his grandiose ideas and the lack of money, he might have been able to complete his engine.

Computers can be divided into three generations. The first generation used vacuum tubes primarily in the hardware. This was the type of system that was used in the development of the ENIAC at the University of Pennsylvania by Eckert and Mauckley in the early 1950's. The problem with the first generation equipment was heat generation and the large amount of space that was taken up by the equipment.

The second generation equipment came about through the advent of the transistor. A Module was used in this type of equipment between 1956 and 1962.

We are now at what is called the third generation of data processing equipment, or those computers that use solid state technology, or integrated circuits. It is claimed that in the type of circuitry used today, about 50 million diodes are contained in one thimble, whereas, heretofore systems of wires and transistors were needed to perform the same function. RCA calls its model "the Chiclet" because it is just about the size of a Chiclet.

People have been talking about the speed of computers and the number of operations that can be performed in one second. The claim is made that they range from 100 calculations or 100 additions a second to a high of perhaps six million calculations a second.

In 1954 the number of computers that had been installed was 54. In 1955, there were 263. In 1966, there were 25,000 computers installed in the United States alone. The forecasts have been that by 1970 there will be 50,000 computers installed. We estimate that it will be closer to 70,000 computers by 1970.

It was feared at first that computers would replace people and that people would be put out of jobs. That is not true, because 19 years after automation there is a people shortage. There is a crying need for more and better-qualified people.

It is estimated that there will be a shortage of 650,000 people in this industry by 1970. It appears that the shortage in programmers alone is expected to hit 300,000.

Let me quote from the April 11 Research Institute Recommendations:

"Any smaller business that isn't using a computer---its own or an outside service center--should have good reason why not. A major IRA study of computer use in companies, in all industries clearly indicates that EDP is no longer for the giant firms only. Whether you're in the 82% married to or flirting with computers, or part of the 18% with a good, sound reason for staying out, you're probably eyeing the next step up on the computer ladder. And for all firms, the IRA study shows, the watchword is caution.

"a 62-page report based on a survey of 8,000 users and nonusers (including smaller firms usually ignored) tells it like it is:

...Users now outnumber nonusers in all types of businesses;
...one-third of all respondents now own or lease a computer;
...one-fourth use an outside service facility---like a bank, computer manufacturer, or indepentent center that sells computer services.
...16% of nonusers have an EDP educated member of management.

"It comes down to this: Any company that has 200 employees, $7,000,000 in sales, no computer usage, is in clear minority. That's still far short of a computer in every business office.

"Forms below those figures should note a further breakdown: Smaller and middle sized companies go more for buying outside services; about 1/3 of those with $3 to $5 million sales do so. Only 10% in this size category have their own in-house operation.

"Larger companies as might be expected, prefer their own computers.

"Outside users (86%) are generally satisfied with the job they get. About 62% say computers pay off in dollars and cents terms. Another 20% say "maybe" on full payoff, simply because it's hard to tell.

"In-house operators grumble more about computer performance though they insist their decision to computerize is paying off.

"Firms thinking about a computer may be interested in advice based on the actual experiences of veterans among the respondents:

...go over all product data systems. See whether a computer can improve what you have. Ask if there is a readiness for the computer's cost and complexities.

...Consider starting off with some outside service. The typical user begins with 2 applications, such as payroll, sales analysis or accounts receivable, then adds a third later. Give careful forethought to the economics of the move.

...The median cost for running the smallest computer is $85,000. This is the yearly cost of just the EDP personnel and the equipment. It does not include rent, power, supplies, etc. On the other hand, three applications come to $10,000 or less. This is a lot less than $85,000 if that's what most of you currently need.

...The median figures for firms with small in-house computers are $21 million in sales and 680 employees. This is not exactly small. The rule is that you have to use a computer to make it worthwhile. Firms with small computers now use 7 applications and plan 4 more. You should ask whether you have that many that you're ready to pay for now."

Here are some general principals that you should keep in mind:

1. It will take from 1 to 2 years from initial planning to installations. Thats for an IBM 360/20, a Honeywell H-110, an NCR 100 or similar equipment.

2. Get good people or don't bother with computers. You will need programmers, planners, and a competent EDP manager. The best computer is no better than the EDP crews operating it.

3. Involve the whole firm from the start in the EDP operation. Integrate the computer with the activities of the other units. Get full participation from both top and "line" management levels.

The computer, in brief, has come a long way from the first generation. Technical performance has soared; operating costs have plummeted. Computers are more compact, more efficient, much more dependable. The quality and availablility of programs has also improved. Many standard business problems have already been pre-packaged.

The door is open wide, but computers still have a long way to go.

Technology is still being perfected, and new breakthroughs will come. But the greatest leap must be made by the computer user himself. Fully 90% of today's computers are underemployed. Harnessing this vast potential will be industry's next challenge.

b. Computer Applications to Business Practices

by
Howard Fergueson
Vice-President
Education Division
Management and Computer Services Corporation
Philadelphia, Pennsylvania

We are going to give you a view of what data processing equipment is available and how it operates. A data processing system is made up of the input, processing, and output units used to perform various operations on data. It is made up of these five functions: origination, input, manipulation, output, and storage.

These five functions can be described as follows:

1. The origination of data-somewhere data originates with a source document.
2. That source document is then put into the input function in a form which will aid further processing.
3. The manipulation of data is the next step in the data processing system. This is the adding, subtracting, multiplying, dividing, summarizing, etc. of the data so that it is now available in the desired format for handling.
4. The data must be produced to our output requirements.
5. An element in the data processing system which is very important is the storage of data, the retention of data for future use.

1. Origination

Let us relate to a mechanized data processing system, beginning with the point of data origination, the source document. Here I have an illustration of a source document. This happens to represent the source document used in a brokerage house. The same type of document could be used in an engineering application or a retail application, where someone will record the various elements of data required for the processing for this transaction.

2. Input

That first document must be transcribed into some media for further processing.

As part of the input process, there are card readers. Some read cards at the rate of 500 cards per minute. Another type of input device is a typewriter, which can be directly connected to a computer. Still another type of input device is a reader-sorter. It senses the magnetic ink inscriptions on the bottom of the checks, and feeds this directly to the computer, punching the checks by the particular routing symbol printed on the check.

Other types of input devices used quite extensively today are those using optical scanning procedure. These may someday replace the punch card as the primary means of entering data into the computer. Paper tape may also be used. Still another means of entering data, used extensively, is mark sensing. After a mark is blackened in the proper space on the card, it is then fed in to a reproducing machine. The marks are read and the information punched into the card. This eliminates or bypasses the key punching function.

Punch cards are the most widely used method of entering data into the computer system. The punch card that you may be familiar with consists of 80 characters of information, or 80 columns across the card. Each column contains 1 character of information. Therefore a punch card can contain a maximum of 80 characters of information. That information can be alphabetical information, numeric information, or special characters such as dollar signs, quotation marks, an ampersand, or asterisks.

If the data to be transcribed into the card consists of more than 80 characters, more than one card will have to be used to contain all of this data.

As a general rule, you can say that a numeric character is represented by one hole punched in a column, an alphabetic character is represented by two holes in a column, and a special character is usually represented by three holes in a column.

A machine called the key punch machine is used to transcribe the data. Before the data can be placed on the card, the card must be divided up into what we call fields. The number of columns that are reserved to capture a particular type of information is called a field.

The key punch function is the function of transcribing from the source document into the punch card. Normally it is a young lady who is sitting at a machine that has a keyboard much like a typewriter. She glances at the source document and her job is to merely transform the data on that source document into the punch card.

After she completes the punching of that card or cards, all the source documents and all of the cards that have been punched go to a second operator. This operator is called a verifying operator whose function is to verify that the data that has been placed into the cards has been captured correctly. This is a very, very, important part of any processing system. This operator uses the same type of machine as the key punch operator. The only difference is that the key punch machine is the one that put the holes into the card, and the verifying machine is the one that reads the holes that are in the card to determine whether the card contains the proper information.

When there is a discrepency between what the key-punch operator and the verifying operator think should be the same column, a notch is put at the top of that column to show someone that the data in the column is suspected to be in error. Now whether it is correct or not must be resolved manually. Someone will have to sit down with the source document, look at the data that was on the source document, and check to make sure that it is properly punched on the card. If it is incorrectly placed on the card, then the card must be repunched with the proper information.

I've seen cards with 20 or 30 little notches on the top. This comes about because of poor data origination, and source documents which are incorrectly prepared. A good example is a payroll that is kept on a construction site. Various men come in and fill out their time cards on a daily basis. They have one piece of thick lead with which they are all trying to write in a little space. By the end of the week the data that is written is not very legible. When it goes to the girl who is trying to transcribe this information on a card, she finds it difficult to interpret correctly.

Source data preparation is a very important part of the data processing system. In designing the forms that are to capture the data originally, a lot of care should be taken to make sure that there are various spaces reserved for specific characters.

The whole point of all this is that we wish to eliminate as many discrepencies as possible in the output phase. Incorrect data must be weeded out. There is an old saying in data processing called "GIGO". It stands for "garbage in and garbage out". If garbage is transcribed in the input phase of the data processing system, then garbage will be processed at extremely rapid rates and it will be pumped out at the other end of the data processing system. When these reports or statistics come out at the end of the system, they will be worthless because they are invalid.

3. Manipulation of Data

Now that data has been captured and placed into the data processing system, let us go to the third phase of the system which is the manipulation of data. There are various machines that are available to process this data.

A sorting machine is used in the sequencing of data. Data captured on cards can be sorted in ascending or decending sequence. We may wish to get all of the employees time records into sequence by social security number or by employee number. We may wish to get all of the cards into sequence by jobs. We may wish to sequence by dates of the job, or completion date, or expected date of completion. We can then produce reports showing that the termination date of a job will come in the next 30 days, 60 days, or 90 days.

A second function of the sorter is the grouping together of like data. Assume there are 37 people working on one job. We may wish to group all of their records together so that it is possible to cost out the job for a particular week.

The third function of a sorting machine is that ability to select a card out of a deck or a file or cards. For example, we can select from a file of cards all those which have a 1 in it, or a 5, or a 3. The selected card is pulled, the remainder of the cards will remain in the exact same sequence that they were in originally.

Other functions that are performed by machines are the reproducing of data, where we can take cards already punched and transfer data from them to unpunched cards. This can be done totally by machine. An example of this might be the payroll cards. Rather than punch repetitive information, such as employee number, date, etc. This information can be reproduced into the cards from a previous week's time cards, leaving blank the information that is variable, such as the number of hours worked and the particular job functions performed.

Another function of a reproducer is the gang punching or the transcribing of information from one card to the succeeding card and from that card to the following card, etc. The difference between gang punching and reproducing is that reproducing is a one-for-one reproduction, whereas gang punching is taking from one card and transcribing into many cards at the same time.

Merging is a function performed by a collecting machine and is the ability to merge two files or cards into one. The requirement to perform this function is that both of the files of cards must be the same sequence. Prior to performing any merging application, both files must be sorted first. Why not just sort rather than merge, if sorting is the same thing as merging. This may be true. A sorting machine is capable of analyzing one column on a card at a time, whereas a collater has the ability of analyzing a complete field of data at a time. For instance, to merge an employee number, which might be a six-digit number, it would take one pass of the cards through the collater, whereas it would take six passes of those cards through a sorter to perform the same function.

Interpreting is a function whereby the holes on a card are read. The information on the card is printed on the card as the holes are read. This is required any time cards are going to be used manually in an application. Let us use payroll cards as an example-data pre-punched into the cards. If these cards are to be sent out to a job, the name and number of the employee to whom that card pertains will have to be printed on the card so that he can read it without trying to interpret the holes.

The calculating machine is another type of machine that is used in the manipulation phase of the data processing system. It is used to perform the various functions such as multiplication, subtraction, division, and addition. The computer results can be punched into the same card or it can be stored. A calculator has the ability to store only very small elements of data.

4. Output

Now that the manipulation phase of the data processing system is clear, let us see how the data may be prepared as an output document. Basically there are two methods of preparing output documents. One is what is called a detailed listing or a detailed report. That means that each set of data or each card that is being processed will be printed on the output document. Here are nine entries. Each of these entries represents one card, so nine cards were read into this machine to produce this output report and each card is printed out producing what is called a detailed inventory transaction listing.

A second method in which this report could have been presented is what is called a summary listing or a group listing report, where one line is printed for each group of items. If the detail is desired, it is available. But in many cases the detail is not required and only a summarization is needed in producing the output reports.

A third type of report that I would like to mention is being used more and more today in data processing. It is the Exception Report. Rather than print out all of the information in either detailed or summary form, the trend now is to print out only that information that is above or below certain limits. If estimates are right on a particular project, it may not be important to see the cost week by week. It may be more important to see those jobs or those projects which are over or under the anticipated cost. Only those jobs will be represented on the output report.

A systems analyst plays a very important part in the data processing system. His function is to design the flow of work through the system. He must design the formats of the input data as well as the output data. He usually attacks the designing of a system from the rear-end. He asks, "What is required from my data processing system?" He will then determine what information is needed to produce that type of desired result. He will use this type of format in designing the various fields and the columns that are required to capture that information. He then will design his input source documents so that the information is available for the key punch operators to transcribe into the punch card. Once he has defined the input and the output, he then uses a series of symbols to represent the flow of the data from the source to the output phase. These symbols are then used to represent the various functions-clerical operations or manual operations.

We talked about two different machines-the accounting machine and the reproducer. The accounting machine has the ability to punch cards and read data. The two machines can be linked together with a cable so that the data that is being accumulated on the accounting machine can then be fed across this cable and punched into a card to represent the total of that data that was captured. We may want to punch a summary card which represents all of the data to date, this avoids having to go back in future processing of data to get all of the cards from the previous weeks to feed into the system.

5. Storage

The storage of data is the fifth element. The whole concept of data processing is to capture the data at the source, transcribe that data into a punch card or into some form which can be processed very quickly by the equipment. The information can be stored and used over and over.

To distinguish between the punch card equipment that we spoke of earlier and a computer, we might say the main difference is a computer has the ability to memorize or to store and retain data. I am not talking about storing a small amount of data in a calculator or accounting machine. I'm talking about data in the hundreds of thousands of characters of information. The operators console may have a display tube and a keyboard for the operator to communicate directly to the central processing unit.

The main method of representing data in a computer is through its core storage. Small magnetic cores which have a series of wires going through them and through which electricity can pass to magnetize a core in either a positive or a negative direction. By sensing with a third wire, it can be determined whether it is positive or negative. If it is positive, it is on; if it is negative, it is off. By grouping these cores together, not only can numeric values be represented, but also alphabetic characters.

There are various techniques for representing alphabetic information, in addition to the pure binary number that was used originally in the computer. The Burrow's 205 (first generation) grouped 11 bits together to form what was called a binary word. Every time that data is processed, a complete word is being processed.

In addition to having a portion of memory reserved for data, there must be a section of memory reserved for the program in order to instruct the computer on what to do. Computers today handle words that are in the neighborhood of 32 bits. These words are processed as fixed words, so that they can also be processed for the persons who want alphabetic information, broken down into four bits of data, of eight bits each. Each of these eight bits of course will represent an alphabet or a decimal digit or a special character, exactly the same as it could be represented on the punch card. If we had 80 characters read into a card, 4 of those 80 characters could read into this 32 bit word.

The main memory is that memory that is instantly available to the central processing unit. We differentiate this from the auxiliary memory which is that memory which is not instantly available but may take seconds from which to retrive information.

What goes into the main memory of a computer? A portion of the main memory is for the program, or the set of instructions that the computer is going to perform. The remainder of main memory is available for data or the data that is being processed or possibly reference type data. An example of reference type data would be rate tables that might be used in computing statistics.

One type of auxiliary storage are magnetic tapes. Magnetic tapes are normally 2400 ft. in length, and data can be transcribed on to these tapes. Data was formerly transcribed at about 200 characters per inch, of tape. Today we are using in the neighborhood of 1,600 characters per inch density. The tapes move from 35 to 115 inches per second. The character rate is up to 20,000 characters per second-that is, it is passing data into the computer at that rate. But even at that extremely rapid rate, it is slow in comparison to the internal speed of the computer itself. The computer is capable of moving data from the various bits of data in the range of hundreds of nano-seconds, or a billionth of second.

The internal speeds of the computer are fantastic when compared to the speed at which data is fed into and out of a computer. Because of this extremely rapid internal speed, we have been able to extend the computer so that people can use the same computer rather than as originally devised-one computer for one application at a time.

Let me point out the characteristics of tape and card filing, and at the same time note their shortcomings.

Card and tape files are files that have to be processed or that are normally processed in what is called a batch mode. Batching transactions for the day are placed on a tape, and sorted into a sequence for processing through various computer runs. It is necessary to tape the transactions for the day and to sort them into a sequence for processing. The task is to put some particular sequence into the run, maybe data sequence, project sequence, or job sequence. Let us say that a payroll represents the salaries of all of the people within the particular project or within a particular company. These are in sequence by employee number. The current payroll records to update this file are available. The current transactions must be presorted in order to process them against the master file. At the end of this complete processing these new transactions are applied to the original data, and the master file is updated.

The transactions may on occasion be on magnetic tape or on some other device, and so it would have to be sorted by a computer and that takes computer time.

Another characteristic of this type of processing is that we must read and write the entire master file. The computer time that is required to process this will be the time that it takes to read, perform the examination as to whether there is activity and to write out every one of the thousands of records.

Also, the file is seldom current. The master file is only as current as of the last running of the file. If it was a month ago, then the statistics are 30 days old. If it was last week, then the statistics are seven days old.

A second type of auxiliary storage is the disc file or a direct access file. A direct access device is a device in which the computer can go to any element of data in a relatively short period of time and bring it into the computer. By short, I mean a time element of five seconds. The direct access mechanism is similar to the old jukebox where you put a nickel in the slot and could select five records. The advantage is you may select any record at random whereas on magnetic tapes this is not possible, because magnetic tapes are usually processed in a sequential fashion.

The old master file and new master file is on a disc file instead of being represented on tape. A disc file consists of nothing more than large discs, about fourteen inches in diameter on which there are tracks. Each of these tracks may contain thousands of characters of information. There are, depending upon the particular manufacturer, from ten to twenty-five different disc surfaces.

When the current transactions are fed into the computer, these transactions will update the master file. Inline processing means transactions will be processed as they occur. Sorting is unnecessary, because, as a transaction occurs in a random sequence, it will be fed into the computer. There is no necessity for sorting these transactions because the program that resides in the computer is capable of finding the master record on this direct access file.

If an employee number 763 is sought, the program has the ability to go to any one of a number of surface discs and find that particular employee's master record and bring that record into memory. Payroll information can be processed against an employee's master record updating his year-to-date gross. His earnings can be calculated for the current week and any deductions that are required may be made.

Sorting is unnecessary because every individual whose payroll record is in this file is as readily available as every other record to be brought into memory under the direction of a program. If only seven transactions need to be processed, only seven records will be extracted from the master file, brought into memory, processed, and then replaced in the master file. There will be no necessity to read the other 9999 records because there is no activity against them today.

This means a shorter job time. Instead of taking an hour or two on that job, it may take only seven minutes to seven seconds to run it, since there are only seven transactions.

The computer automatically goes to the proper surface track and obtains a breakdown as to which information track on that surface the data can be found. The data is brought into memory and the computer searches through perhaps five sets of data for the particular one that is required. The time that it would take to do that would be two searches: one seeking the master index and one seeking the particular disc index. It would take exactly the same amount of time regardless of how many sets of data or the volume of data. Only the records that are affected are read and written.

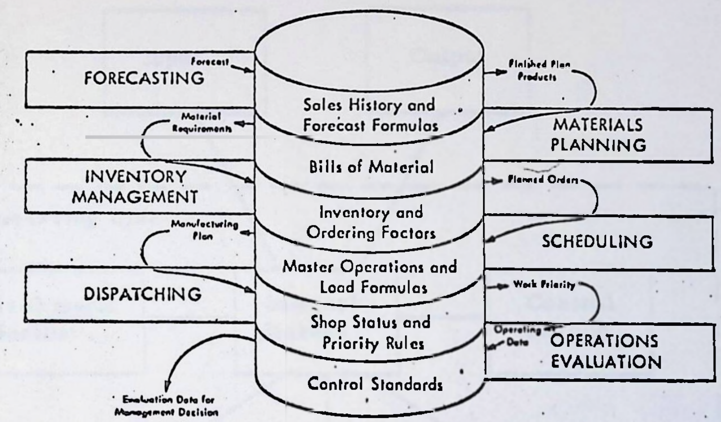
Another point is that the file is up-to-date. This can be done on a daily basis or as transactions are taking place.

Another point that should be considered in processing of direct access files is that one pass of the transactions can update all of the files that are required. Let us assume that we are concerned about the payroll. Another file can be put in which would have job numbers. As this transaction is being processed; the program will seek the payroll master record and apply the information to that master record. Then it will seek the particular job number and post the fact that there are additional hours and expenses recorded against that job. If any other files need to be processed, one transaction can cause the extraction or the processing against multiple master files.

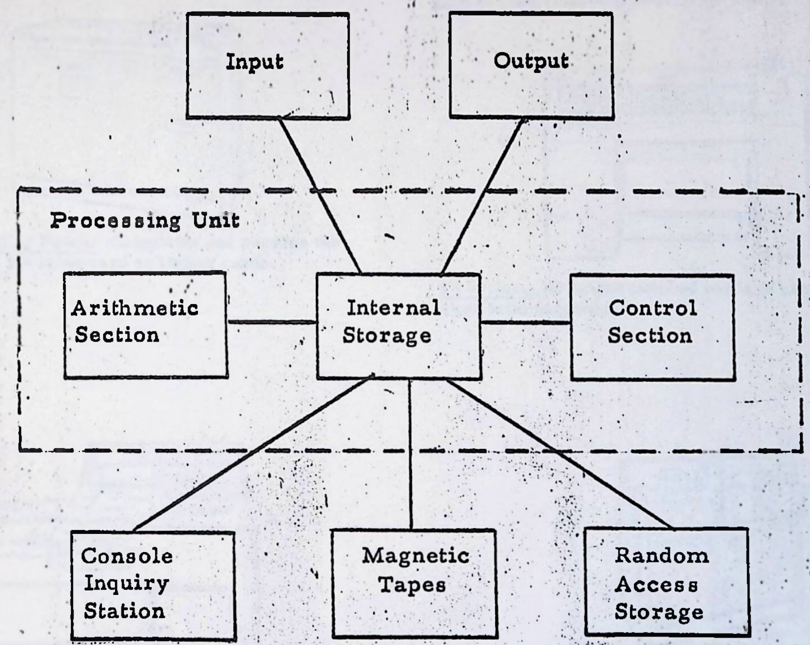
Also, of course, the final advantage is that inquiry is relatively simple now with this type of system. By having an individual sitting at a console or a typewriter device, he can inquire into the master file, extract that record in a matter of seconds, and have it typed out on a typewriter, and then go back and continue the processing with only a few seconds extracted from the normal job processing time to give you the desired information and inquiry as to the state of the particular project.

Computers are used in business for a variety of reasons. If properly applied, they can save money. In many situations they make it possible to obtain information not otherwise economically justifiable. They provide the basis for improved management control.

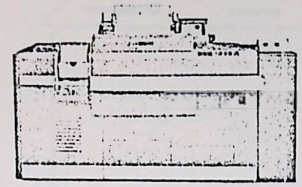
THE MANAGEMENT OPERATING SYSTEM CONCEPT



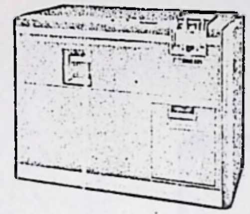
SCHEMATIC REPRESENTATION OF THE RELATIONSHIPS AMONG THE COMPONENTS OF A COMPUTER SYSTEM



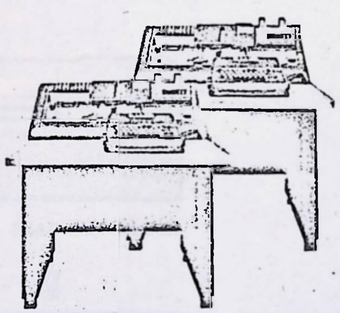
IBM PUNCHED CARD EQUIPMENT



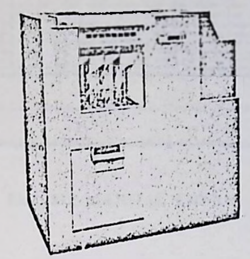
403 Alphabetic Accounting Machine. Prepares alphameric printed reports and accumulates totals from data punched in cards. Counter totals are punched into summary cards by a cable-connected 514.



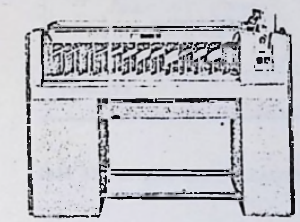
602 Calculating Punch. Calculates and punches the results into the same card or trailer cards.



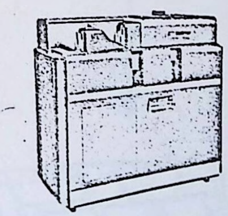
26 Printing Card Punches. Punches data into cards under manually operated keyboard control Prints the punched character at the top of the card column.



85 Collator. Compares two sets of numerically punched cards, performing file maintenance operations such as matching, merging, selecting, and filing.

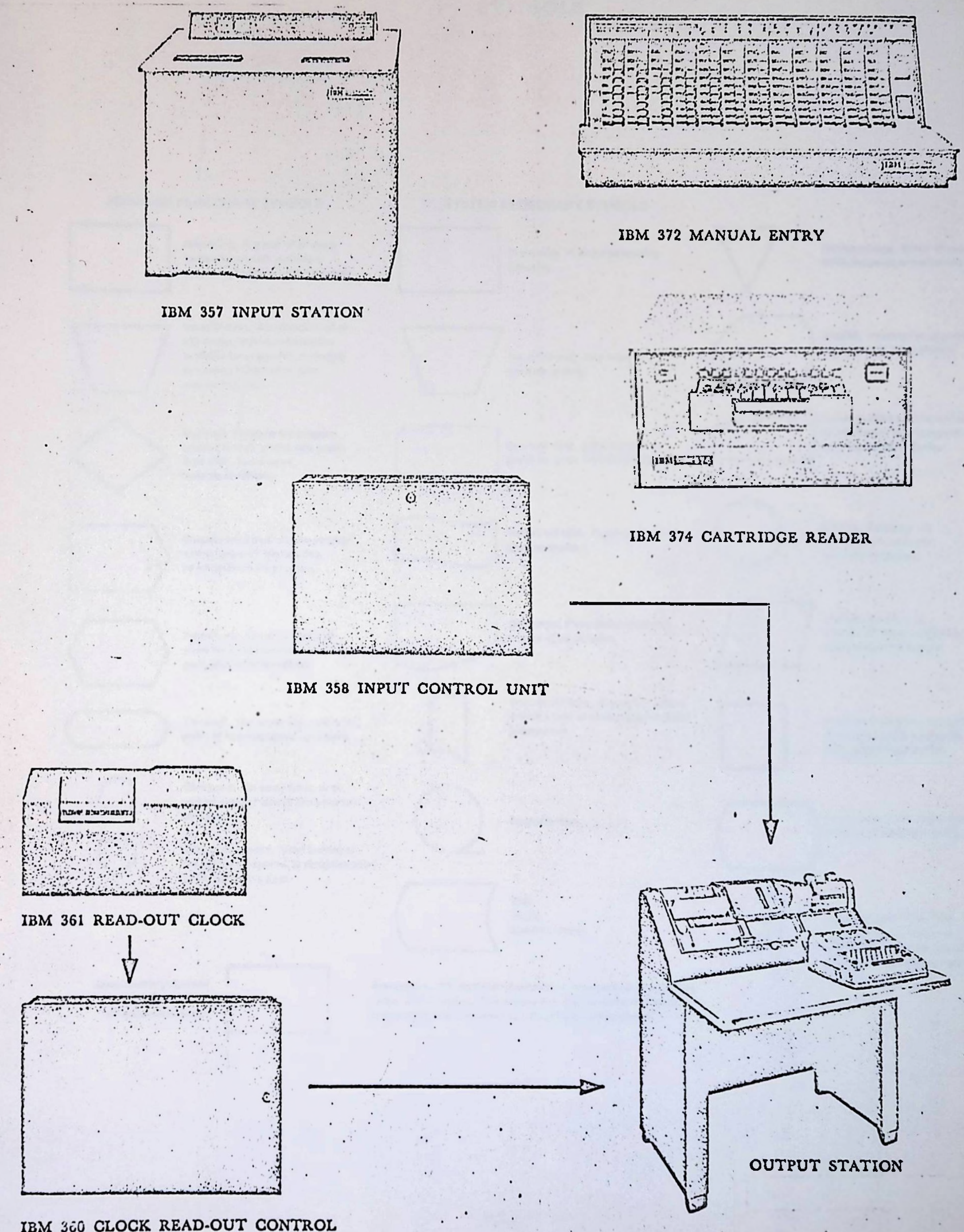


82 Sorter. Arranges punched cards in numerical or alphabetic sequence.



514 Reproducing Punch. Reproduces punched cards, gang-punches data from a master card into succeeding cards, and punches summary cards under control of the 403.

DATA COLLECTION SYSTEM



PROGRAM AND SYSTEM FLOWCHART SYMBOLS

PROGRAM FLOWCHART SYMBOLS

Processing. A group of program instructions which perform a processing function of the program.

Input/Output. Any function of an I/O device (making information available for processing, recording processing information, tape positioning, etc.)

Decision. Points in the program where a branch to alternate paths is possible, based upon variable conditions.

Program modification. An instruction or group of instructions which changes the program.

Predefined process. A group of operations not detailed in the particular set of flowcharts.

Terminal. The beginning, end, or a point of interruption in a program.

Connector. An entry from, or an exit to, another part of the program flowchart.

Offpage connector. Used instead of the connector symbol to designate entry to or exit from a page.

SYSTEM FLOWCHART SYMBOLS

Processing. A major processing function.

Input/Output. Any type of medium or data.

Punched card. All varieties of punched cards, including stubs.

Perforated tape. Paper or plastic, chad or chadless.

Document. Paper documents and reports of all varieties.

Transmittal tape. A proof or adding machine tape or similar batch-control information.

Magnetic tape.

Disk.
Drum.
Random access.

Offline storage. Either of paper, cards, magnetic or perforated tape.

Display. Information displayed by plotters or video devices.

Online keyboard. Information supplied to or by a computer utilizing an online device.

Sorting. Collating. An operation on sorting or collating equipment.

Clerical operation. A manual offline operation not requiring mechanical aid.

Auxiliary operation. A machine operation supplementing the main processing function.

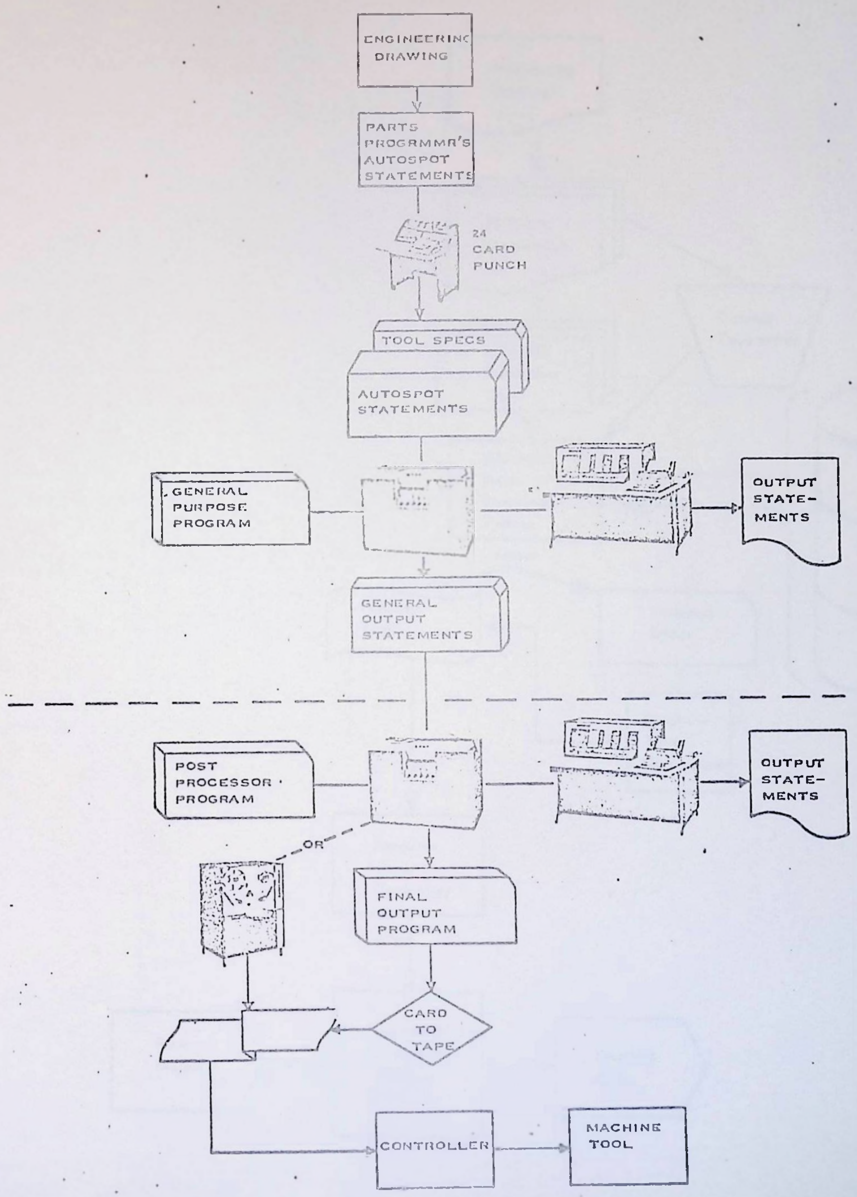
Keying operation. An operation utilizing a key-driven device.

Communication link. The automatic transmission of information from one location to another via communication lines.

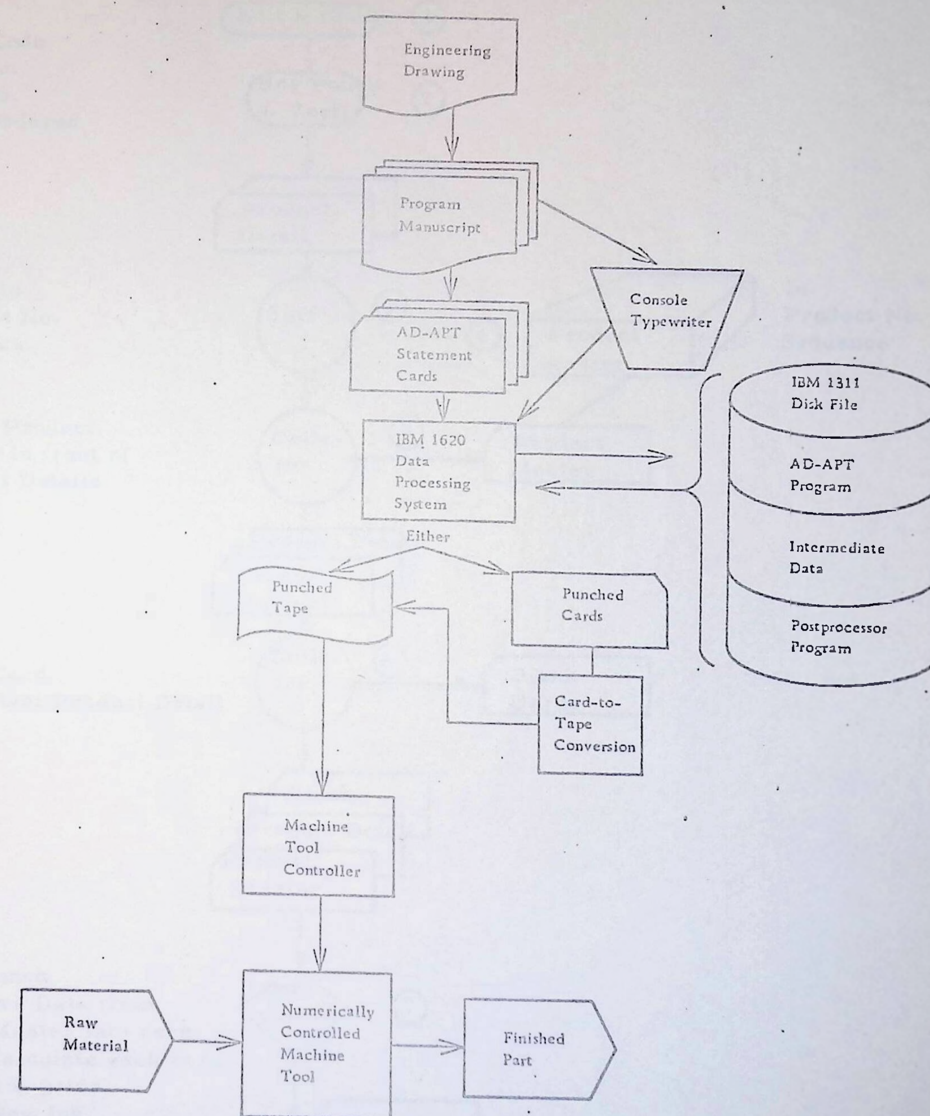
Supplementary Symbol for System and Program Flowcharts

Annotation. The addition of descriptive comments or explanatory notes as clarification. The broken line may be drawn on either the left or right, and connected to a flowline where applicable.

AD-APT SYSTEM FLOWCHART

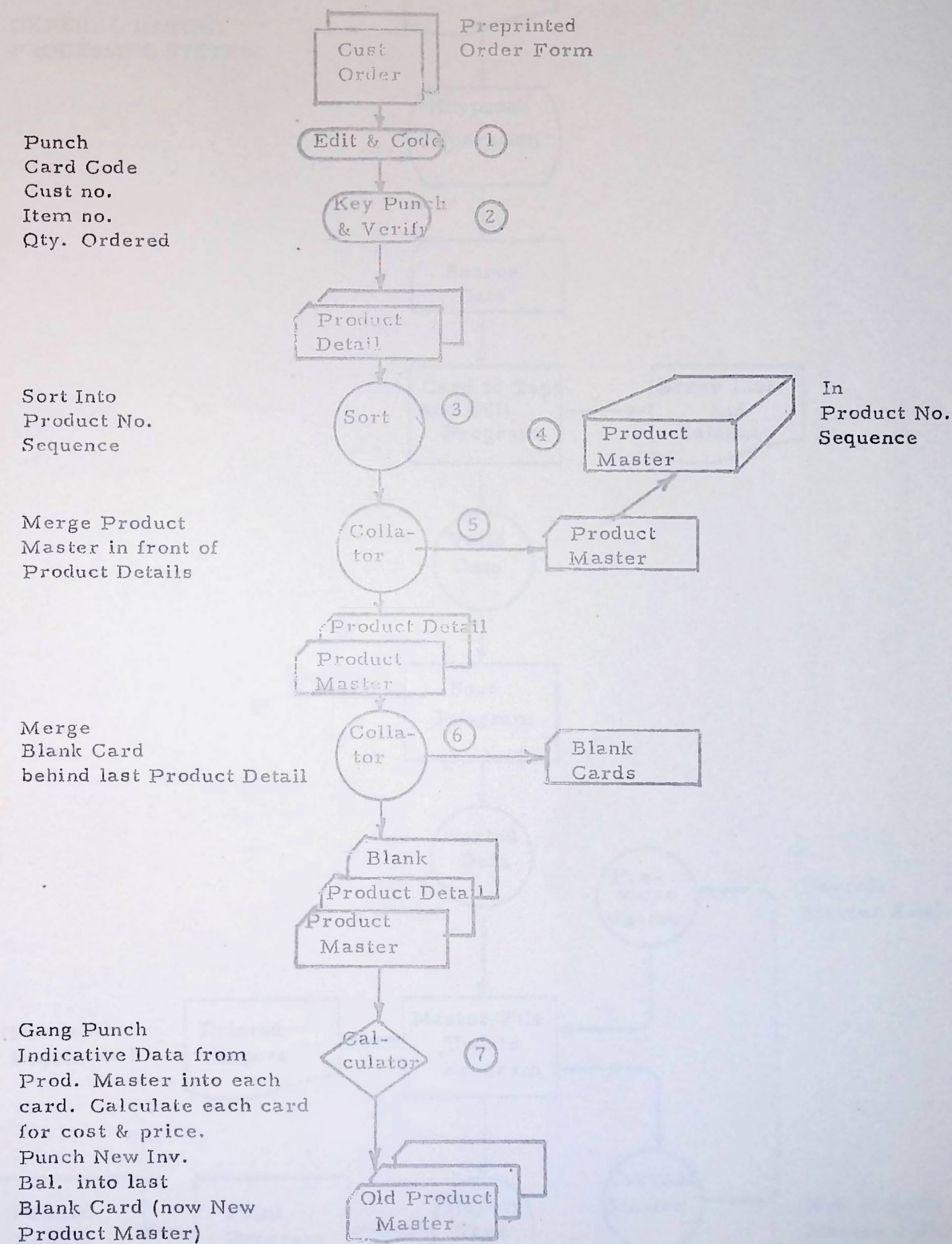


AD-APT SYSTEM FLOWCHART

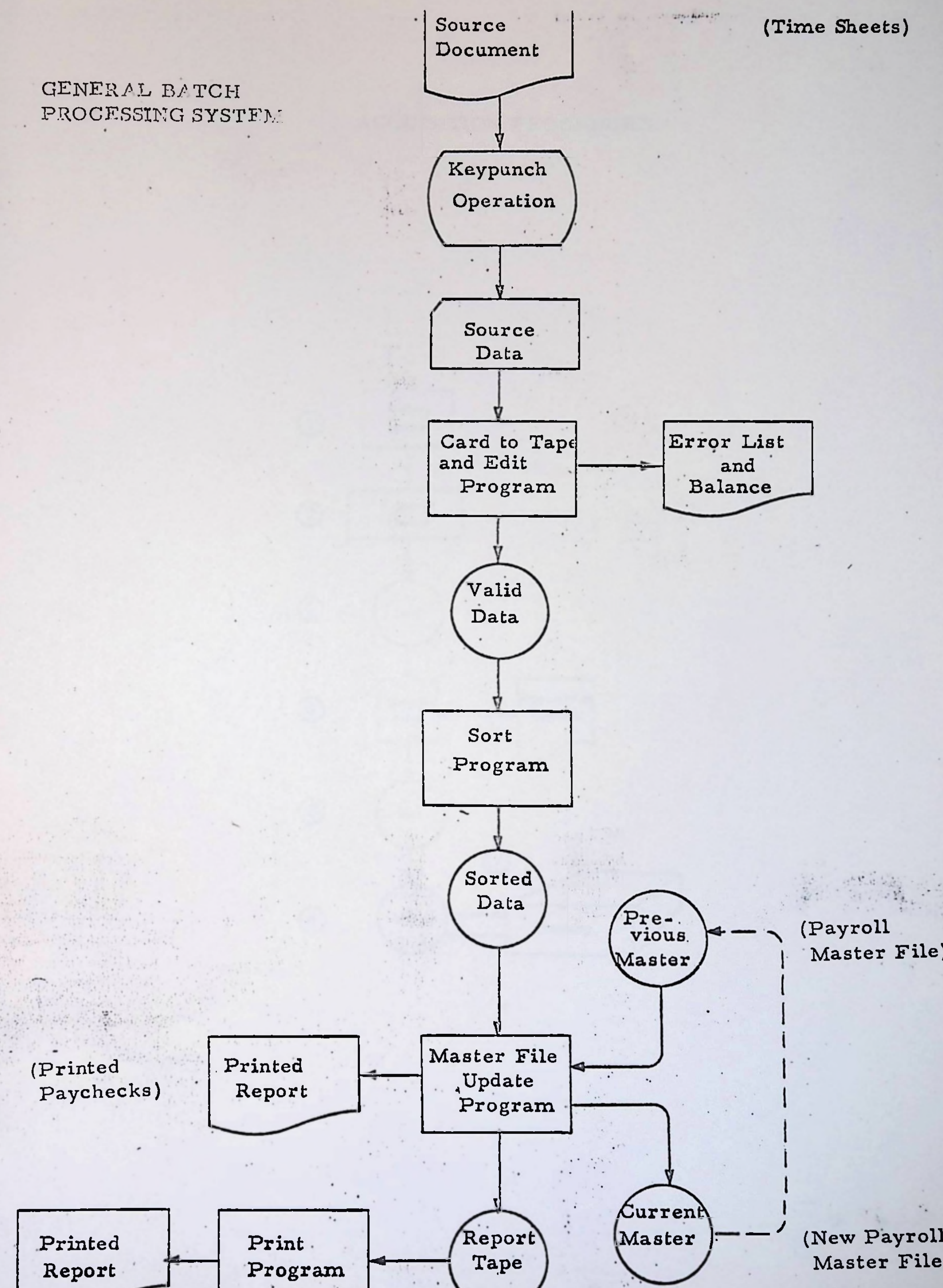


7

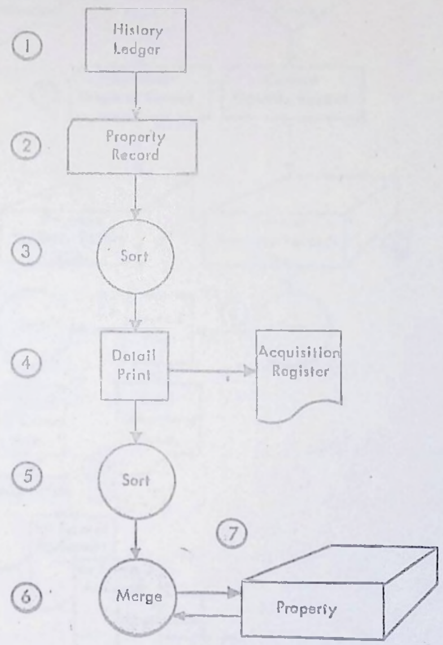
PROCEDURE


Cust Order
Preprinted Order Form
Edit & Code
1
Punch
Card Code
Cust no.
Item no.
Qty. Ordered
Key Punch & Verify
2
Product Detail
Sort Into
Product No.
Sequence
Sort
3
4
Product Master
In
Product No.
Sequence
Merge Product
Master in front of
Product Details
Colla-tor
5
Product Master
Product Detail
Product Master
Merge
Blank Card
behind last Product Detail
Colla-tor
6
Blank Cards
Blank
Product Detail
Product Master
Gang Punch
Indicative Data from
Prod. Master into each
card. Calculate each card
for cost & price.
Punch New Inv.
Bal. into last
Blank Card (now New
Product Master)
Cal-culator
7
Old Product Master

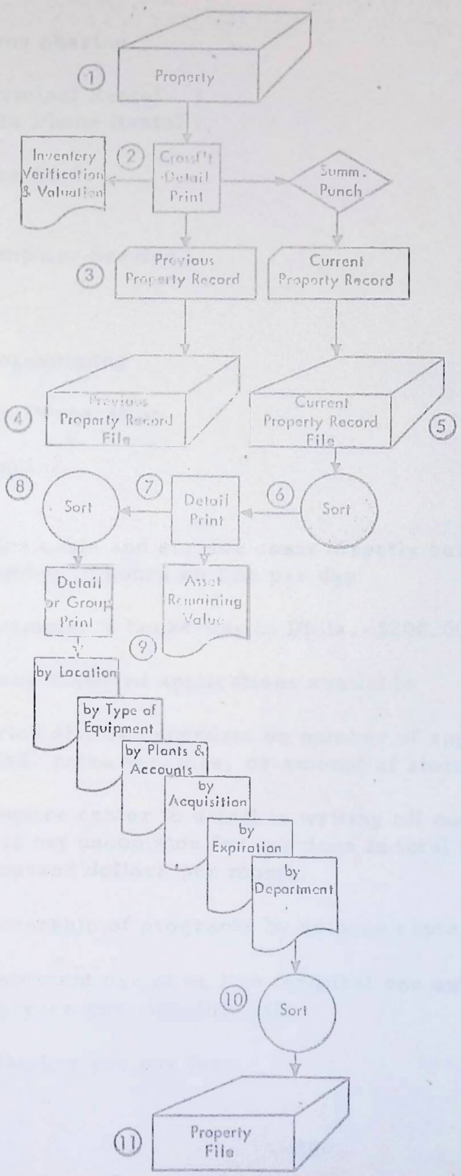
GENERAL BATCH PROCESSING SYSTEM



ACQUISITION PROCEDURE



DEPRECIATION



COST CONSIDERATIONS

A. Service Centers	Estimates
1. Time Sharing	
Terminal Rental) Data Phone Rental)	$ 95.00/month
Line Costs	75 miles $95/ month
Computer Service	$100.00/month and up as required
Programming	$100.00/day and up
File Preparation	variable
Supplies	variable

- Line costs and service costs directly related to number of hours on line per day

- Example: 2 hours/day in Phila. - $200.00/month

- Many standard applications available

- Price also is dependent on number of applications used, extra services, or amount of storage required

- Require center to detail in writing all costs involved, as it is not uncommon for services in total to run several thousand dollars per month

- Ownership of programs by service center

- Inefficient use of on line terminal can substantially increase your monthly bill

- Mistakes you pay for

2. Batch Processing - Service Bureau

<u>Costs</u> - Pickup and delivery - sometimes included
Per item charges - $.10/item
Supplies
Monthly minimums per application - $100 and up

-Programming setup can be paid at beginning or amortized over contractual period

-Ownership of programs can be yours if planning future growth

-3 applications can cost $10,000/year or less

-Per item charges allow for accurate growth costing and no runaway bills

-Mistakes in input preparation generally paid for by center

B. Rental of Excess Computer Time

-Run costs substantially less than service centers

-Input preparation yours

-Prices are per hour of wall clock time so that reruns will cost more dollars

-Rentals generally range as follows for hardware only

360/20	$ 26/hour
360/30	$ 75/hour
360/40	$115/hour
360/50	$200/hour
360/65	$475/hour

C. Joint Venture

Costs will be proportionate share of in-house system

D. In-house System

-Total costs will be 3 to 4 times equipment costs

(1) Small Unit Record Installation
$24,000 to $75,000/year

Personnel problems

(2) Small Computer 360/20, MH 120, Univac 1050
$85,000/year

Medium-sized Computer 360/30
$150,000 - $400,000/year

(3) Hardware Monthly Rentals

Small scale systems

(a)	Minimum capabilities Card systems	$1500-2500
(b)	Tape/Disk	$2500-5500

Medium beginning system (360/30, MH 200, RCA 35, Univac 9300) $5500-15,000

SHIFT IN DATA PROCESSING EQUIPMENT COSTS*

	1963	1973
Main Frame and Memory	53%	21%
Data Files	21%	13%
Input/Output	12%	13%
Comm. Lines & Equipment	14%	31%
New Functions: Private Voice Comm, Image Files, Displays, Graphic Input/Output	0%	22%

*Harvard Business Review, 1965

TRANSPORTATION

a. Introduction

by
Cromwell E. Thomas
Assistant Professor in Engineering
Wilkes College

This is the second session of the Wilkes College Penntap Seminar on Computers as applied to business and industrial organizations. This transportation seminar will deal with such problems as route accounting, bus scheduling, maintenance scheduling, freight billing, and general problems in the area of traffic management, and therefore should be of interest to trucking companies, bus companies, dairies, and retailing and light industries. In addition, this seminar should be of interest to many of the local consolidated school districts which may have bus scheduling problems.

Many times, the most difficult part of using the computer system is in defining the problem properly. Certainly, one of the most important aspects in providing proper service is that of scheduling.

The scheduling must meet the customer's needs. For instance, a customer may not be able to accept goods on his loading dock before a specific time in the morning. Or, the driver may be unassisted and may have to depend upon the customer for aid in unloading and handling the material. In the case of a grocery store, the goods may have to be on the counters by a specific time. All of these problems, of course, are intricately involved in scheduling.

Another aspect of the whole problem is the routing. What is the best route? Is the best route the shortest route? Will the shortest route require the least time?

If a customer increases the size of his order, room must be made for this order somewhere on the truck. This means that some other customer's order must be removed from the truck. How can this best be accomplished? This might involve rescheduling.

An effort, of course, must be made to minimize transportation cost. This is the purpose for using the computer. From this partial statement of the problem, we embark on the Transportation Session.

b. Options in a Computer Program

by

Francis A. Schiegel
President
Management and Computer Services Corporation
Philadelphia, Pennsylvania

The distribution of products and services is a vital part of the service that an organization provides. More efficient use of available facilities for distribution can contribute significantly to profit. Computers have been successfully applied to a wide variety of functional tasks in business. The mechanization of basic phases of order entry is a typical example. More recently, attention has been paid to the scheduling of vehicles. There are quite a number of programs in actual operation that provide this type of service. We want to look into some of the problems involved, some of the limitations which must be set up, and the way in which these parameters may be combined in order to produce an efficient distribution system.

In most systems, with the possible exception of the school bussing problem, all outlets are probably serviced by vehicles operated from a central depot. Most of the trips the vehicles make probably involve more than one call. The vehicles probably return to the same depot after a final call. We can also presume that the quantity of goods to be delivered at any single stop is less than the size of the vehicle used. Our problem then involves fitting a list of calls to a number of vehicles, so that the route of each vehicle is well defined by the sequence of calls assigned to it. The main objective is to produce that schedule which uses the fewest possible vehicles by: first, allocation of loads and mileage of each vehicle; and, secondly, establishment of work standards. The basis for this is that the generally fixed costs associated with the running of a vehicle fleet - wages, rent, insurance, and so on - which are all independent of mileage traveled usually grossly exceed the operating costs, i. e., fuel, tires, maintenance, depreciation, and so on.

A few slides will be used to illustrate some of the problems that arise, although the problems obviously vary between companies, even those within the same industry. Since their policies and order cycles are very different, the pattern of distribution is also very different. Some industries control most of their outlets, and can thus dictate the day on which orders should be placed and deliveries will be made. However, many manufacturers, distributors, and service organizations have a vast number of customers with little or no control over their order pattern, except that the traveling salesman can call on specific days and take orders. The problem is even more varied when finite detail is considered, e.g. some of the vehicles may be divided into compartments, or there may be a great diversity in vehicles, in size, capacity, weight, or volume.

Transportation problems may be extremely varied, but the solutions required are the same in that the aim is to minimize the number of vehicles required to meet the pattern of delivery.

Usually routes must be very quickly established. Frequently, there is little time to determine the routes which a truck will take. A computer used in route scheduling would probably take a half hour to an hour to provide this type of information, depending on various factors. IBM has come up with a vehicle scheduling program that will run on a 360-25 in which many of the problems raised are answered. In many instances, the problems appear almost insoluble. For instance, we must know something about the customer's loading facilities. Is a side loading or an end loading truck required? Is there enough room to put a trailer in and not block the street? Are there other things that might make it difficult? Is conjestion such that the driver is going to be held up for a period of time in attempting to make a delivery? There are needs for new routes. The problem of availability of equipment is also a serious problem.

As we begin to look at all these problems that must be solved in order to establish an efficient and profitable distribution system, it is evident that the options fall into two categories: customer option and fleet operator or route option.

Customer options are dictated by the customer purchasing the service. The customer may have a specific time or range of times during which a delivery must be made. Certain areas where the customer is located require that there be no night loading, restricted parking hours, or residential noise laws. Deliveries normally require time in addition to unloading and loading, for activities such as parking, weighing, and paperwork, at the customer's location. There might be vehicle limitations at specific calling points. Related to the customer's location are low underpasses, municipal laws determining the maximum vehicle size for a zone and the type of vehicle entering that zone. Many times assigning a particular type of vehicle may cause a larger than necessary vehicle to travel the route, and yet the option can be quite useful as a method for maintaining a desired driver to customer relationship. The program should have some method for directing the general path of delivery in order to take into account such restrictions and factors.

The program should also include options for a number of parameters determined by the fleet operator or the route requirements. There are different types of vehicles with different capacities and different average vehicle speed. Consideration must be given to the earliest possible starting time and the latest possible finishing time or stated days, hours, and minutes for the entire fleet. No week will start before or end after specified times. These, of course, must also include considerations of meal time, rest breaks, or night breaks, overnight breaks, multiple day journeys, and so forth. A method for controlling overtime, and allotting work times equitably must be provided. The driver's time should be scheduled in such a way that it is as evenly distributed as possible, and such factors as adverse weather might cause a reduction in speed and hence a longer delivery time than calculated.

The specifications of a load unit is quite difficult. Usually weight and volume are stated. As an example, a trailer loaded with steel plate might have only 10% of its usable space occupied, whereas a trailer loaded with cases of ping-pong balls might be jammed to the ceiling and not reach its load rating. If all were computed strictly on volume, the steel load might fit easily into an assigned vehicle, but would probably exceed the practical and the legal weight limit of the vehicle. On the other hand, a load computed just on weight may hopelessly exceed the available space in the vehicle.

In those cases where an option such as this is not required for capacity considerations, it fulfills a number of other useful purposes. For example, one of the specifications per unit could be an average cost factor for load valuation, or a case count for control purposes.

These problems indicate that there is a need for these particular options in a computer program to provide you with an economical scheduling of vehicles.

c. School Bus Scheduling

by

Howard Fergueson
Vice-President
Education Division
Management and Computer Services Corporation
Philadelphia Pennsylvania

As in the study of any system, the primary question should be "What should I now be doing?" Your answer should be "Decide to act now."

The benefits of data processing must be analyzed, and in doing so, frequently benefits are realized which go far beyond the original purpose of the study. All areas of the operation should be reviewed. Perhaps some of them need not be automated. Frequently, a study for the purpose of providing info-mation for automation may actually show that all that is needed is a revision for an upgrading of business procedures.

The factors that contribute to the desire to convert any application to electronic data processing would be:

(1) high volume
(2) repetitive transactions
(3) interrelated variables
(4) quick response
(5) fairly elaborate mathematical calculations

And the normal benefits that we might expect should be:

(1) time savings
(2) cost reduction
(3) greater accuracy
(4) better customer service
(5) better control
(6) extension of business base
(7) new information

This information could be presented in the form of the sales analysis or cost analysis which would help management in the solution of the various problems that it meets. It could also be presented in the form of financial analysis or inventory management schedule, which would provide better control for the industry or business.

The primary requisite for setting up the parameters for a program and to assess the advantages of an electronic data processing schedule distribution or collection system would be a careful analysis of transportation costs. A study should be made of the number of vehicles used, the number of miles traveled, the route time, and of course, the cost of the transportation system. It is interesting to note that of the customer's dollar, 11¢ goes for transportation, and 1¢ for profit. Hence, an improvement in the transportation of approximately 10% would mean that the profit would be increased immensely.

In the IBM system for vehicle scheduling, the program consists of two basis parts. These may be run either independently or in conjunction with each other. The first of these is network analysis and the second is scheduled production. Network analysis determines the distance and traveling time between each pair of potential delivery points. However, the resulting file is then reduced to contain only those sets of pairs that represent practical conbinations of deliveries. And the final output is sequenced so that the pair with the largest savings obtainable by placing both deliveries on the same vehicle is first. This file is referred to as the "savings file" and becomes input to the schedule production.

The input to the network analysis portion of the program may be of several types. Two most common are called "true distances" and "coordinate" system seems to be the most desirable. It gives the cleanest and quickest answers to the solution of a routing system. However, there are a number of difficulties not immediately apparent. For one thing, the coordinate system yields only an approximate distance, whereas the "true distance" method will give an exact distance traveled and actual road distances between points, so that unique speeds can be specified for each link in the network if so desired.

The "coordinate method" utilizes coordinates to define each location and assumes the existance of a grid, which is used as a basis for the distance calculations. A grid can be laid as an overlay on a map, and the grid intersections used to determine the coordinates. Coordinates may also be used to describe barriers through which no path exists, such as a river in which no bridge in the immediate vicinity exists. or conjested areas in which a lower average speed should be used. While data gathering for the "coordinate" method is simpler, greater accuracy is obtained through the use of the "true distance" method.

The "true distance" method, as the name implies, uses input consisting of actual distances over known roads. The key words in this method are point, node, zone, and link, as we have previously defined them. In network analysis, the "true distance" method is oriented toward a relatively static geographic situation, where a high degree of accuracy is desirable. Location of existing customers and of potential future customers is necessary. This approach lends itself to situations where network analysis will be re-run infrequently.

In order to reduce the size and complexity of a network, the area should be thought of as a series of nodes including when practical more than one customer and delivery point. Zones that are too large may lessen the efficiency of the network. Points together with the actual distances between the points are the basic input. As an option the individual speed for each link can also be stated. Thus a statement of time as well as distance for each link can be given for any degree of accuracy desired. Known bottlenecks as well as posted speed limits can be indicated for consideration in the schedule produced. Alternatively, speed can be considered as an average for the network, and given as input in the schedule position.

A map of sufficient detail must be used to locate all customers. If it is used in conjunction with other maps, it should be of compatible scale. Both actual and potential customers must be located on the map. In setting up a schedule, a number of points must be defined on the map. The network of several intersecting roads and linking roads can then be shown on the map. A node is an intersection or junction of roads, and a link is a section of road joining two other roads. A zone is a closeknit area in which the deliveries may be made and within which traveling distances is negligable. This may be a town, a portion of a city, a shopping center, and so on. The diagram shows that the links are the shortest connections between these nodes. A path is a combination of links, in order to go from one node to another.

It is possible to insert many options into the scheduling program. Some of each were mentioned earlier - such as, the limited or specific calling times per stop, special time for individual calls, delayed pickups, expected delays. For instance, in school bussing, a crippled student might require more loading time than the average student requires.

In the area of school bussing, the problems are somewhat complicated. The following is a statement of safety rules proposed by David H. Soule, Chief, School Bus Safety Division, National Highway Safety Bureau. He states that good routing is based on safety, efficiency, and economy. He therefore recommends the following rules:

(1) Routes should begin at the periphery of the district or attendance area and follow the shortest and safest way to the school.

(2) Bad road conditions and heavy traffic should be avoided.

(3) Routes should include as many dead head miles as possible, in other words, miles over which no loading or unloading of children is necessary.

(4) Routes involving railroad crossings, narrow bridges, steep hills and so forth should be traversed with as small a load as possible.

(5) Busses should make multiple trips, i.e. pick up children on one route, deliver them to school then run a second and maybe a third route.

(6) The number of stops for loading and unloading should be minimized.

(7) Routes should be equalized in terms of miles for the sake of even depreciation of the fleet and a regular pattern of replacements.

(8) No two busses should go over the same road except when deadheading; this minimizes the chance for children to ride any bus that comes along, thereby overloading one while another bus runs nearly empty.

(9) Pickups on four lane highways and other heavily traveled roads should be made on the resident's side of the road.

(10) Expressways should be used for express routes and deadheading only.

(11) Routes should avoid private roads, dead end roads, and trailer camps.

(12) No state laws or Department of Education policies should be violated.

(13) Under certain circumstances feeder units should be used, i.e. cars, station wagons, or small busses for transporting children over roads inaccessible to large busses.

He further states that it is difficult for the transportation supervisor to adopt these practices without some sort of system that allows him to change routes in minutes instead of hours or days as is often the case. Under the manual approach, routes may become patched to the degree that they no longer satisfy the fundamentals of safety or economy. The manual routing system cannot absorb changes rapidly without sacrificing route balance, cannot control large numbers of vehicles and drivers while retaining enough flexibility to apply variable operating conditions down to the individual stop, road link, or vehicle level.

As in the use by commercial houses for scheduling and routing of trucks, the school bussing counterpart can be set up in the same manner. For instance, a customer might be called a bus stop, a delivery would be a bus stop for unloading, a fleet would be a group of school bussing vehicles, order quantities might be a number of students at a bus stop, an outlet might be a bus stop, and so on.

The stop options would be similar, e.g. limited calling time per stop, traffic flow, one-way street restrictions, specified route direction, or the arrival time of students to the bus stop. If used in the sense of having more than one start time, multiple schools may be scheduled on one computer run. Using this type of an option in the scheduling program, schools would control the types and sizes of vehicles assigned to their particular stops. Special vehicles might be assigned to handle mentally retarded or crippled children. Difficult access might require vehicles of special types or capacities as in the case of limited capacity bridges, troublesome road surface, or local travel restrictions.

Considerations such as decreasing the number of children at a stop, might result in the using of fewer vehicles. For example, if the average number of children assigned per stop is 25, a bus with a capacity of 60 could make only two stops and would have ten empty seats. If the number per stop were reduced to ten, the bus could make six stops and would be fully loaded. Decreasing the average number of children per stop also reduces the likelihood of misbehavior and mishaps at the stop. This decrease means more stops, which means the fleet and the children are on the road for a longer period of time. Therefore, some kind of trade-off would have to be made considering the total effects.

The computer can work very quickly. The answer will come back rather rapidly, almost as soon as the programmer finishes inserting the data. The most economical route for delivering materials to the stops shown on the map can very easily be indicated.

We see that the problem of school bussing can be made to operate on a system devised for other types of vehicle scheduling. As a matter of fact, IBM Corporation has come out with a school bus scheduling program which will take into consideration many of the requirements of the school people. Comparative costs have been reviewed with you.

We hope that this Seminar has provided you with enough information so that you may now have some questions which you would like to have answered.

ORIGINATION OF TRAFFIC

DAILY TERMINAL BUSINESS REGISTER

Terminal	Code	Shipper	Originated Traffic		# Shipments	Connecting Line Traffic	
			Weight	Revenue		Weight	Revenue
19		PIONEER INC	1040	17.51	3		
19		PITNEY BOWERS	434	9.70	2		
19		PITT MFG CO			1	368	1.75
19		PITTSBURGH STL			1	30727	92.61
19		POKOM SHOE STO		3.00	1		
19		POLAROID CORP			1	59	1.20
19		POMONA TILE MF	50	5.95	2		
19		POWER CURVE			1	200	2.54
19		POWER M EQUIPM	100	2.95	1		
19		POWER EQPT CO	725	5.96	2		
19		PRANE LAB		3.00	1		
19		PRANE LABS		8.90	3		
19		PRATT LAMVERT			1	380	2.21
19		PRECISION PART	3251	56.52	3		

CONSOLIDATION BY TERMINALS

PERIOD SHIPPER ANALYSIS

Terminal	Code	Shipper	Originated Traffic		# Shipments	Connecting Line Traffic	
			Weight	Revenue		Weight	Revenue
20	7196	SHEPARD ENGINEERING	342	6.08	2		
			342	6.08	2		
05	7199	SHEPERD WARNER ELEV	217	6.29	1		
			217	6.29	1		
02	7203	SHERWIN WILLIAMS CO	24833	357.05	54	1012	6.92
03	7203	SHERWIN WILLIAMS CO	40	3.00	2	130	1.41
04	7203	SHERWIN WILLIAMS CO			1	410	3.12
09	7203	SHERWIN WILLIAMS CO	1040	11.03	2		
14	7203	SHERWIN WILLIAMS CO	1325	6.94	2		
17	7203	SHERWIN WILLIAMS CO	11036	164.61	7	260	2.34
19	7203	SHERWIN WILLIAMS CO	1982	20.91	16	33482	146.17
21	7203	SHERWIN WILLIAMS CO	50	3.50	1		
22	7203	SHERWIN WILLIAMS CO		5.05	2		
			40406	571.09	87	35294	159.96
05	7214	SHIPPING ROOM SPLIER	1915	54.25	18		
			1915	54.25	18		

SHIPMENTS BY TRAFFIC LANE

DAILY REVENUE AND TONNAGE

DATE: 10/01

TERMINAL FROM	TO	NUMBER OF SHIPMENTS TOTAL	LTL	TL	WEIGHT TOTAL	LTL	TL	REVENUE TOTAL	LTL	TL
PGH	JER	297	280	17	593,607	369,737	223,870	7,946.14	3,933.54	4,012.60
PGH	ELM	489	485	4	449,026	390,792	58,234	6,293.17	5,493.07	854.10
PGH	PHL	495	488	7	499,840	356,828	93,012	7,920.06	6,806.84	1,113.22
PGH	DCA	395	393	2	245,789	211,608	34,181	5,270.64	4,678.23	592.41

COMPARISON OF TONNAGE BY MONTH AND YEAR

CUSTOMER BY TERMINAL

CUSTOMER NAME	TERM	S'MAN	CURRENT SHIP	CURRENT MO TONNAGE	PRIOR MO TONNAGE	SAME MO PRIOR YR	CURRENT YR	PRIOR YR
ABERFOYLE BELMONT	02	04	123	128071	120883	175455	1452904	1283261
ACHESON DISP ORANGE	02	14				32649		84382
ACME SPINNING BELMONT	02	04	71	290345	152473	123169	2134013	1240975

TRAFFIC DATA BY CONSIGNEES

SALES ANALYSIS

☐ Shipper
☒ Consignee

Period Ending 10/31

	# of Shipments				Weight				Revenue			
NAME	This Period	YTD	Last YTD	% Change	This Period	YTD	Last YTD	% Change	This Period	YTD	Last YTD	% Change
A&B MFG.	22	141	44	221	14,160	98,026	33,456	193	186.10	1,327.72	368.81	260
ABBOTT CO.	46	293	187	57	18,424	139,262	257,892	46-	3,840.79	7,847.43	9,342.18	16-
ALLEN SCREW	33	449	416	8	36,117	223,729	211,065	6	8,612.41	21,075.53	18,817.44	12

TRAFFIC ANALYSIS BY SALESMEN

SHIPPER ANALYSIS BY SALESMAN

SALESMAN CODE 121 PERIOD ENDED 1/18/66 WITH YEAR TO DATE

TM	CUST #	ACCOUNT NAME	ACCOUNT CITY	SHPS	PER TON	PER REV	YTD SHPS	YTD TON	YTD REV	REV PER SHIP	YTD ENTR
1	127	PIONEER INC	ELIZABETH	13	2,031	37.89	13	2,031	37.89	291/ 291	
			TERMINAL TOTAL	13	2,031	37.89	13	2,031	37.89	291/ 291	
2	340	PITNEY BOWERS	TRENTON	3	1,173	17.90	3	1,173	17.90	597/ 597	
2	131	PITS MFG		260	92,949	1,800.46	260	92,949	1,800.46	692/ 692	
2	359	MORGAN BROS		2	291	8.30	2	291	8.30	415/ 415	
2	343	ABC INC									
2	346	CONNELLY CO		4	5,133	91.62	4	5,133	91.62	2291/ 2291	
2	353	PRICEMEN		3	36,682	173.50	3	36,682	173.58	5786/ 5786	
2	356	WAYNE & CO		12	3,932	106.06	12	3,932	106.06	884/ 884	
			TERMINAL TOTAL	284	140,160	2,197.92	284	140,160	2,197.92	774/ 774	
4	171	FORRESTER	NEWARK	41	66,829	965.38	41	66,829	965.38	2355/ 2355	
4	102	JACK & JILL		106	83,752	1,033.12	106	83,752	1,033.12	975/ 975	
4	128	GORDEN INC		3	464	9.00	3	464	9.00	300/ 300	
			TERMINAL TOTAL	150	151,045	2,007.50	150	151,045	2,007.50	1338/ 1338	

PROFIT BY CUSTOMERS

S H I P P E R   R E P O R T

SHIPPER NAME	ORIGIN CITY	ORIGIN STATE	TRIPS	GALLONS	ACTUAL REVENUE	MINIMUM STD REVENUE	PROF %
ABC	FINDLAY	OH	4	23,641	$ 238.76	$ 223.84	6.7% *
CDE	TOLEDO	OH	3	19,000	189.00	113.60	66.4% *
EFG	FINDLAY	OH	45	115,650	3,857.83	2,862.72	34.8% *

NEGATIVE PROFIT BY TRIPS

UNPROFITABLE LOADS FOR THE MONTH

SHIPPER NUMBER	SHIPPER NAME	ORIGIN CITY	ORIGIN STATE	TANK #	WGT BILLED	TRIP HRS	ACT MILES	DESTINATION CITY	DESTINATION STATE	ACTUAL REVENUE	MIN STD REVENUE	% PROF
205	ABC	CLEV	OH	190'	6304	5.75	125	YOUNGSTOWN	OH	58.00	58.94	1.6-
205	DEF	CLEV.	OH	1901	6304	5.50	127	YOUNGSTOWN	OH	58.00	58.23	.4-
205	GHJ	CLEV	OH	1965	6315	6.00	121	YOUNGSTOWN	OH	58.10	59.28	2.0-

FREIGHT BILL

STAPLE HERE

LOCATION ____________

INITIALS - DATE - ORIG. TERM. | COMMOD. | PRO. NO.

SHIPPER

SHIPPER'S NO.

CONS.

NO. PCS.	DESCRIPTION	WEIGHT	RATE	CHARGES

· MUSHROOM-KEYSTONE
P. O. BOX 9551
PHILADELPHIA, PA. 19124

UNIT #

ORIGINAL FREIGHT BILL

ORIGIN CARRIER	PRO. NO.	DR.	CR.	DELIVERING CARRIER	AT	DR.	CR.

RECEIVED IN GOOD CONDITION
PER

DELIVERED BY ________ DATE ________ COMPANY NAME ________ RECEIVER NAME ________ DATE ________

DAILY REPORT OF FLOW AND FREIGHT MIX

DAILY REVENUE AND TONNAGE REPORT DATE 10/01/__

TERMINAL		NUMBER OF SHIPMENTS			WEIGHT			REVENUE		
FROM	TO	TOTAL	LTL	TL	TOTAL	LTL	TL	TOTAL	LTL	TL
PGH	JER	297	280	17	593,607	469,737	223,870	7,946.14	3,933.54	4,012.60
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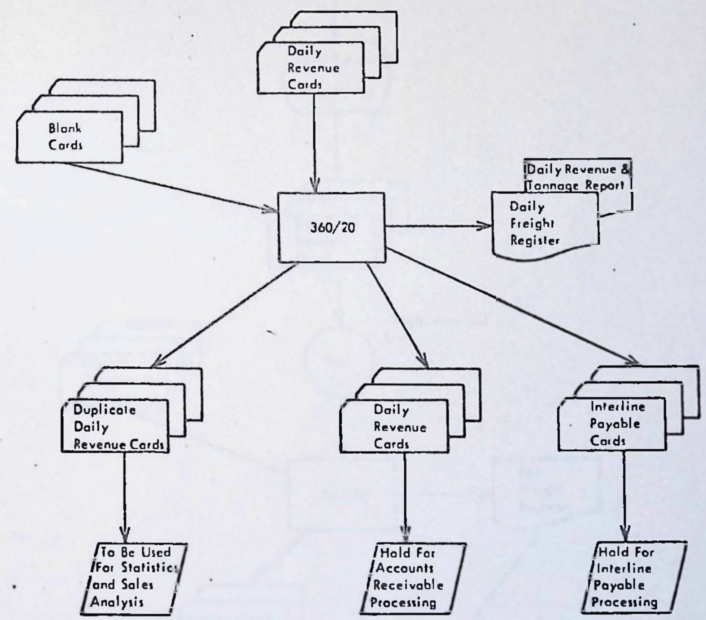
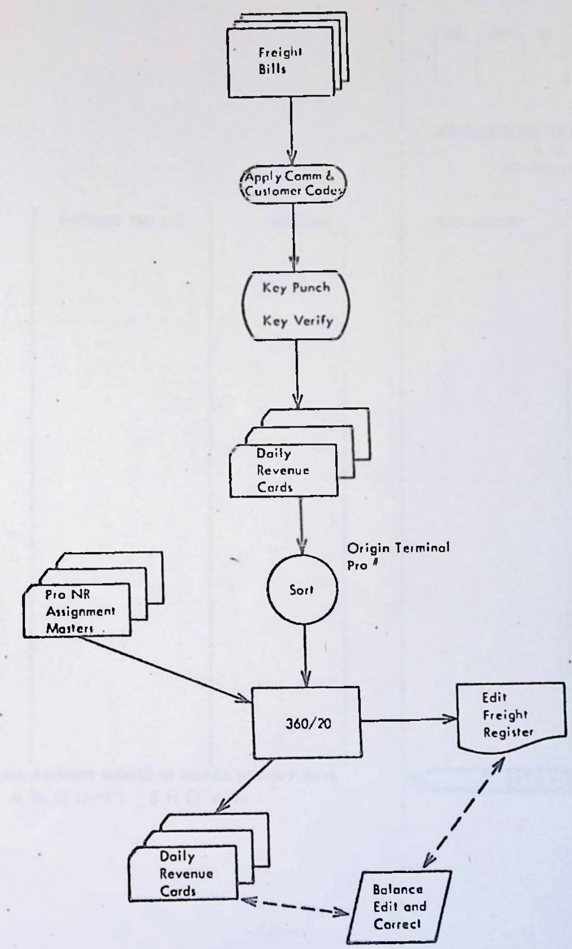
PGH	DCA	395	393	2	245,789	211,608	34,181	5,270.64	4,678.23	592.41

DAILY FREIGHT REGISTER FLOW



DAILY REVENUE EDIT FLOW



INVOICE

Please make your check payable to:

MUSHROOM TRANSPORTATION CO., INC.
P. O. BOX 9551 • PHILADELPHIA, PA. 19124
PARENT CORP. OF KEYSTONE EXPRESS & STORAGE CO., INC.

STATEMENT DATE

MO.	DAY	YR.

PRO DATE	PRO NUMBER	INTERLINE PRO NO.	AMOUNT

TO COMPLY WITH I. C. C. REGULATIONS, PAYMENT SHOULD BE MAILED WITHIN 7 DAYS

PAY LAST AMOUNT SHOWN

FOR PROPER CREDIT
DETACH & RETURN
STUB WITH CHECK TO:

MO.	DAY	YR.

MUSHROOM TRANSPORTATION CO.
P. O. BOX 9551
PHILADELPHIA, PA. 19124

PRO NUMBER	AMOUNT

DETACH HERE

ROAD DRIVERS WEEKLY PAY SUMMARY

ROAD DRIVERS' WEEKLY PAY SUMMARY

NAME ______________ Local No. ______ Week Ending ______

I. B. M. Code ______

THROUGH RUNS

Date	From	Trac. No.	Trlr. No.	To	To	Trlr. No.	Mileage	NYS Miles	P/U Time	Del. Time	Tire Time	Bkdn Time	Hook Up	Waitg. Time	Lay-over Time	Layover Chgs. 14 hrs.	Layover Chgs. 16 hrs	Trip Exp.	Misc Exp.
TOTALS --																			

(show no. of hrs. in time columns) — EXPENSE ITEMS

PAY SUMMARY:

Mileage	______	miles @	______	= $ ______
P/U or Del'y.	______	hrs. @	______	= ______
Tire Time	______	hrs. @	______	= ______
Breakdown Time	______	hrs. @	______	= ______
Hook Up Time	______	hrs. @	______	= ______
Waiting Time	______	hrs. @	______	= ______
Layover Time	______	hrs. @	______	= ______
Holiday Pay (slip attached)	______	hrs. @	______	= ______

EXPENSE ITEMS:
(to be paid from G.O.)

Trip Expense $ ______
Layover Chgs: 14th hour ______ 16th hour ______
Miscellaneous: ______
(explain & att. receipt) ______
Total Exp. $ ______

If any cash is disbursed at term., explain in 'remarks'

TIRE TIME (Check one)
Changed By: ______ (driver) ______ (outside garage)
If Outside Garage: ______ (name) ______ (charge)

REMARKS

This Report Prepared By:
______
(signature)

GROSS PAY $ ______

DEDUCTIONS

FICA	W/H Tax	Local Tax	State Tax	Contributions	Hosp.	Bonds	Union Dues		
		NET PAY --- $							

ITC 201 (5/67)

RETAILING

a. Introduction

by

Betty L. Jahr
Instructor in Mathematics
and Computer Science
Wilkes College

The computer seminar on retailing will deal with such problems as merchandise control (unit control and dollar classification control), accounts receivable, accounts payable, sales audit, and other pertinent problems. This particular seminar should be of interest to any of the reasonably large retailing operations in the area, including department stores, speciality shops, and furniture stores, to mention just a few.

The most important objective of data processing is to provide customers with the merchandise they wish to purchase.

For the retail shop owner or the department store, the two problems that flow from giving the customer what he wants are choosing the merchandise and maintaining a balanced stock.

System Advantages are too numerous to mention, among them are the following:

1. Through simulation - determine the effects of alternate management policies
2. Advanced forecasting - allow for trends, seasonal fluctuations, etc.
3. Automatic signaling and correction to significant variations of item's sales patterns
4. Constant monitoring of stock level, inventory investment and sales
5. Creation of store performance reports for each department and location
6. Maintain inventory in proper balance in response to management policy
7. Proper vendor lead time control
8. On-order control

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The techniques of simulation, by which the effects of possible alternatives are indicated to management, and forecasting, by which future sales, (including safety stock) can be estimated, are available to progressive department store management.

From this short introduction, let us now hear from Mr. Ferguson.

b. Retailing

by
Howard Fergueson
Vice-President
Education Division
Management and Computer Services Corporation
Philadelphia, Pennsylvania

Let me describe a modern store which has developed a highly effective system using punched card data processing equipment. All information entering the system is checked and balanced. The system provides historical data as a means of comparing store performance from year to year. The emphasis in the system is on control. Sophisticated equipment was used in accounts receivable, dollar inventory control, sales analysis, payroll, and accounts payable. By careful planning and efficient operation of the system, an economical and effective approach can be developed for information and control.

Merchandise reports and records are used by retail management to maintain balanced stocks, improve turnover of profitable items and decrease the necessity to mark down merchandise. These general but vital objectives are being accomplished through the use of Data Processing showing activity in detail and supplying (1) historical records for the buyer; (2) broader classification and price line reports for the merchandise manager as well as the buyer; and (3) "open to buy" statistics for the buyer, merchandise manager and controller. All of this information is originally obtained from the same basic source, the price ticket.

A system of Merchandise Control using the Ticket Converter can be used. The Punched Price Ticket is designed to serve two basic purposes: (1) it fulfills all the normal functions of a price ticket; and (2) it contains information, in the form of punched holes, which enables the ticket itself to be a source of information. This ticket may be prepared with from 2 to 6 stubs, depending upon the requirements of the individual store or department.

A single stub, when processed through the Ticket Converter, produces a punched card which contains all of the information stored in the price ticket, plus whatever additional information of a fixed nature is desired. This conversion from ticket to card is accomplished at a rate of 6,000 cards per hour, completely punched and verified.

Some of the outstanding features of this method are:

1. Preparation of punched price tickets is accomplished

in the same manner as preparation of conventional price tickets.

2. Unit stock records can now be mechanically posted, giving the buyer an up-to-date, accurate historical record.

3. Merchandise reports for the various levels of management can be prepared from the same cards which prepare the buyer's records. These reports can be specific or general in nature as desired, and can be scheduled to be received when they are most meaningful.

4. Merchandising decisions based upon more complete and timely merchandise information will enable stores to operate more profitably.

5. Merchandise control through IBM punched cards can be installed in logical steps over a projected period. In this way, training and experience can be obtained and investments made in equipment only as required.

The Print Punch Marking Machine is a dial-set punch marking machine operated with the same ease and speed that has been offered in the marking equipment prior to the adding of punched holes.

Naturally, the procedure to be adopted will depend on the scope of the merchandise control job to be performed and the setting of the machine. Assume that a two-part price ticket is to be hung on the garment when it is displayed on the selling floor. When incoming merchandise has been checked in and received at the marking room, a three-part Dennison ticket is prepared.

The three-part salescheck used by Hamburgers contains the basic information required by the data processing operation. The original or first copy is for processing, the second part is the customer's receipt, and the third part is retained by the salesman or used for C.O.D. shipments.

Salescheck processing provide information to four areas:

1. Unit sales reporting
2. Comparative sales reporting and dollar inventory control
3. Accounts receivable
4. Payroll

1. Unit Sales Reporting

Each salesperson turns in a tally sheet listing all sales, and the original copy of each completed salescheck. These original copies are reviewed and arranged in sequence by salesperson number. The original copy of the salescheck is used as a source document to punch a salescard for each item sold, and a card for the tax and total amount of the salescheck. The individual salescards for each item sold are used to prepare the daily Sales Report and filed for the preparation of the Sales and Inventory Report. Customer returns can be handled in several different ways. Where a two-part price ticket is displayed, returned merchandise is re-marked before being displayed for resale.

The tally sheets turned in by the sales people are used to prepare a handwritten sales-by-employee flash report within each department. This report includes the date, department, salesperson number and name, and the number and dollar value of sales.

At the time the price ticket is attached to the item, a third stub is detached and sent to the data processing department. These tickets are processed through a Ticket Converter and stock record cards are produced bearing a transaction code indicating a receipt. A daily Receipts Register is prepared and used for a daily Sales Report. The stock record cards are then filed to be used in preparing the weekly Sales and Inventory Report.

The Stock Record Card and the Weekly Sales and Inventory Report indicate two methods of showing sales and inventory. The preparation of either necessitates combining all sales, inventory, on order, last summary, and miscellanious transaction cards. In the case of the Stock Record Card, a single summary card can be prepared for each style, color, class, etc. of an item. It is merged ahead of the corresponding Stock Record card and posted on the line representing the week being posted. It is apparent that in certain cases some items will not have activity in any given week. This inactivity will be reflected by a blank line, which is very significant to the buyer and will stand out by being blank.

To prepare a Sales and Inventory Report, it is necessary to punch cards for orders placed and also for miscellaneous transactions such as transfers, returns to vendors, order cancellations, etc. Where a Sales and Inventory Report is prepared all activity cards are sorted together with the last period's sales figures. Special reports, such as the Buyer's Guide, are prepared periodically or upon request from either summary cards or combines summary and detail cards.

The preliminary audit of the sales information ensures that:

- Line cards, one for each item on the salescheck, equal the total card for the entire salescheck.
- Flash reports of sales by salesperson within each department equal the total salescheck amount for each salesperson.
- Commission cards equal the line and total cards.

This processing checks the addition on each salescheck, verifies the punching, and provides an audit trail in addition to control totals for subsequent operations.

The line cards are separated from the total cards, and are used for sales analysis and to provide price and class information.

The final control report is generated from the salescheck total cards. The report contains totals, by store, for:

- Parcel post charges
- Alteration charges
- Price adjustment
- Sales tax
- Employee discounts
- Total charges
- Charge credits
- Cash
- Cash credits
- C.O.D.
- C.O.D. credits

The control totals on cash, charge, and C.O.D. transactions are further substantiated by detail listings. In addition, cash register tapes are collected, the totals punched into cards, and the totals are balanced to those on the final control report.

The final balanced control figures are referred to in accounts receivable, sales analysis, and payroll processing.

2. Comparative Sales and Inventory

This daily report consists of two parts. The first is a month-to-date report of sales by department arranged in class sequence within the department. The second shows the change in sales between the date of the report and the equivalent date last year for comparison. Both are strategically important for inventory control.

The monthly unit sales report can provide unit sales information by class and price. It shows sales within each store for each merchandise class. Each class is shown in various dollar categories based on the needs of the buyer.

The dollar value inventory report is prepared from the month-to-date file and the year-to-date file. This report can include:

- Inventory at retail
- Cost of goods on hand
- Transfers in
- Sales year-to-date
- Discounts and markdowns

The report can be prepared in three ways:

- By class with each store
- By store within each class
- By class within all stores

3. Accounts Receivable

Credit account activity (charges, credits, and payments) are processed with close attention to the totals on the control report. Charges and credits are manually inserted in the combined name and address file. The account number is then punched into the activity cards. The Sorter is used to separate the budget and regular account name and address cards and the charge account activity cards.

Cards reflecting charges and credits are merged with the cash payment cards and the balance-forward cards for regular 30-day accounts. This combined file is matched against the name and address file for regular accounts. Matching activity, name and address, and balance-forward cards are held for regular account processing. The unmatched activity and balance-forward cards are matched against the budget account name and address cards in a similar fashion.

As a result, all charges, payments, credits, and balance-forward cards are separated into two groups, budget and regular accounts, which are processed separately. Any unmatched activity or balance-forward card is separated from the file by a Collator, and is quickly checked, investigated and corrected.

The aged trial balance format is a comprehensive presentation of customer accounts that can be used in many ways:

- Accounts in arrears are immediately identifiable.
- Account activity - payments, charges, credits - are detailed.
- Zero balance accounts are included as credit references.
- Payment can be manually posted daily, with adjustments to totals balancing to daily deposits.
- Telephone inquires pertaining to account numbers, payments, and the correct balancing to be easily answered.
- Budget and regular 30-day accounts are identifiable by codes.

Payment processing may involve a multi-column card and a stub. The customer may be requested to retain the stub and return the statement with his payment. The statement cards are reproduced into cards with the amount paid, which are balanced to the cash register tape prepared by the accounts receivable clerk handling payments and then used to update the balance-forward cards.

Payroll Processing

Many different compensation plans can be handled in payroll processing:

- . Salary
- . Salary and commission
- . Commission
- . Hourly
- . Hourly and commission
- . Commission with draw, including arrearages
- . Extra commission

Four basic cards are used for each employee:

1. Payroll master card, containing employee name and number, method of compensation, rate, Social Security number, and other basic information.

2. Current earnings card, prepared from time sheets and/or commission reports

3. Deductions card

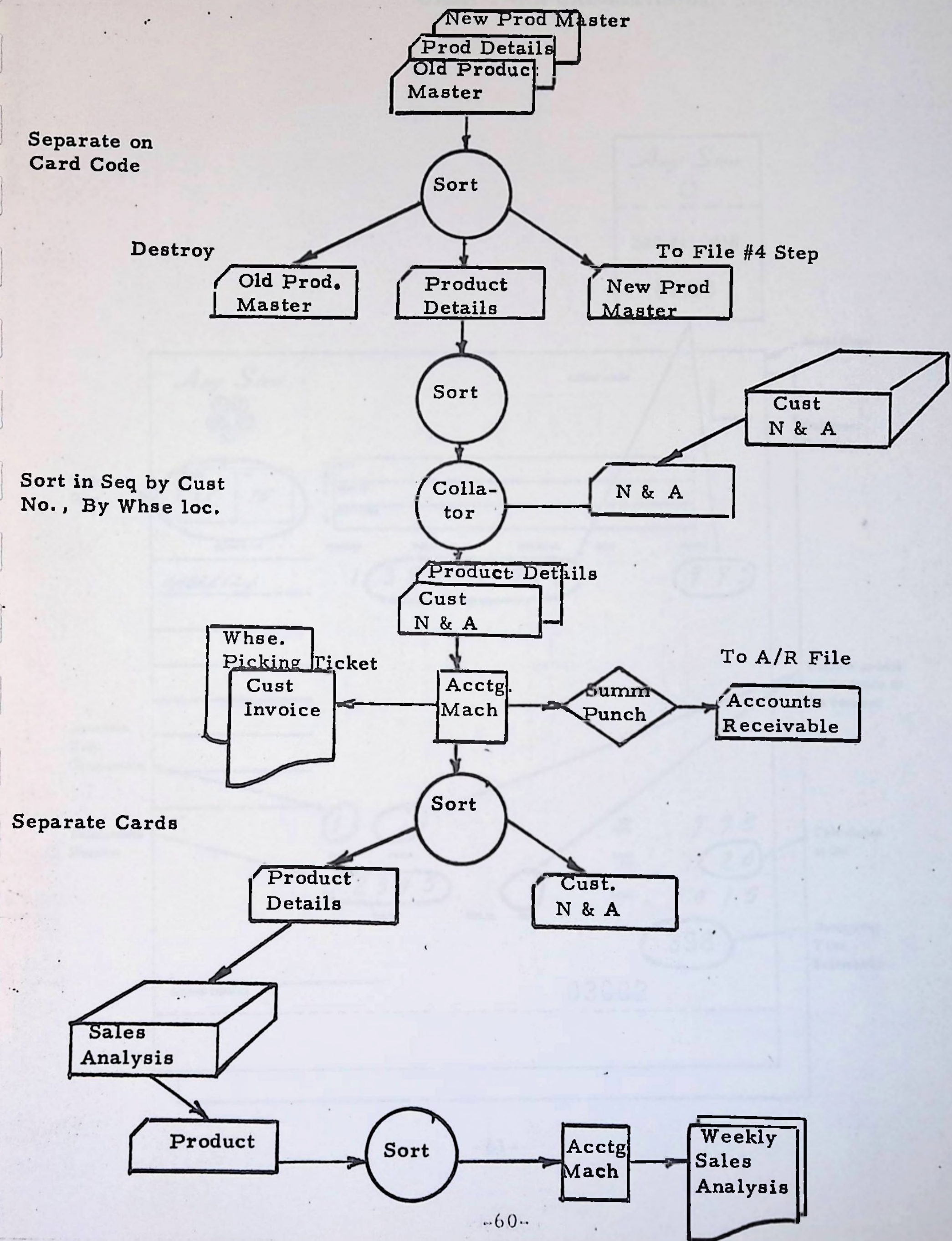
4. Year-to-date card

The payroll register is prepared using all four cards. At the same time, a new year-to-date card is punched. After the payroll register is reviewed, the pay vouchers or checks are prepared using the payroll master, current earnings, and deductions cards.

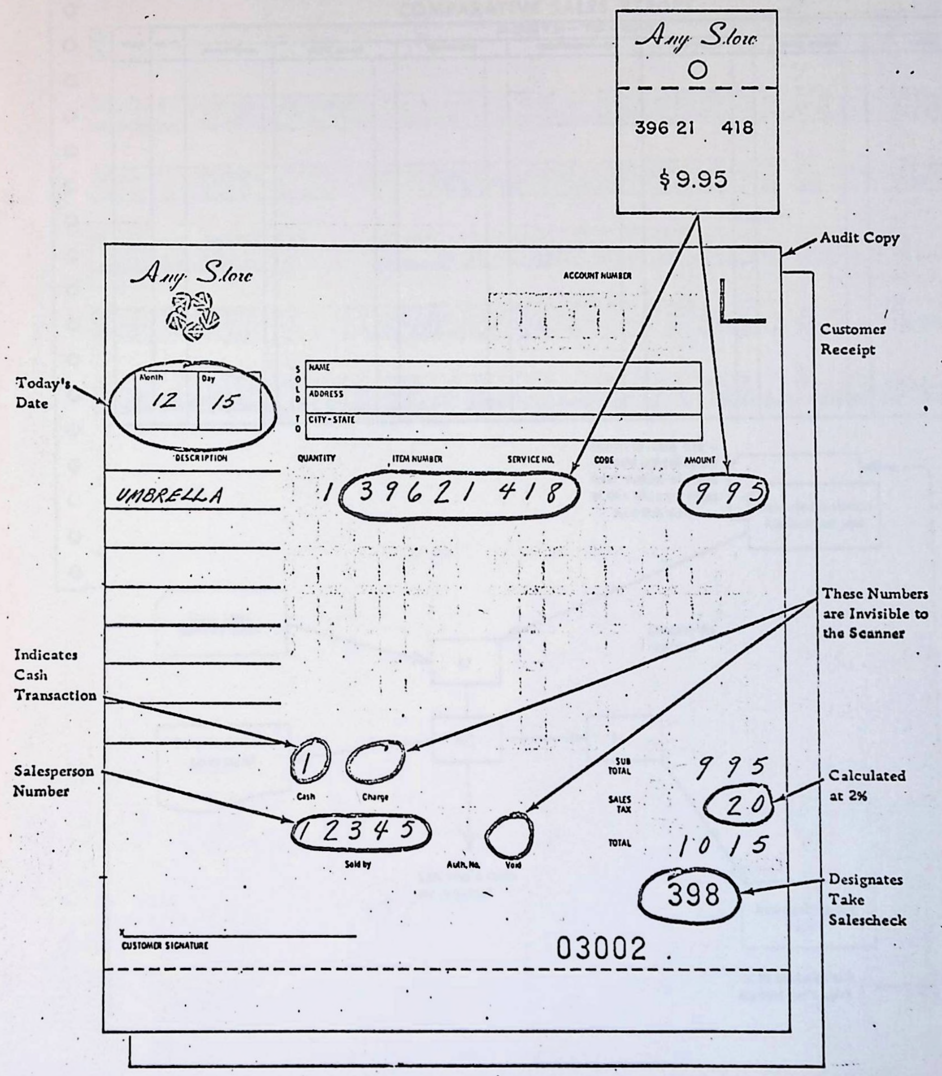
Although the frequency and content of reports vary with organizations and individuals, the versatility of punched cards provides a tailor-made set of reports and records for each company. The preceeding illustrations cover some of the basic requiremtnts and are shown to suggest what types of reports can be prepared. Daily sales reports show customer buying trends and changes in consumer demand. Stern analysis can easily be added as can unit and dollar analysis of returns. Such a report might well be prepared weekly or semi-weekly should an individual store's requirements so dictate.

We are now ready to go into specific questions as they relate to your particular business. After lunch we will continue the question and answer period on retailing and General Business applications of data processing.

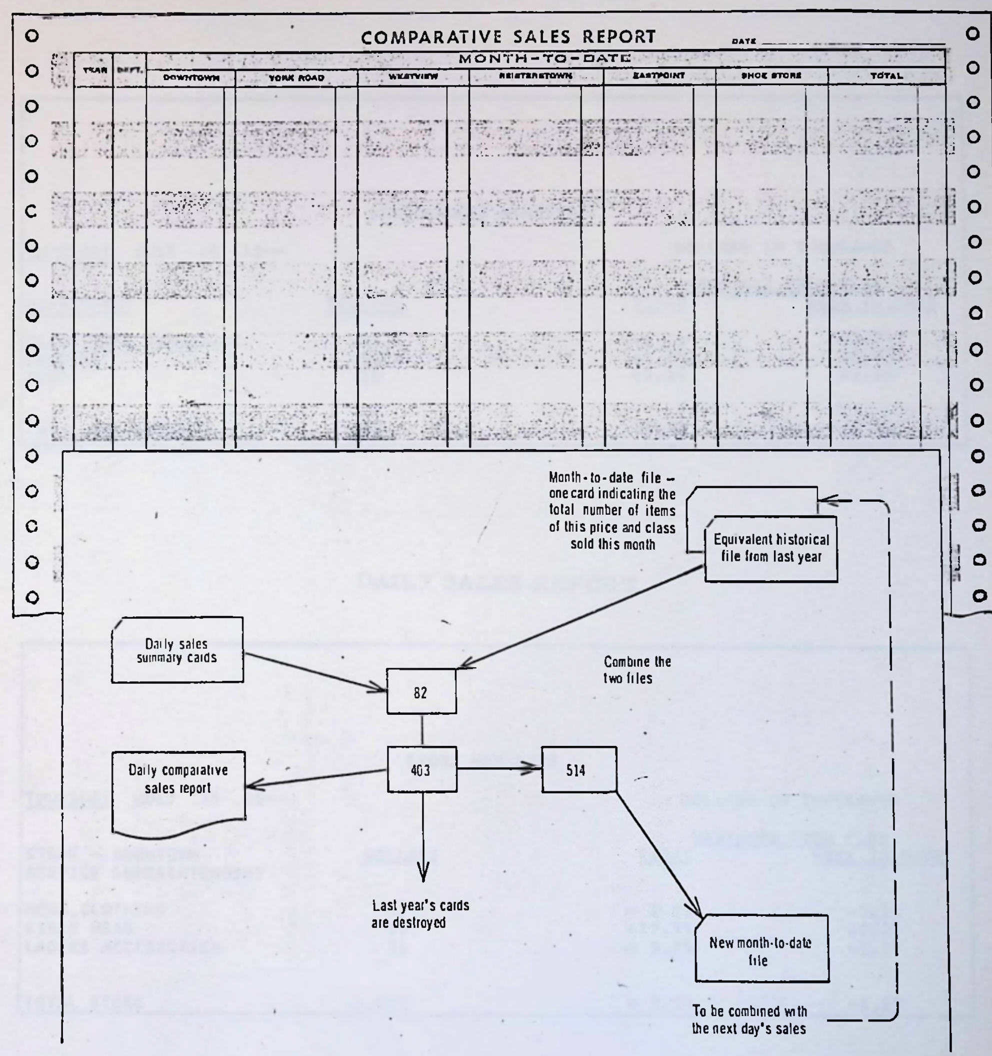
SORT FOR SALES REPORT



CASH TAKE SALESCHECK



DAILY COMPARATIVE SALES REPORT



MANAGEMENT INFORMATION SYSTEM

DAILY SALES REPORT

MERCHANDISE MANAGERS

THURSDAY JULY 18 19—

DOLLARS IN THOUSANDS

DEPARTMENT	DOLLARS	VARIANCE FROM PLAN TODAY	VARIANCE FROM PLAN WEEK TO DATE
OCCASIONAL FURNITURE	41	+6.7%	+3.9%
BEDDING	28	+1.2%	+6.9%
RUGS	36	+4.1%	+3.2%
TOTAL FURNITURE	247	+5.4%	+6.7%

DAILY SALES REPORT

STORE MANAGERS

THURSDAY JULY 18 19—

DOLLARS IN THOUSANDS

STORE - DOWNTOWN
SERVICE SUPERINTENDENT

	DOLLARS	VARIANCE FROM PLAN TODAY	VARIANCE FROM PLAN WEEK TO DATE
MENS.CLOTHING	47	- 8.9%	-6.1%
GIRLS WEAR	29	+12.1%	+8.1%
LADIES ACCESSORIES	36	+ 3.7%	-9.2%
TOTAL STORE	5,674	+ 3.7%	-8.9%

MANAGEMENT INFORMATION SYSTEM

DAILY SALES REPORT - UNAUDITED

OPERATING BOARD

THURSDAY JULY 18 19— DOLLARS IN THOUSANDS

STORE	DOLLARS	VARIANCE FROM PLAN TODAY	VARIANCE FROM PLAN WEEK TO DATE
EASTWOOD	567	+3.7%	-8.9%
SOUTH GATE	137	+6.4%	+2.9%
NORTHWOOD	86	-4.8%	-2.7%
COMPANY	2,647	+1.8%	-6.3%

MERCHANDISE CATEGORY

GROUP	DOLLARS	VARIANCE FROM PLAN TODAY	VARIANCE FROM PLAN WEEK TO DATE
HARDGOODS	1,010	+0.9%	-2.1%
SOFTGOODS	1,350	-2.7%	-4.3%
BUDGET STORE	287	+5.4%	+0.8%

DAILY SALES REPORT

GENERAL MERCHANDISE MANAGERS

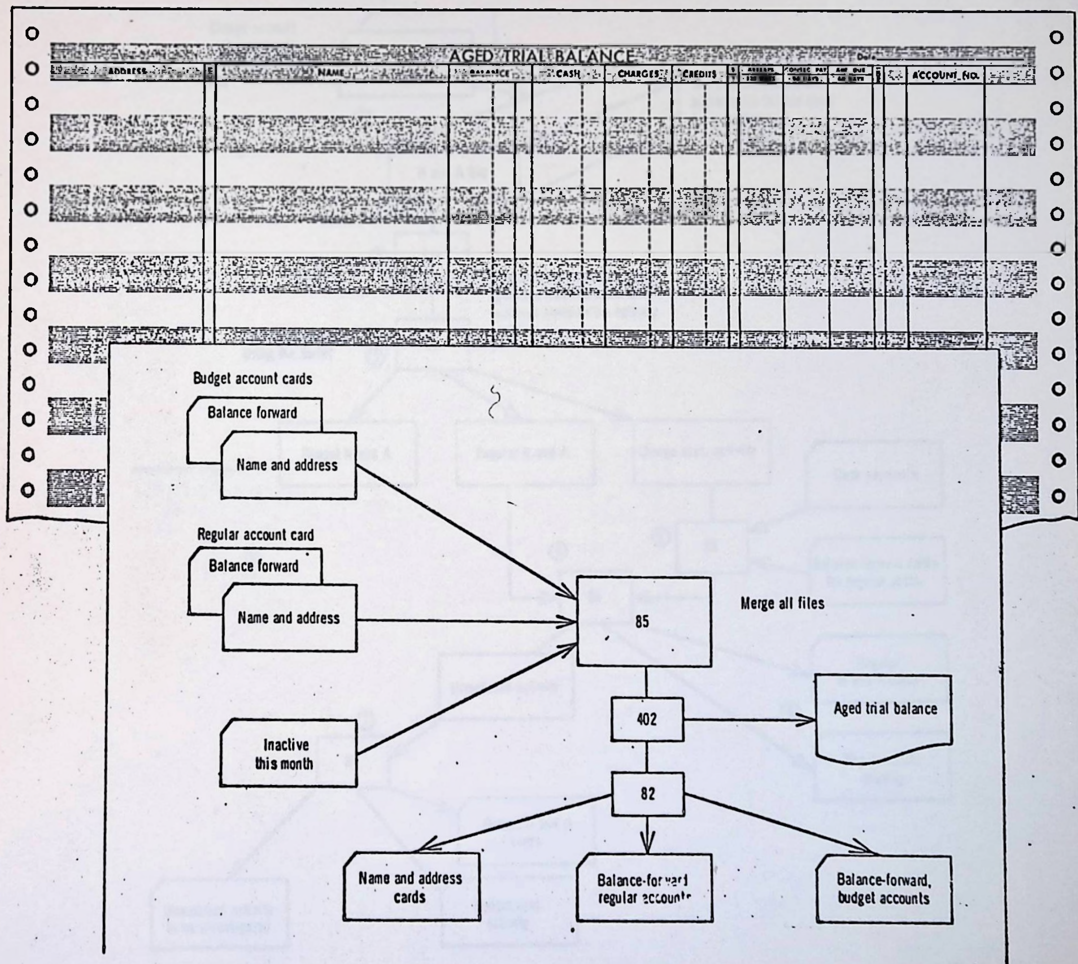
THURSDAY JULY 18 19— DOLLARS IN THOUSANDS

GROUP	DOLLARS	VARIANCE FROM PLAN TODAY	VARIANCE FROM PLAN WEEK TO DATE
FURNITURE	247	+5.4%	+6.7%
FOOD	38	-6.8%	-9.8%
HOUSEWARES	27	+5.1%	+6.7%
TOYS	36	-8.1%	-10.1%
TOTAL HARDGOODS	1,010	+0.9%	-2.1%

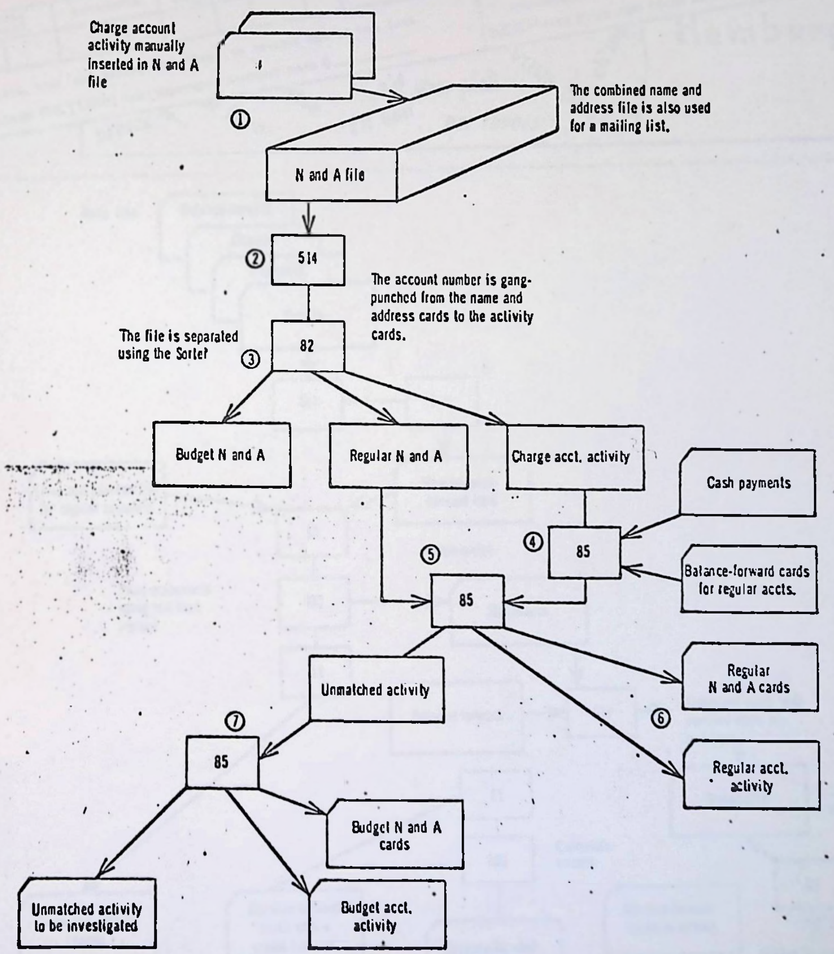
BUYERS GUIDE

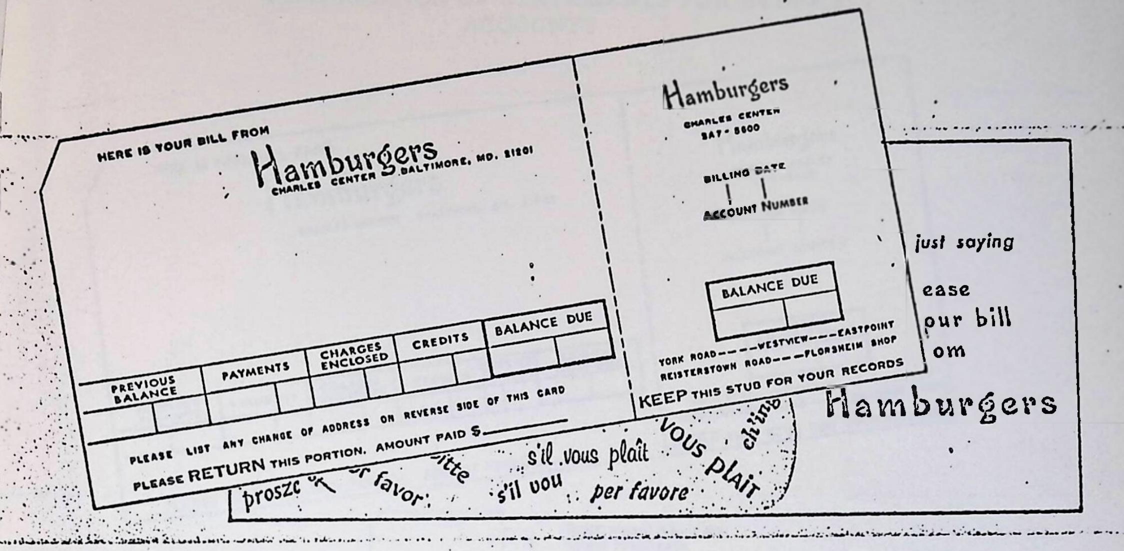
DEPT.	CLASS	PRICE	ON ORDER		ON HAND		SALES: ☐NEXT MONTH LAST YEAR ☐NEXT SEASON LAST YEAR	
			UNITS	DOLLARS	UNITS	DOLLARS	UNITS	DOLLARS'
42	1	17 95			10	179 50	7	125 65
	1	18 00			14	252 00		
	1	19 95	70	1369 50	23	458 85	35	698 25
	1	22 95	30	688 50	18	413 10	13	298 35
	1	25 00	18	450 00	27	675 00	34	850 00
	1	29 95	29	868 55	45	1347 75	27	808 65
	1	35 00			16	560 00	11	385 00
	1	39 95	4	159 80	6	239 70	5	199 75
	1	45 00	4	180 00	6	270 00	1	45 00
	1	49 95	4	199 80	10	499 50	12	599 40
	1	59 95					2	119 90
	1	69 95			9	629 55		
			159*	3943 15	184*	5524 95	147*	4129 95
42	2	17 95					3	53 85
	2	22 95	18	413 10	3	68 85	62	1422 90
	2	25 00	18	450 00	17	425 00	12	300 00
	2	29 95	6	179 70	19	569 05	2	59 90
	2	35 00			4	140 00	1	35 00
	2	39 95	17	679 15	2	79 90	14	559 30
	2	45 00	12	540 00	5	225 00	7	315 00
	2	49 95	11	549 45	7	349 65	9	449 55
	2	59 95	14	839 30	5	299 75	1	59 95
	2	69 95			7	489 65	3	209 85
	2	79 95			1	79 95		
	2	89 95			1	89 95	2	179 90
	2	99 95			1	99 95		
	2	119 95			1	119 95		
			96*	3650 70	73*	3036 65	116*	3645 20

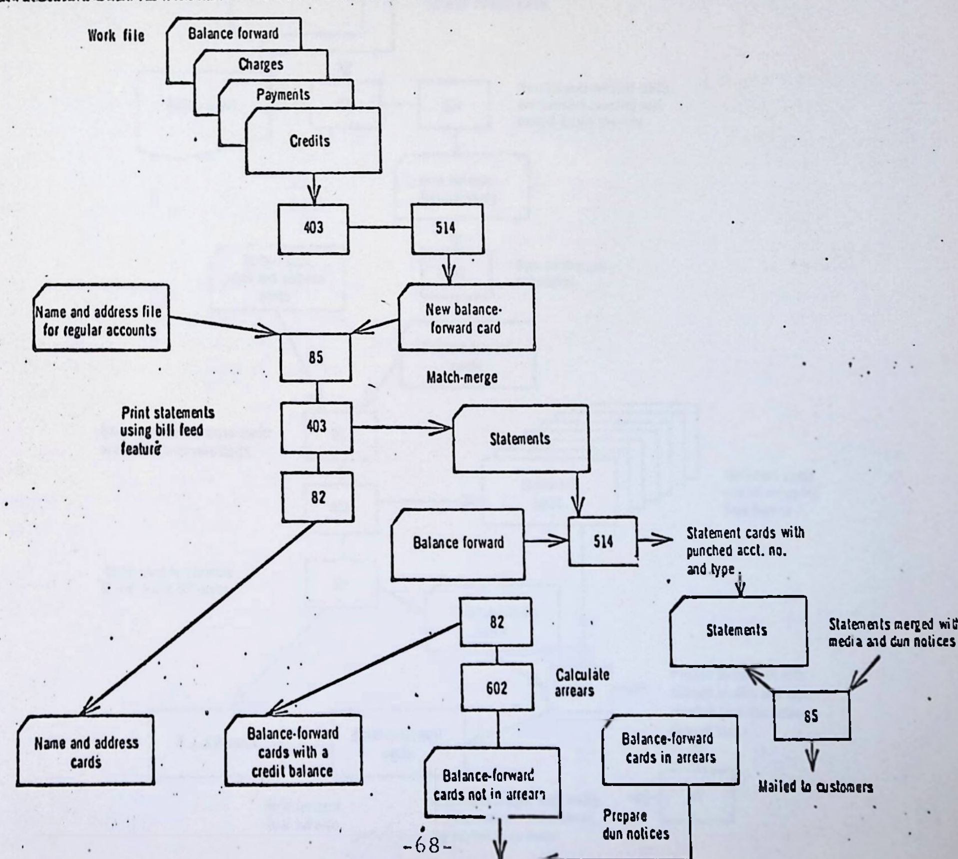
PREPARATION OF AGED TRIAL BALANCE



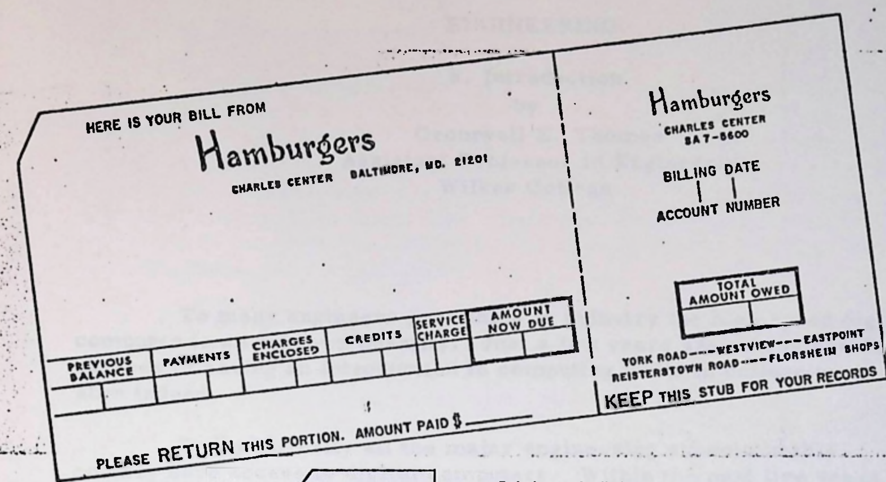
ACCOUNTS RECEIVABLE -- INITIAL PROCESSING

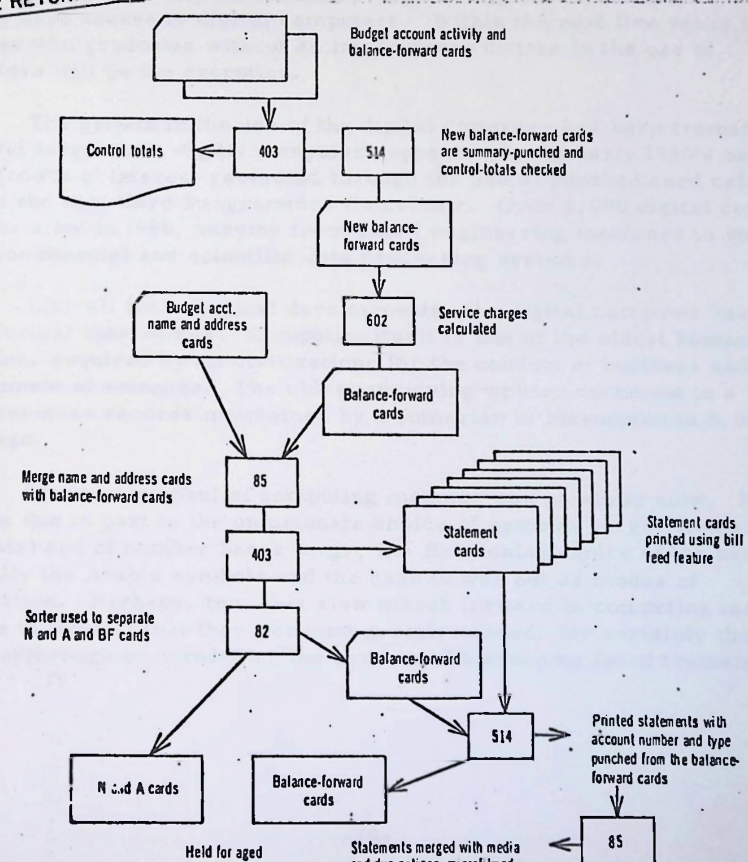



HERE IS YOUR BILL FROM
Hamburgers
CHARLES CENTER BALTIMORE, MD. 21201
PREVIOUS BALANCE
PAYMENTS
CHARGES ENCLOSED
CREDITS
BALANCE DUE
PLEASE LIST ANY CHANGE OF ADDRESS ON REVERSE SIDE OF THIS CARD
PLEASE RETURN THIS PORTION. AMOUNT PAID $
Hamburgers
CHARLES CENTER
SA7-8600
BILLING DATE
ACCOUNT NUMBER
BALANCE DUE
YORK ROAD—WESTVIEW—EASTPOINT
REISTERSTOWN ROAD—FLORSHEIM SHOP
KEEP THIS STUD FOR YOUR RECORDS
just saying
ease
our bill
om
Hamburgers
s'il vous plaît
s'il vou
per favore
vous plait
proszc
favor


Work file
Balance forward
Charges
Payments
Credits
403
514
Name and address file for regular accounts
New balance-forward card
85
Match-merge
Print statements using bill feed feature
403
Statements
82
Balance forward
514
Statement cards with punched acct. no. and type
82
Statements
Statements merged with media and dun notices
602
Calculate arrears
85
Name and address cards
Balance-forward cards with a credit balance
Balance-forward cards not in arrears
Balance-forward cards in arrears
Mailed to customers
Prepare dun notices

PREPARATION OF STATEMENTS FOR BUDGET ACCOUNTS





ENGINEERING

a. Introduction
by
Cromwell E. Thomas
Assistant Professor in Engineering
Wilkes College

To many engineers practicing in industry the high speed digital computer is an unknown quantity. Just a few years ago an engineer's chances of having an introduction to computing while in college were slim indeed.

Today virtually all the major engineering schools in this country have access to digital computers. Within the next five years the engineer who graduates without an introductory course in the use of computers will be the exception.

The growth in the use of the digital computer has been tremendous. The first large scale digital computers appeared in the early 1950's as an outgrowth of interest generated through the use of punched card calculators such as the IBM Card Programmes Calculator. Over 4,000 digital computers were installed in 1960, varying from small engineering machines to very large commercial and scientific data processing systems.

Like all technological developments, the digital computer has its historical antecedents. Computing itself is one of the oldest human activities, required by all civilizations for the conduct of business and the development of sciences. The oldest surviving written document is a set of business records maintained by a Sumerian of Mesopotamia 5,000 years ago.

The development of computing methods was painfully slow. Perhaps this was due in part to the unfortunate choice of symbols (e.g., Roman numerals) and of number bases (e.g., the Babylonian choice of the base 60.) Gradually the Arabic symbols and the base 10 won out as modes of computation. Perhaps, too, this slow march forward in computing methods was due to the fact that they were not greatly needed, for certainly the first big breakthrough occurred when the science of astronomy faced tremendous computing effort in its advance.

Computer programming is a difficult and exacting profession, made more difficult by the fact that there are dozens of different computers, each with its own language. A programmer who thoroughly understands his computer has difficulty in communicating with a different computer until he learns the language peculiar to the Computor. COBAL (Common Business Oriented Language) is a language system developed, as a joint effort, to bridge the gap between an English-like programming language and the machine language of a Computer.

Although COBAL claims to be a type of "universal" programming language, it still leaves something to be desired. If it is poorly used it can lead to disastor and could prove to be much more costly than programs developed in more conventional ways. On the other hand, when properly used, it can be an extremely powerful tool. A careful system analysis must be made before attempting to write a program. Frequently much study is required before a competent program is arrived at since any program may be written several different ways to arrive at a single solution.

If we are talking about programs that provide numerical answers to numerical problems we turn to such languages as Fortran (Formula Translation) or Algal (Algartlhmic Language) and a number of other recently developed languages which all the engineers use to communicate directly with the computor.

From these few comments may I present Mr. Howard Furgeson, who will speak on the language of the computer for the engineer.

b. Engineering

by
Howard Fergueson
Vice-President
Education Division
Management and Computer Services Corporation
Philadelphia, Pennsylvania

The language of the computer is a binary language made up of ones and zeros, that is all the computer understands. Data is represented through the magnetizing of various cores within the memory of the computer. It is very difficult for a programmer to work with this type of a language, and a programmer is a very important person within a data processing system. He is the guy who tells the machine exactly what is to be done. The language that these people use are of two types, two general categories. Computer oriented languages and problem oriented languages. Computer oriented language is one that is developed by the manufacturer for his particular equipment. You have to know his equipment and then you have to know his language to use it. Today manufacturers are coming out with problem oriented languages, languages that are not tied specifically to any piece of hardware. The two types that are most widely used are COBAL and FORTRAN. COBAL is a language that is used in commercial application, it stands for Common Business Oriented Language. It is a language which enables you to set up an equation such as amount plus tax equals Total (Amt. + Tax = Total) in an English-like program structure. The computer will understand and there will be a program the manufacturer will normally supply which will take this English language and translate it into the actual machine language for processing by the computer.

FORTRAN is not the natural language of a computer, nor is it the natural language of the engineer. Rather, it is a compromise between the two. To satisfy the computer, it uses symbols that the computer can understand and requires that the rules for their use be closely followed. To satisfy the engineer, it eliminates as many of the detailed computer control operations as possible from the job of writing programs and uses a problem statement format close to that of the mathematical equation.

The engineer describes his problem in the FORTRAN language: what he writes is translated into the natural machine language of the computer to be used in obtaining the solution. The translation is accomplished by the computer itself with the aid of a program called the FORTRAN Processor. The resulting machine-language program is then ready to be used to obtain the solution.

How does this affect the engineer?

The use of computers in the field of engineering analysis has experienced tremendous growth in the last decade. The advent of the electronic computer has created a new approach to the solution of engineering problems. The costly "build and try" method is now often replaced by "construct mathematical model and simulate."

For the engineer, in some respects this represents a return to the textbook. He must describe the physical problem by means of a mathematical model. Then the computer can operate on the model and describe the operating results for many sets of operating conditions.

Many articles have been printed in professional publications on the solution of difficult engineering problems by the use of electronic computers, and yet a lack of knowledge and experience prevents the full use of the computer as an engineering tool. The average engineer is simply not aware of what a computer can do for him and expects either too little or too much from this mechanism. It is highly desirable, therefore, that every engineer understand how problems can be described for handling by electronic computers.

It is convenient to think of computing problems as falling into one of two classes:

1. Straightforward computations
2. Iterative problems

Straightforward computations are those which have in the past been handled by slide rule or paper and pencil. They also include those for which the technique of solution, while known, has required too much computation to tackle.

Iterative problems comprise a large area, mostly unexplored. To explain this, the question should be asked, "What is the function of the engineer today?"

The engineer is a person who builds physical systems to do particular jobs. If a particular construction does not work, modifications are made until it does work. These modifications are often the result of vague ideas. Engineering is done largely by trial and error.

A very obvious conclusion which one reaches in talking with engineers is that they employ a minimum of their textbook analysis techniques. Mathematical approaches soon pick up dust on the engineer's worktable. Why? One reason is that real life simply does not fit the pat equations of the textbooks. Often the basic difference is that in a textbook it always seems possible to apply mathematical techniques and arrive at solutions of the kind

$$x = f(y, z)$$

where the value of the variable of interest can be determined simply by plugging in known values for y and z on the right-hand side. However, in real-life engineering, often the problem becomes stated as

$$x = f(x, y, z)$$

where x is on both sides of the equation. x cannot be solved for explicitly; that is, there is not enough information to remove x from the right-hand side. The problem is too complex.

This problem can usually be handled mathematically by estimating the value of x, testing the estimate, and, if it is wrong, making a better estimate. Essentially, numerical analysis (in computer mathematics) is the science of making progressively better estimates. To estimate repeatedly is to "iterate." This iterative idea is the heart of the computer approach, whether for the simplest cam problem requiring algebra, or for the most complex nuclear problem involving sets of differential equations.

I would like to take a few moments today to go into the FORTRAN language and show you the simplicity of this particular language. In FORTRAN there are symbols that are used to perform the arithmetic functions. Multiplication is represented by an asterisk. Addition and subtraction are represented by the plus and the minus signs and division is represented by the slash sign. To raise to an exponential is represented by two asterisks consecutively on a base. So what happens, a programmer would sit down to determine his desired result. He knows what his input is and now he writes a path or the number of the steps that must be performed to translate that input data into the desired results. He will use these various operators and combine them into various statements and record them on a programmer's coding sheet or, as you will see today, actually type them on a typewriter and have them feed directly into a computer. Arithmetic expressions are used in a computer, and in the FORTRAN language we use the symbol, (=) the equal sign, to show the placement of something rather than that something is equal to something else. For example, we may say that A is equal to B plus C. What this means is that the quantity B plus C will replace the value of A, giving A a new value and the new value is then available for processing in the various runs. We can also use letters to represent various elements that are being processed. Of course each of these letters must be defined within the program so that we can come up with the proper results. Let me just show you some various types of processing. Here is an arithmetic statement and we can even say that X equals an expression. Now what does that expression mean? A times B divided by C and then raised to the power of D ? Well the computer will examine that expression and compute it based upon a hierarchy of these various symbols. A parenthesis can also be used within an expression to clarify the meaning of the expression.

Because the printer and typewriter on a computer print only in upper-case letters, have a limited number of different characters, and are incapable of properly showing exponents and subscripts, FORTRAN statements at first appear somewhat confusing.

An example of an arithmetic statement as it would appear on a FORTRAN coding sheet is:

```
ROOT = ( -B+SQRTF(B**2-4.*A*C))/(2.*A)
```

Translated, this says:

The quantity to be known as root is equal to - that is, can be determined by-evaluating

$$\frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

where A, B, C are given values stored within the computer.

Arithmetic statements look like simply statements of equality. The right side of all arithmetic statements is an expression which may involve parentheses, operation symbols, constants, variables, and functions, combined in accordance with a set of rules much like that of ordinary algebra. The symbols + and - are employed in the usual way for addition and subtraction. The symbol * is used for multiplication, and the symbol / is used for division. The fifth basic operation, exponentiation, is represented by the symbol **. A**B is used to represent A to the exponent B (that is, A^B).

The FORTRAN arithmetic expression

A**B*C + D**E/F - G

will be interpreted to mean

$$A^{B}C + \frac{D^{E}}{F} - G$$

That is, if parentheses are not used to specify the order of operations, the order is assumed to be:

1. exponentiation
2. multiplication and division
3. addition and subtraction

Parenthese are employed in the usual way to specify order. For example

$$(A(B + C))^{D}$$

is written in FORTRAN as (A*(B +C)) **D.

There are just three exceptions to the ordinary rules of mathematical notation. These are:

1. In ordinary notation AB means A· B or A times B. However, AB never means A*B in FORTRAN. The multiplication symbol cannot be omitted.

2. In ordinary usage, expressions like A/B· C and A/B/C are considered ambiguous. However, such expressions are allowed in FORTRAN and are interpreted as follows:

   A/B*C means (A/B)*C
   A*B/C means (A*B)/C
   A/B/C means (A/B)/C

Thus for example, A/B/C*D*E/F means ((((A/B)/C)*D)*E)/F. That is, the order of operations is simply taken from left to right, in the same way that

A + B - C + D - E

means

(((A + B) -C) + D) - E

3. The expression A^{B^C} is often considered meaningful. However, the corresponding expression using FORTRAN notation, A**B**C, is not allowed in the FORTRAN language. It should be written as (A**B)**C if $(A^B)^C$ is meant, or as A**(B**C) if $A^{(B^C)}$ is meant.

Besides the ability to indicate constants (like 3.57 and 2.) simple variables (like A and ROOT), and operations (like - and*), it is also possible to use functions. In the previous example, SQRTF ( ) indicates the square root of the expression in parentheses.

Since the number of possible functions is very large, each computing center will have its own list of available functions, with information about their use. Functions given in this list must be referred to exactly as indicated. For example, -A*B/I + H or A*(B/I) + H

Therefore, if this expression is meant to be A times B divided by I, then it will be processed that way. However, if it was intended to be some other way, it would then have to be represented as if it was A times the result of B divided by I, this would have to be parenthesized to perform that particular operation. So what will happen here, we will say the result of A times B we will call J, divided by I plus H and then the next J divided by I which will give us K plus H and the result will eventually be that K and H will be added together to give us the final result. That is the way the computer programmed in the FORTRAN language will solve the particular expression. As far as you are concerned as a programmer, you merely express it as this particular statement and you will get the result. Does it look complicated? Does it look difficult? Does it look like it takes a long time? Sure it does, but the computer can perform it in speeds of what we this morning said were nano-seconds and micro-seconds and so this entire expression is computed and solved before you can even remove your finger from the keyboard.

There are four or five statements within the FORTRAN language that are used to advantage as a programmer writes a statement he will sometimes give it a number. You can use any number, you can call that statement number 25, you can write the expression that I had previously on the board and use it. He just numbers them for his own benefit to reference a particular statement. Now the technique of computer processing is that the computer will execute the statements that are written by the programmer in the sequence that he has recorded them on the sheet and will feed them to the computer in that order. If the programmer wishes to change the normal sequencing of the steps within his program, there is a statement which is called a "go to" statement. All he has to say is "go to" 56 and what he is doing then is transferring sequence of his program rather than going to the next statement which might be X equals A minus B divided by C, he will jump to statement 56 wherever that happens to be in his program. So it is called an unconditional branch within the logic of a program. Remember I showed you the diagram of a chart, this could represent the logic of a program, and depending on an event, if the value is negative, I wish to go to one thing, if the value is positive, I wish to go somewhere else and perform a different type of operation on this data. So this is called an unconditional go to. A very simple expression used in FORTRAN. There is a statement which is called a computed go to and it is made up of an expression, (E) 25, 10, 50, or 70. What this expression says is go to the statement which I have numbered 25, 10, 50, or 70, you can put them in any sequence, go to that particular statement depending upon the value of I in this case. I might be a cariable that is read in from a card. When I is read in, or someone keys it in to the computer, depending upon what that variable is, I will go to one of these particular statements. If this value happens to be a 1, we will go to statement 35. So what we are saying is that we can test an element and depending upon that particular element, go to specific locations within the program and perform the particular processing that is required. A computed go to, a very simple expression. Now we have had two, an unconditional go to and now a computed go to. The third type of expression that is used in FORTRAN language is what is called the arithmetic IF. The arithmetic IF is the statement in FORTRAN programming that says perform this expression, this calculation, and depending upon the result of that calculation, go to one of these three statements. Example - IF (E) N_1, N_2, N_3. If the value that is computed in here is negative, go to statement number N_1 and perform the calculation or the steps at stemnet N_1. Statement number N_1 might say A plus B plus or minus C equals X, or something like that, or maybe pront something on a pronter or read another element or something. If it is zero, if this expression results in a zero, then it will go to statement number N_2, if the expression results in a positive result, we will go to statement number N_3. It may be that we wish to go to statement number N_1 if it is zero or a negative, so that these elements in here should say N_1, N_2, N_3. So on a positive result, we will go to statement number three. On anything other than a positive result or a non-zero result, we will go to statement number N_1. We have computed an arithmetic IF statement. In this expression when it is computed, if the result is negative, zero or positive, go to that particular statement within the program. There is another statement that is used in FORTRAN which is the DO statement. What this statement says is DO all of the statements down to and including the statement member which follows DO. DO 25 I=I, 1000 says do all of the statements down to and including statement number twenty-five, initializing the value I at one, incrementing it by this increment, which in this case is one, until this I reaches its maximum. So what is going to happen, we are going to compute and the computer is going to perform this statement and all of the other statements down to and including statement 25 varying the value I by one, each time, until it has done this a thousand times. Again this will be done in less than a second. It is done in micro-second speeds. So we can compute this expression a thousand times and see what effect will be by varying this one particular value. And we may say that I equals A, we might have an array of answers. We could say that A sub I, subscripted by A, I equals this or here what we are doing is an array of a thousands elements in a table, we are going to start at element number one and we will compute B plus C divided by this particular element I, which will vary from one to thousand and we are going to come up with a result and replace it in our table because every time we replace A, the value of I is going to be subscripted by I so we will be setting up a thousand different elements in this table. Subscripting is another feature of the FORTRAN program. And this is it; this is the FORTRAN language. Go to, do, ifs, plus the reading and the writing statements.

The reading, the writing get to be a little more hairy in FORTRAN, but as you will see today when we get on to the computer, that's a piece of tape, and there is no reason why anyone should be afraid of programming a computer using the FORTRAN language. You are probably more familiar with it than I, because this type of expression is something that you would use very frequently in your particular fields of interest.

Along with a discussion of specific problems for engineers, demonstrations of GEOM (coordinate geometry), GOGO (compute analytical geometry problems), and ECAP (electronic circuit analysis program) will be given by Mr. David Wills and Mr. George Johnson of CSI, in this afternoon's session.

FORTRAN PROGRAMMING LANGUAGE

The Fortran language is especially usefull in writing programs for scientific and engineering applications that involve mathematical computations. A set of statements representing a source program are written in the Fortran language. The Fortran compiler analyzes the source program statements and transforms them into machine language. The translated set of instructions represents the object program.

Fortran statements are usually composed of certain Fortran key words used in conjunction with constants, variables and expressions. The five categories of Fortran statements are as follows:

1. Arithmetic Statements
2. Control Statements
3. Input/Output Statements
4. Specification Statements
5. Subprogram Statements

Constants

1. Integer constant is a whole number written without a decimal point. It may be positive, zero or negative.

2. Real constant is a number with a decimal point. It may be positive, zero or negative.

3. Double Precision Constant is a number with a decimal point optionally followed by a decimal exponent. This exponent may be written as the letter D followed by a signed or unsigned one or two digit integer constant.

$(7.9D3 = 7.9X10^3 = 7900.0)$

Variables

A Fortran Variable is a symbolic representation of a quantity that is assigned a value. The value may be unchanged or change for different executions or at different stages within the program.

Variable Names

Are symbols used to distinguish one variable from another. The name is from 1 through 6 alphameric characters, the first of which must be alphabetic.

If the first character of the variable name is I, J, K, L, M, or N, the variable is integer.

If the first character of the variable name is other than the above alpha characters, the variable is real.

Arithmetic Operations

+	Addition
-	Subtractions
*	Multiplication
/	Division
**	Exponentiation

Arithmetic Expressions

If more than one constant or variable appears in an arithmetic expression, they must be separated from one another by an arithmetic operator.

When parentheses are used in an arithmetic expression, the expression within the parentheses is evaluated before the result is used; otherwise, the order in which the operations are performed is as follows:

1. Exponentiation
2. Multiplication and division
3. Addition and subtraction

When two operators of the same hierarchy are used, they are performed from left to right.

The expression

A*B/C**I+D

is evaluated as follows:

1.	C**I	Call result X (A*B/X+D)
2.	A*B	Call result Y (Y/X+D)
3.	Y/X	Call result Z (Z+D)
4.	Z+D	Final result

Subscripts

Is a number used to refer to a particular variable within an array. Subscripts must be enclosed in parentheses.

Example: Array (1, 4)

Array (I, J)

Statements

Arithmetic statements closely resemble conventional algebraic equations. The equal sign specifies replacement.

B = I**J + D

GO TO statement is used to transfer control to some statement other than the following statement.

GO TO 25 (go to statement 25)

Computed GO TO (X_1, X_2, ... X_n), i

This statement causes control to be transferred to the statement numbered X_1, X_2, etc., depending on whether the current value of i is 1, 2, 3, or n.

Example:

```
        GO TO (25, 10, 50, 7), ITEM
                       .
                       .
                       .
       50 A = B  +  C
                       .
                       .
                       .
        7  C  =  E**2+A
                       .
                       .
                       .
       25   L  =   C
                       .
                       .
                       .
       10   B  =  L+HOLD
```

Arithmetic IF

This statement causes control to be transferred to the statement numbered X_1, X_2, or X_3 when the value of the arithmetic expression is less than zero, equal to zero or greater than zero.

Example:

```
        IF (A(J,K)**3-B) 10,4, 30
             .
             .
             .
        4 D=B+C
             .
             .
             .
       30 C=D**2
             .
             .
             .
       10 E = (F*B)/D+1
```

DO Statement

A statement to repeatedly execute the statements that follow, up to and including the statement numbered X.

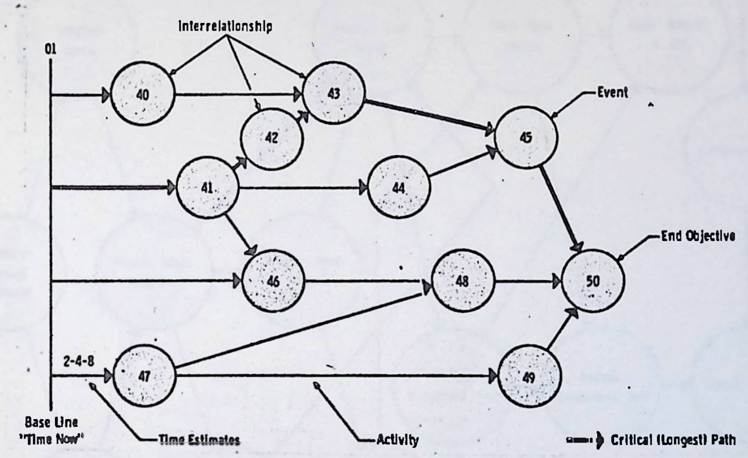
```
DO 25 I = 1, 1000, 1
```

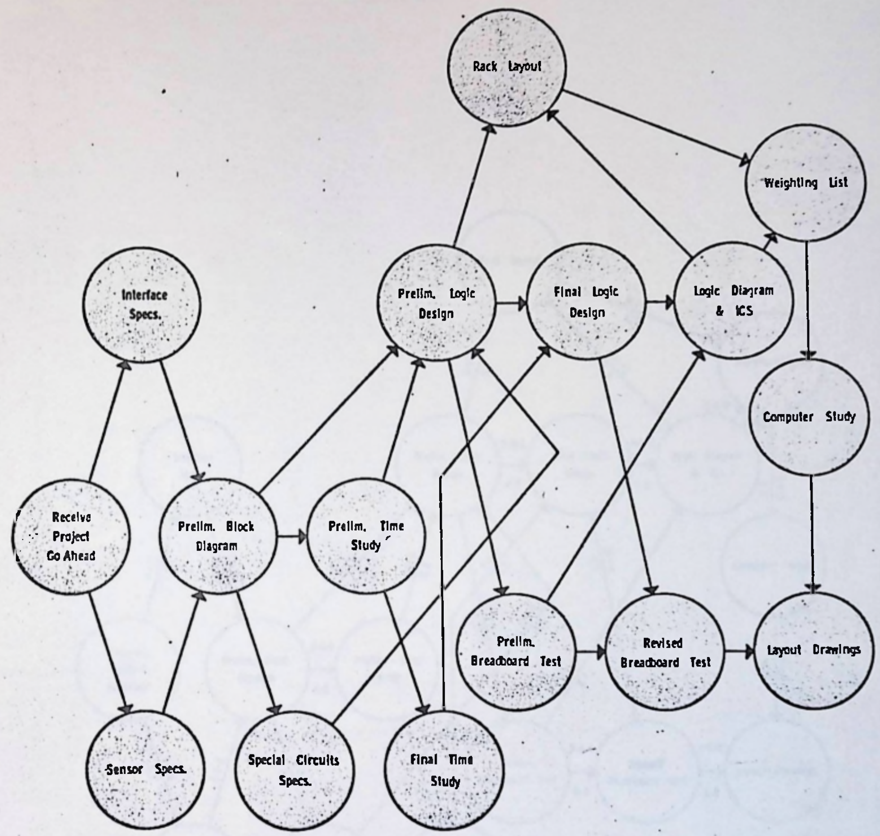
STOCK (I) is the initial stock-on-hand

OUT (I) is the number of each item used.

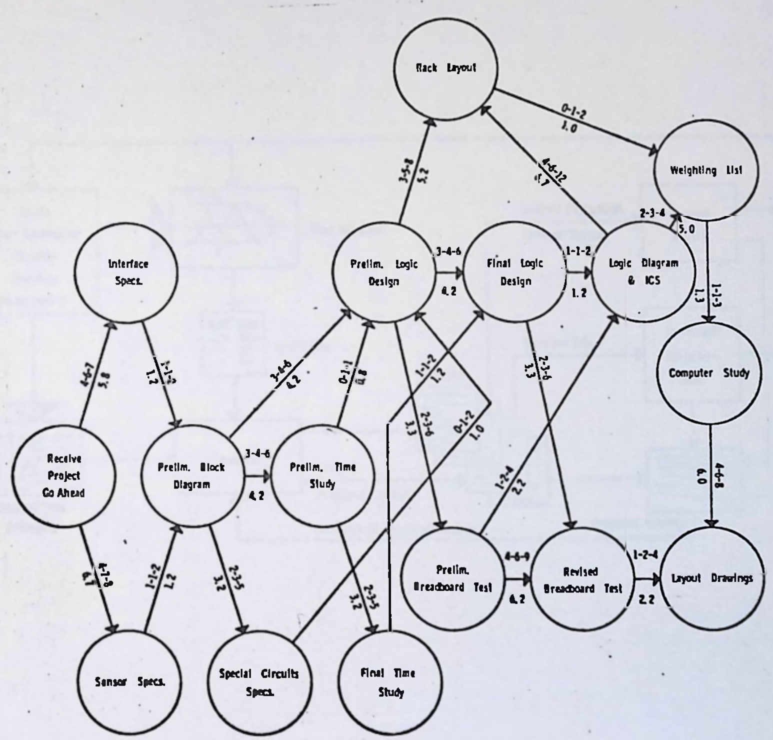
```
 5    I =0
10    I =I+1
25    STOCK (I) = STOCK (1) = OUT (I)
15    IF (I-1000) 10, 30, 30
30    A = B + C

      DO  25  I = 1, 1000

25    STOCK (I) = STOCK (I) - OUT (I)

30    A = B + C
```

PERT NETWORK OF EVENTS AND ACTIVITIES

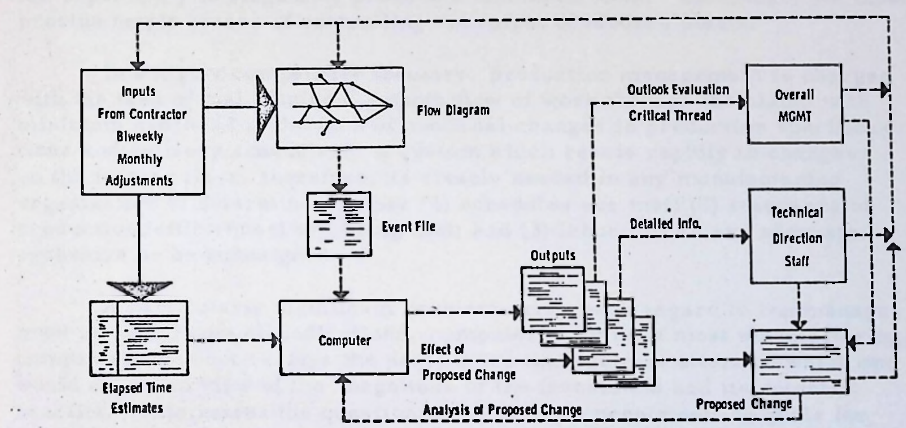



Rack Layout
Weighting List
Interface Specs.
Prelim. Logic Design
Final Logic Design
Logic Diagram & ICS
Computer Study
Receive Project Go Ahead
Prelim. Block Diagram
Prelim. Time Study
Prelim. Breadboard Test
Revised Breadboard Test
Layout Drawings
Sensor Specs.
Special Circuits Specs.
Final Time Study

COMPLETED PERT NETWORK



PERT SYSTEM IN OPERATION



MANUFACTURING

a. Introduction

by

Cromwell Thomas
Assistant Professor in Engineering
Wilkes College

The replacement of the skilled craftsman as the basic productive force in American industry has created numerous difficulties in assuring a quality product. Unlike his predecessor, today's worker is no longer responsible for a finished item. In the past, a man would devote his effort to guarantee that something he had made would work. This motivation is no longer present. Mass production, interchangeability, and advanced technology has minimized the opportunity to singularly produce a functional item. Therefore, we must provide ample means of controlling the output of modern plants.

In a highly competitive industry, production management is charged with the task of maintaining a smooth flow of work through the plant, with minimum overhead in the face of continual changes in production specifications and delivery schedules. A system which reacts rapidly to changes on the factory floor, therefore, is clearly needed in any manufacturing organization to determine whether (1) schedules are met; (2) standards of production (efficiences) are being met; and (3) labor forces are adequate, excessive or be reassigned.

A particularly significant problem exists with regard to top management itself. From all indications, computer activity in most manufacturing companies does not receive the serious top management attention which one would expect in view of the magnitude of the investment and its potential benefits. This raises the question; Are the right people setting goals for computers ? This is one of the prime reasons why companies often fail to realize the true potential from their data processing investment.

The morning session of this Penntap Seminar will deal with such problems as production control, inventory forcasting, labor efficiencies, scheduling, and machine loading. The afternoon session will deal with sales planning, inventory projections, and total expenditure projections.

We are certainly hopeful that the participants from the light manufacturing industries in Northeastern Pennsylvania, of which there are about 150, find this topic informative and beneficial.

b. Manufacturing

by

Howard Fergueson
Vice-President
Education Division
Management and Computer Services Corporation
Philadelphia, Pennsylvania

The primary objective of a manufacturing concern is to make profits. Meeting this objective calls for providing ordered goods when they are required, competitively priced, and manufactured at a cost that is less than the sale price. Profits may be increased by widening the gap between the sales price and the manufacturing costs.

To achieve the profit objective, manufacturing management must establish a plan, execute it and then evaluate it. Planning and the execution of plans are continuous operations. Decisions must be based upon the latest facts. Data processing systems are able to give management the most up-to-date data on which to base these decisions.

There are six basic management operation functions which are common to most manufacturing companies, regardless of the type of industry. Some of these functions implement planning and others implement execution.

1. Forecasting initiates the cycle and produces the master plan on which all activity is based.
2. Materials Planning develops the master plan for materials.
3. Inventory Management completes the material plan and partially executes it.
4. Scheduling develops the master plan for machines and manpower and starts it into action.
5. Dispatching completes the execution of the plan.
6. Operations Evaluation is the planning function which replans the five preceeding functions on the basis of an evaluation of execution.

The objective of manufacturing may be defined as the management of materials, machines, manpower and money in such a way that the maximum profits are realized.

In the area of materials, machines, manpower, and money some examples of the tangible results which may be expected from good management of the six functions are:

1. Materials. Lower investment in inventory. With an annual carrying charge

of 25%, reductions in inventory can produce substantial savings.

2. Machines. Increased utilization, with a subsequent reduction in costly idle time.
3. Manpower. Higher efficiency. Planning increases effectiveness.
4. Money. Increased profit. In addition, working capital may be increased.

One of the primary tasks of a manufacturing organization is to fill customer time requirements. For certain unique items made to customer specification the manufacturer can start production only after receipt of the customer order. In most cases, however, it is necessary to start the manufacturing cycle before any order is received in order to meet the customer's time requirement competitively. The total length of the manufacturing cycle may be too great to permit quoting a delivery date before it has started. Thus it is common practice to produce either the final product or its parts, assemblies or base mixes in advance, so that on receipt of an order only the final operations need be performed and firm delivery dates can be predicted.

The problem which arises may be expressed in the question, "How many of what must we manufacture?" If too few of a given item are produced, orders may be lost. If too many are made, money may be wasted. The same is true if a desired item is not produced, and vice versa. A manufacturing plan based on expected product demand must be established.

There are two basic methods of anticipating demand: prediction and forecasting. Prediction is the educated guess of management and involves no formalized use of numerical data. Forecasting implies some manipulation of numerical information. Often the two methods can be used together--for instance, management's knowledge of an impending sales campaign, a natural disaster or war scare, could be combined with prior sales history--to establish a manufacturing plan.

Two basic types of data are used in forecasting: intrinsic factors, such as the sales history of an item, and extrinic factors, such as economic conditions, development of new materials, etc. Using intrinsic data, a projection is made into the future based upon the past. With extrinsic factors the projection is made by correlating external conditions with sales.

The moving average method of forecasting, based on intrinsic factors, involves storing a complete product sales history for a fixed number of periods, with updating at the end of each period.

There are drawbacks to the straight moving average method, however. Two of its apparent weaknesses are (1) that each period's demand has equal weight and (2) that the weight assigned to the current period's demand depends on how many periods make up the average.

In an attempt to circumvent these handicaps, weighted moving averages may be used. They perform in the same manner as the straight moving averages, but a heavier weight is given to the current period's demand. The weight given to each period in the average is usually scaled giving heavier weights to the more recent demands.

By weighting the demand, the forecast will react to change a great deal faster than with the straight moving average method.

Forecasting on IBM data processing equipment makes the creation and maintenance of confidence limits easy. Current demand is evaluated against forecast to determine whether any deviation is above or below a preset acceptable limit, that is, the confidence limit. Management should know when actual sales deviate from the forecast by more than a fixed percentage, say 5% or 10%, whatever limit is set. If many product lines are involved, management needs to be informed of those which deviate from the prescribed limits as the deviations actually occur, since a change in trend may be the trigger for a change in the manufacturing plan. One of the most important requirements of forecasting is that the information it produces be ready in time for management to take action while internal conditions may be economically altered--not after money and machines have been utilized in creating too much or too little.

In addition to the end product forecasts for a given period, other forecasts often have to be made. It may be necessary to forecast the mix of devices which go to make up an end item assembled to customer specifications. If the end product and service parts must be stocked, in many branches throughout the country, the forecast may even have to be extended to cover the number of items and spare parts which should be produced and then stocked in each location.

Sales history and forecasts are stored inside the system. Shipments and orders enter the system to update the stored sales history. Trend changes are noted. The end item forecast is preliminary to the forecast for the devices which make up the end item. Because the end item may contain a different configuration of devices, it is necessary to keep track of both end item usage and device usage on the end items in order to create and adjust the manufacturing plan if deviations occur.

To select the best forecast plan, actual data should be analyzed and simulated. The test can be performed either manually or by computer. The manual approach is arduous, time-consuming and open to error, while the computer approach is much faster and more accurate. There are several computer programs available to aid in the selection of the forecast plan; such as demand analyzers, inventory management analyzers, inventory management simulators and plot programs.

<u>The demand analyzer</u> will diagnose particular demand patterns and aid in the selection of the forecasting parameters mentioned earlier. (The ability of the exponential smoothing formulas to forecast are directly related to demand.)

<u>The inventory management analyzer</u> will catalogue inventory by investment, profits, etc. Basically, the program helps to stratify the inventory.

<u>The inventory management simulators</u> enable the testing and evaluating of many different parameters in a short time. (Most simulators include forecasting and ordering plans.)

<u>The plot programs</u> graph the output from the simulators to make analysis much easier.

Either the finished products plan developed in the forecasting function or specific customer orders are used in materials planning to generate planned orders, which are input to the scheduling and purchasing functions. The term finished product includes service or repair parts as well as prime products. In addition to the interrelationship of functions, one of the chief advantages of a Management Operating System utilizing random processing techniques is the ability to react quickly to changes in forecast, order cancellation and plant rescheduling.

The problems involved in exercising control over a manufacturing process are to a great extent determined by the complexity of the end products. A basic problem in controlling the efficiency of a complex manufacturing process is maintaining detailed requirements planning. This is a matter of extablishing the type and quantity of component parts and assemblies which will be needed for future production calendar periods. A related problem is insuring that the component parts and assemblies required are actually on hand as needed. So far as materials planning is concerned, this entails the examination of current inventory and the issuance of the necessary make or buy orders.

At any given point the fundamental questions are: "What will we need and when will we need it?" and "What must we place on order?" The correct answers to these questions serve the objective of assuring that component inventories will be sufficient for production purposes without excessive capital outlay. The price of insufficient inventory is interrupted production and inadequate customer service. The price of surplus inventory is an investment which not only yields no profit, but is subject to the further cost of physical deterioration, obsolescence, storage and insurance. The balancing of these opposing objectives is termed optimal inventory planning.

Determining the required quantity of any specific component is not a simple process. Accuracy and soundness of method are of great importance since production planning schedules form the basis for determining the expenditure of operating funds for facilities, manpower and materials. Accurate materials planning will assure management that all material, labor and burden costs are properly charged against a specific product once it is in production. Among other things, the manufacturer must consider the economical quantity to be ordered, the existing inventory turnover, the lead time needed to produce the component, and the inventory levels advisable for floats or bands, protective stock, spare parts and scrap.

The technique of materials planning varies with the nature of the products and the methods of planning required by the financial resources of a company. Manufactured products may be described through four classifications:

Completely standard or stock items--Comparatively stable in design, and exhibiting a constant or repetitive demand. Production performed on a continuous assembly or process basis. Examples: household appliances, food/durgs.

Completely custom-built--Individually designed to meet each customer's peculiar requirements, with a demand which is usually nonrepetitive. Described as job shop. Examples: construction, spacecraft, castings.

Modified standard, assembly with options--Constructed by adapting standard products to customer requirements through introducing options prior to final assembly. Combination of job shop and continuous assembly. Examples: transformers, switchgear, aircraft, data processing equipment.

Custom-assembled--Built by selecting standardized options for assembly to meet a given customer's needs. Combination of nonrepetitive demand with use of standard options to produce the effect of constant or repetitive demand for the components. Examples: automobiles, machine tools.

The choice of a planning method is governed by the nature of the product and the financial resources and policies of the manufacturing organization. For these reasons several or all types of planning may be used in a given business. The principal classification of planning methods and the factors which usually dictate their selection may be summarized as follows:

Planning to order--Authorization for the purchase, fabrication or assembly of materials is given only when an order is received. This method is usually adopted only for custom-built products or options, but it may be applied to any product if it is desirable to limit inventory investment, and if a high percentage of components is purchased and procurement lead time is relatively short.

Planning for stock--Finished products are distributed to the consumer from accumulated stocks, and authorization for the purchase, fabrication or assembly of materials is given in anticipation of orders to be received. This method is widely used for all types of products except those built to order.

Planning for semifinished stock--Authorization for the purchase, fabrication and assembly of materials to a partially completed stage is given in anticipation of orders, but the completion of a product is deferred until an actual order is received. This method is well suited to the control of custom-assembled and modified standard products, or of any product with a manufacturing lead time longer than market conditions will accept for delivery.

One of the greatest problems facing industry today is how to meet customer schedules while maintaining reasonable levels of inventory. Schedules are frequently met through sheer force of plant facilities, at low utilization, and excessive labor costs. In order to fully appreciate the contribution a data collection system can make to the manufacturing industry, it is necessary to re-examine the manufacturing organization in light of the latest communication developments.

In a highly competitive industry, production management is charged with the task of maintaining a smooth flow of work through the plant, with minimum overhead in the fact of continual changes in product specifications and delivery schedules. Crises develop daily as a result of changes in customer requirements, machine-too breakdowns, excessive spoilage, engineering changes, and the many scheduling changes forced upon management by other obscure factors. A large force of indirect labor is required to record and process these changes if any type of control is to be achieved. Supervisory personnel frequently become involved in stock-chasing, long production meetings and excess paperwork in an effort to meet the crises.

Advantages

· Adequate communications will provide close control over shop operations with a minimum of paperwork.

· Card volume in the plant will be reduced because the same job ticket can be used over and over again by employees on all shifts. Variable data, pieces produced, and the type of transaction associated with a specific job can be entered through manual entry devices.

· There will be increased accuracy in job reporting. Each change in activity will be reported as it occurs, rather than be reconstructed several hours later.

· All jobs may be reported daily, whether completed or not, without increasing paperwork. Thus, management will be assured of a complete and accurate knowledge of work in process. Available capacity or overloads will be pinpointed for management action.

· Location and status of all jobs will be known at all levels. Decisions, based on accurate and timely data, can be made in time to prevent critical situations from developing.

· Foremen and other production personnel will be released from time-consuming clerical functions. Foremen can take time to plan, rather than to expedite.

· Overtime to relieve bottlenecks will be reduced.

· Accurate daily machine load, production and performance reporting will be available from the system to serve each level of plant responsibility. Machine and manpower utilization will be improved.

Planned orders can be scheduled according to master operations and loading formulas. Operation hours are planned by time period. The result is the manufacturing plan which is then implemented in dispatching.

Dispatching relates the manufacturing plan to shop status to come up with daily work priority. A priority system may take into account the type of order, the type of customer, the timeliness of the order and other factors. Such priority rules are applied by the system. Thus the plant is able to operate on a manufacturing plan which is adjusted every day, each adjustment affecting all related areas.

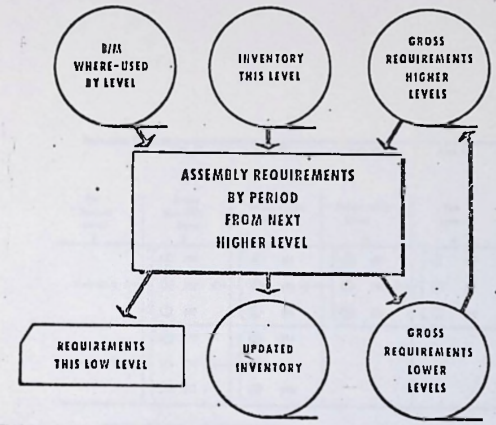
Computers may back-schedule from delivery date through each operation to raw stores, taking into consideration transit time. The time required in each department, based on standards and quantity on order, will be computed, as well as raw material requirements.

The Master Operation cards are duplicated to create job cards (labor tickets). In addition, move tickets may also be generated to move the material between departments. A routing sheet may be prepared from a duplicate operation deck showing each operation in sequence by machine and department number.

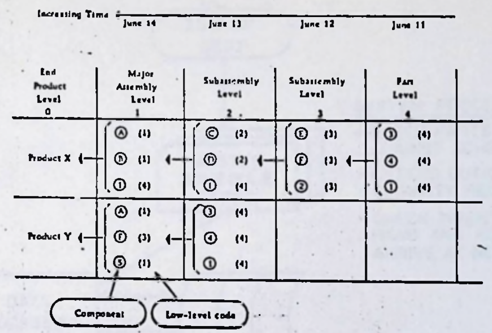
The labor tickets and routing sheet are sent to raw stores, or to the starting department. They travel with the order throughout the plant. An alternate method is to send each job card directly to the working departments and use the routing sheet or move tickets to move the order. Only one card is required per operation, regardless of the number of shifts required to complete the operation and the number of times the job may be interrupted. The job card is the authorization for a specific department or cost center to produce a given quantity of parts. The job card, prepared by standard data processing techniques, contains all the information pertinent to the job and to the particular operation.

As adjustments are made, operations are evaluated to determine whether standards are being adhered to or whether exceptions are occurring which call for management decisions. Operations evaluation is the determination of performance in the five previously mentioned areas. Operations are compared against standards in money, time and capacity. Management is able thus to determine the effectiveness of the organization as a whole in regard to materials, machines, manpower, and money. Areas of ineffectiveness may be bolstered by current action which will permit return to standards before other areas become affected.

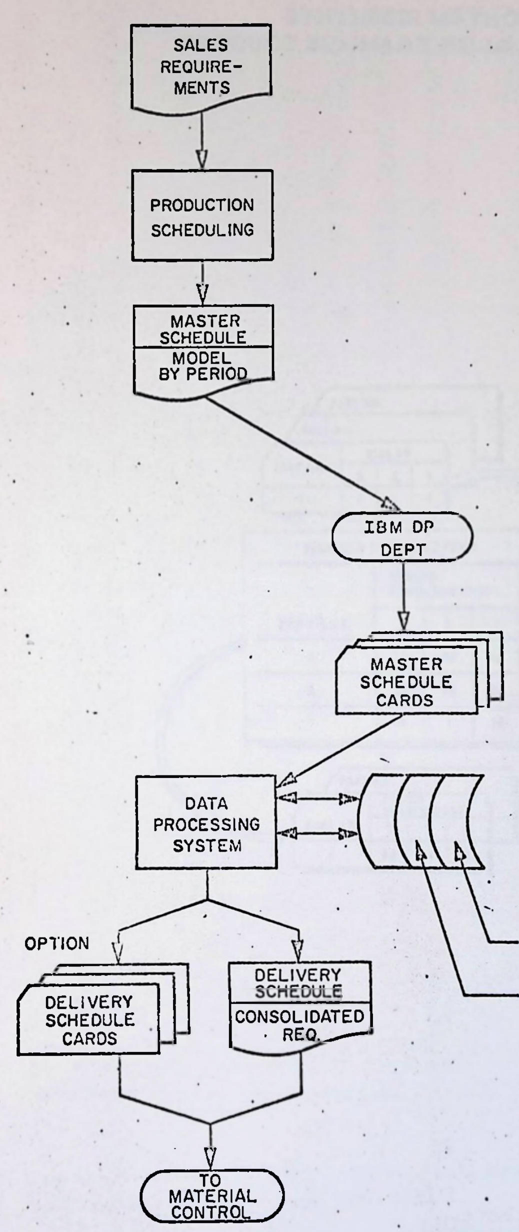
ASSEMBLY REQUIREMENT BY PERIOD



ANALYSIS--TIME SERIES LEVEL-BY-LEVEL PLANNING



SYNTHESIS-SINGLE LEVEL PLANNING APPROACH



FROM SALES PLANNING

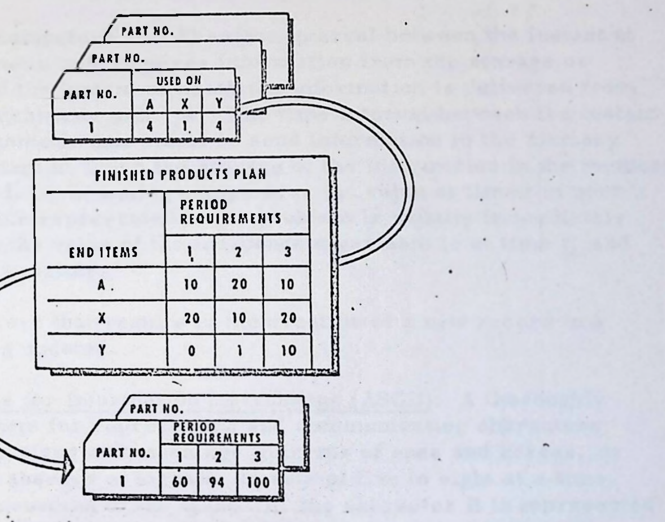
NET MODEL REQUIREMENTS DETERMINED.
MASTER SCHEDULE SHEET FOR NEXT 3 MONTHS PREPARED.

SYSTEM PROCESS

- MATCH PARTS LIST BY PRODUCT AGAINST SCHEDULE.
- EXTEND QUANTITY PER X QUANTITY REQUIRED.
- CHECK INVENTORY FOR STOCK ON HAND AND RELEASED ORDERS TO ARRIVE AT NET REQUIREMENTS.

82-161427

SYNTHESIS METHOD
PRODUCT SUMMARY BILLS OF MATERIAL



APPENDIX A

Data Processing Seminar
Wilkes College
Wilkes-Barre, Pa.

GLOSSARY

Absolute Coding: Coding in which instructions are written in the basic machine language; i.e., coding using absolute operators and addresses.

Accumulator: A storage register where results are accumulated.

Access Time: (digital computers) 1. The time interval between the instant at which the arithmetic unit requires information from the storage or memory unit and the instant at which the information is delivered from storage to the arithmetic unit. 2. The time interval between the instant at which the arithmetic unit starts to send information to the memory unit and the instant at which the storage of the information in the memory unit is completed. --In analog computers, the value at time t of each dependent variable represented in the problem is usually immediately accessible when the value of the independent variable is at time t, and otherwise not accessible.

Addition Record: A record that results in the creation of a new record in a master file being updated.

American Standard Code for Information Interchange (ASCII): A thoroughly coordinated system for representing and communicating characters, digits, and other signs and meanings in terms of ones and zeroes, or the presence or absence of signals, in sets of five to eight at a time. For example, according to the standard, the character B is represented as 00 010 or as 1 000 010 or as 11 00 010; and the signal "rub out" is represented as 11 111, or as 111 111, or as 1 111 111, or as 11 111 111.

Analysis: The investigation of a problem by a consistent method, and its separation into related units for further detailed study.

Arithmetic Operation: Any of the fundamental operations of arithmetic, e.g., the binary operations of addition, subtraction, multiplication and division.

Arithmetic Unit: That component of computer hardware where arithmetic and logical operations are performed.

Automatic Checking: Computers. Provision, constructed in hardware, for automatically verifying the information transmitted, manipulated, or stored by any device or unit of the computer. Automatic checking is "complete" when every process in the machine is automatically checked; otherwise it is partial. The term "extent of automatic checking" means (1) the relative proportion of machine processes which are checked, or (2) the relative proportion of machine hardware devoted to checking.

Automatic Data Processing (ADP): The processing of information by: (1) obtaining input information in machine language as close to the point of origin as economically possible; (2) operating on the information by automatic computer and other machines, without human intervention, as far as economically justified; and (3) producing just the output information needed. For example, a department store would have attained automatic data processing if: (1) at the time of each sale the details were entered mechanically into the system by a salesperson's plate, a customer's plate, and a merchandise punched ticket; and (2) reports to management, bills to customers, reorders for low inventory, commissions to salesclerks, and other desired output reports were all competed and produced by the system without human intervention.

Automatic Programming: Digital-Computer Programming. Any method or technique whereby the computer itself is used to transform or translate programming form a language or form that is easy for a human being to produce into a form that is efficient for the computer to carry out. Examples of automatic programming are compiling routines, interpretive routines, etc.

Batch Processing: A systems approach to processing where a number of similar input items are grouped for processing during the same machine run.

Binary Digit: A digit in the binary scale of notation. This digit may be only 0 (zero) or 1 (one). It is equivalent to an "on " condition or an "off" condition, a "yes", or a "no", etc.

Binary Notation: The writing of numbers in the scale of two. Positional notation for numbers using the base 2. The first dozen numbers zero to eleven are written in binary notation as 0, 1, 11, 100, 101, 111, 1000, 1001, 1010, 1011. The positions of the digits designate powers of two; thus 1010 means 1 times two cubed or eight, 0 times two squared or four, 1 times two to the first power or two, and 0 times two to the zero power or one; this is equal to one eight plus no fours plus one two plus no ones, which is ten.

Binary Number System: A number system using the equivalent of the decimal integer as a base.

Biquinary: A two-part representation of a decimal digit consisting of a binary portion with values of 0 or 5 and a quinary portion with values 0 to 4, e.g., the number 7 is coded as 12 which implies 5 + 2.

Bit: A binary digit; a smallest unit of information; a "yes" or a "no"; a single pulse in a group of pulses; a single magnetically polarized spot in a group of such spots; etc. This word is derived from the "b" in "binary" and the "it" in "digit" the word replaces the obsolete invented word "bigit", and takes on added meaning from the word "bit" meaning "small piece".

Block: A group of records, words or characters handled as one unit. Used in this book primarily to denote a group of records on magnetic tape.

Calculator: A person or machine who performs arithmetic or mathematic calculations.

Calling Sequence: The instructuions used for linking a closed routine with a main routine, i.e., basic linkage and a list of the parameters.

Card: Computers. 1. A card of constant size and shape, adapted for being punched in a pattern which has meaning. The punched holes are sensed electrically by wire brushes, mechanically by metal fingers, or photo-electrically. Also called "punch card". One of the standard punch cards (made by International Business Machines Corporation) is 7 3/8 inches long by 3 1/4 inches wide, by 0.007 inches thick, and contains 80 columns in each of which any of 12 positions may be punched. Another of the standard punch cards (made by Remington Rand Division of Sperry Rand) is of the same size, but contains 90 columns in each of which any one or more of 6 position may be punched. 2. A thin board of plastic or similar material for mounting small circuit parts connected by printed circuits; a pringed-circuit board.

Card Code: The combination of punched holes which represent characters (letters, digits, etc.) in a punched card.

Card Feed: A mechanism which moves cards into a machine one at a time.

Card Field: A fixed number of consecutive card columns assigned to data of a specific nature, e.g., card columns 15-20 can be assigned to identification.

Central Processing Unit (CPU): Computers. The unit, usually assembled in one frame, containing the arithmetic unit, the control unit, and the fast storage or rapid memory, consisting often of magnetic cores.

Character: Digital Computers. (1) A decimal digit 0 to 9, or a letter A to Z, either capital or lower case, or a punctuation symbol, or any other single symbol (such as appear on the keys of a typewriter) which a machine may take in, store, or put out. (2) One of a set of basic or elementary unit symbols which, singly or in sequences of two or more, may express information and which a computer may accept. (3) A representative of such a symbol in a pattern of ones and zeros representing a pattern of positive and negative pulses or states.

Check Digit(s): One or more digits carried along with a machine word (i.e., a unit item of information handled by the machine), which report information about the other digits in the word in such a fashion that if a single error occurs (excluding two compensating errors), the check will fail and give rise to an error alarm signal. For example, the check digit may be 0 if the sum of other digits in the word is odd, and the check digit may be 1 if the sum of other digits in the word is even. It is possible to choose check digits for rows and columns in a block of characters recorded on magnetic tape, for example, in such a way that any single error of a 1 for a 0 or a 0 for a 1, can be located automatically by row and column, and eliminated automatically by the computer.

Clock: Digital Computers. In a synchronous computer, the master circuit which provides pulses at equal times which schedule the operations of the computer. --In an synchronous computer, there is no need for such a clock, since the closing or completion of one circuit initiates the operation of a subsequent circuit.

Code: N. 1. The assignment of meaning to a character or group of characters, e.g., an alphabet.
2. A label to identify a routine, location, operator, operand, name, etc.
3. To translate and write information in an abbreviated or shorthand form, e.g., to write machine instructions, symbolic notation, etc, from statement of the problem.

Collate: To compare and/or merge two or more similarly ordered sets of items into one ordered set.

Collating Sequence: The relative ranking of permissible graphic symbols of their representations.

Computer: (1) A machine which is able to calculate or compute, that is, which will perform sequences of reasonable operations with information, mainly arithmetical and logical operations. (2) More generally, any device which can accept information, apply definite reasonable processes to the information, and supply the results of these processes. (3) A human being who can perform these operations and processes.

Computing Efficiency: Computer Operations. The ratio obtained by dividing (1) the total number of hours of correct machine operation (including the time when the program is incorrect through human mistakes) by (2) the total number of hours of scheduled computer operation including time when the machine is undergoing preventive maintenance.

Console: A part of the computer where most of the external controls for a computer operation are exercised and where most of the indicators of internal operation are located.

Control Card: A card which contains input data or parameters for a specific application of a general routine.

Control Unit: Digital Computers. That portion of the hardware of an automatic digital computer which directs the sequence of operations, interprets the coded instructions, and initiates the proper signals to the computer circuits to execute the instructions.

Core Storage: A form of high speed storage in which information is represented by the magnetization of ferromagnetic cores.

Data: A collection of facts, numbers, letters, symbols, etc., which can be processes or produced by a computer, i.e., a representation of information.

Data Processing: A generic term for all of the operations carried out on data according to precise rules of procedure: a generic term for computing in general as applied to business situations.

Detail File: A file to be processed against a master file.

Diagram: A schematic representation of a sequence of operations or routines.

Digit: (1) One of the symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, used in numbering in the scale of ten. (2) One of these symbols and sometimes also letters expressing integral values ranging from 0 to n-1 inclusive, used in a scale of numbering to the base n.

Digital Computer: A computer in which information is represented in discrete form and which calculates using numbers expressed in digits and yeses and nos expressed usually in 1's and 0's, to represent all the variables that occur in a problem.

Disk Storage: A storage device which uses magnetic recording on flat rotating disks.

Electronic Data Processing (EDP): Computing and data processing using electronic devices, and therefore very high speeds, now approaching a ten million operations a second.

External Storage: A storage device outside the computer which can store information in a form acceptable to the computer, e.g., cards, tapes.

File: An organized collection of information directed toward some purpose.

Flowchart: (1) A chart to represent, for a problem, the flow of data, procedures, growth, equipment, methods, documents, machine instructions, etc. (2) A graphic representation of the system in which data provided by a source document are converted to final documents.

General-Purpose Computer: A computer designed to handle the usual logical and arithmetic operations and not limited to solving one type of problem.

Hard Copy: A printed copy of machine output in a visually readable form, e.g., printed reports, listings, documents, summaries, etc.

Hardware: The mechanical, magnetic, electrical and electronic devices or components of a computer.

Information: (1) A set of marks or an arrangement of hardware that has meaning or that designates one out of a finite number of alternatives. (2) Any facts or data. (3) Any marks, characters, or signals which are put in, processed by, or put out by a computer.

Input: Computers. (1) Information transferred from outside the computer, including secondary or external storage, into the internal storage of the computer. (2) The sections of the computer which accept information from outside the computer, for example, magnetic-tape readers or punch-card readers.

Input-Output Channels (IOC): Computers. Input and output devices considered together.

Instruction: Computers. A machine word or a set of characters in machine language which specifies that the computer take a certain action. More precisely, a set of characters which defines an operation together with one or more addresses (or no address) and which, as a unit, causes the computer to operate accordingly on the indicated quantities. Note: The term "instruction" is preferred by many to the terms "command" and "order"; "command" may be reserved for electronic signals; "order" may be reserved for uses in the meaning "sequence", as in "the order of the characters".

Integrated Data Processing (IDP): (1) Data processing organized, coordinated, and carried out in a completely planned and systematic way, without bottlenecks and with the least possible duplication of tasks such as entering data. (2) A group of data processing procedures built around a common machine language and common representation of data, in which there is a minimum of duplicate operations, such as entering the same data more than once.

Internal Storage: Computer storage for data and instructions, from which instructions can be moved directly to the control unit for execution.

Key: (1) That part of a word, record, file, etc., by which it is identified or controlled. (2) To code information.

Linkage: The interconnections between a main routine and a closed routine, i.e., entry and exit for a closed routine from the main routine.

Magnetic Disk: A storage divice in which information is recorded on the magnetizable surface of a rotating disk. A magnetic disk storage system is an array of such devices with associated reading and writing heads which are mounted on movable arms.

Magnetic Ink Character Recognition (MICR): The technique of using black (or colored) ink containg magnetized particles, printed (on checks, bills, etc.) as humanly readable characters, which are also recognized by electronic devices that sense the magnetization and translate these characters into machine language.

Magnetic Tape: Tape made of paper, metal, or plastic, coated or impregnated with magnetic material, on which polarized spots representing information may be stored.

Master File: A file of semipermanent reference information which is usually updated periodically.

Memory: Computers (1) The units which store information in the form of the arrangement of hardware or equipment in one way or another. Same as "storage". (2) Any device into which information can be introduced and then extracted at a later time.

Multiprogramming: A technique for handling in a computer many routines or programs at what seems to be the same time. This is accomplished by overlapping or interleaving their execution, and by permitting more than one program to share the time of machine components and units.

Output: Computers. (1) Information transferred from the internal storage of a computer to secondary or external storage, or to any device outside of the computer. (2) The device or devices which bring information not of the computer.

Procedure: A precise step-by-step method for effecting a solution to a problem.

Process: A generic term which may include compute, assemble, compile, interpret, generate, etc.

Program: N. Computers. (1) A precise sequence of coded instructions for a digital computer to solve a problem. (2) A plan for the solution of a problem. A complete program includes plans for the transcription of data, coding for the computer, and plans for the effective use of the results.

Punched Card: A card which may be punched with holes to represent letters, digits or characters.

Random Access: Computers. Access to the memory or storage under conditions where the next register from which information is to be obtained is chosen at random, in other words, does not depend on the location of the previous register. For example, access to names in the telephone book is "random access". The next name that anyone is going to look up in the book may be almost anywhere in the book with roughly equal probability.

Read: To transcribe information from an input device to internal or auxiliary storage.

Record: A collection of fields; the information related to one area of activity in a data processing activity; files are made up of records.

Retrieval: (1) The recovery of something searched for. (2) The act of finding again.

Routing: Selection and assignment of the communication path.

Simulator: (1) A program or routine corresponding to a mathematical model or representing a physical model.

Software: The entire collection of computer programs used to make a computer so useful work, including ordinary problem-solving programs and general programs such as operating systems, compilers, assemblers, editors, debuggers, supervisors, translators, etc. Software is contrasted with "hardware" --the machinery and the electronics of the computer.

Sort: To break down or distribute into groups according to a given set of rules, usually to make a numerical, alphabetic or aphameric sort.

Storage: A general term for any device capable of retaining information.

Stored Program Computer: A computer which can alter its own instructions in storage as though they were data and subsequently execute the altered instructions.

Systems Analysis: The analysis of a business activity to determine precisely what must be accomplished and how to accomplish it.

Tape: A linear medium for storing information which can be used as input or output to a computer, e.g., magnetic tape.

Time-Sharing: Equipment. Using a device for two or more functions during the same overall time interval, by allocating (in rotation, for example) small divisions of the total time interval to the performance of each function. For example, the operating system of a powerful, fast, central computer may offer a thirtieth of a second of computing time in rotation to each of 20 human users at 20 consoles, and so to all the users it appears that each has entire command of the computer, although actually it is shared in time.

Transaction File: A file containing current information related to a data processing activity; usually used to update a master file.

Update: To modify a master file according to current information, often that contained in a transaction file, according to a procedure specified as part of a data processing activity.

Write: To transfer information from internal storage to auxiliary storage or to an output device, e.g., to store data on magnetic tape.

APPENDIX B

Data Processing Seminar
Sponsored by Wilkes College and PENNTAP

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